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PREFACE

EAPRIL is a non-profit organisation that bridges practice and research with the aim to cross the boundaries between education and working life. The association promotes practice-based research on learning issues in the context of initial, formal, lifelong and organisational learning with the aim to enhance practice. EAPRIL encompasses different contexts (such as schools of various educational levels as well as organisations and corporations across fields, such as engineering, medicine, nursing, business, and teacher education), at different levels (individuals, teams, organisations and networks), and in different stages of life (from kindergarten over students in higher education to workers at the workplace)

Moreover, EAPRIL aims to enhance and empower practice by narrowing down the gap between researchers doing research on education and learning and practitioners in the educational field. It also bridges education, community and working life.

At the annual EAPRIL conference and during the year, the association promotes exchange, of practice-based research on educational, learning and developmental issues sharing, construction and co-creation of insights, knowledge and improved practice of different educational themes and within various fields. Both research and practice are represent in this profound dialogue and exchange of information.

Via these Conference Proceedings EAPRIL wants to encourage further connections between research and practice. This issue is the result of four days of interactive sessions from November 24-26, 2014. More information about our conference, you can find on our [conference website](#).

Each year EAPRIL selects interesting keynotes who can inspire other practitioners and researchers. The abstracts and videos of the keynotes of the 2014 Conference can be consulted via [this link](#). Moreover, EAPRIL awards each year the Best Research and Practice Project. In 2014, the BR&PP Award was awarded to the project *Using mobile technologies for helping apprentice chefs to assemble learning experiences from various arts and places –a project of the Leading House “Dual-T – Technologies for vocational training”* of Alberto Cattaneo and his research team. More information about this and the other shortlisted projects, can be [found here](#).

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THE SYNTHESIS OF A UNIFIED PEDAGOGY FOR THE DEVELOPMENT OF E-LEARNING SOFTWARE FOR THE COMPUTING GCSE

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ABSTRACT

This study investigates the need for a unified pedagogy for the development of E-Learning software for high-school Computer Science. Additionally, it will result in Computer Science E-Learning software that can be used in student instruction or asynchronous learning. Both the pedagogy and the resulting E-Learning software will be evaluated in terms of their impact on learning performance and student motivation. The problem domain focuses on the recent challenges faced in UK education that resulted in the Programme of Study for ICT being temporarily dis-applied and a new emphasis towards Computer Science GCSEs. However, it should be noted that the findings are broadly transferable to other developed nations. The pedagogy synthesises the following Learning theories: Constructivism, Social Constructivism, Connectivism, Cognitive Load and VARK learning styles classification, and in Phase 1, these are distilled into 36 principles. The study is broken into three main phases; Phase 1 is the Initial Pedagogical Strategy and Prototype, Phase 2 is the Elaboration via Action Research, and Phase 3 is the Final Mixed Methods Experiment. The study is currently in Phase 1, with preliminary results planned for release in the next few months. However, preliminary findings confirm Computer Science as an area of educational significance, which would benefit from the proposed E-Learning pedagogy and resultant E-Learning software.

INTRODUCTION

“Sometime in the early 1980’s computers appeared in UK schools and a generation of children were taught how to program them. That generation grew up to make the UK a world leader in computer related technologies. Today the picture is very different: with the best of intentions, we have lost the “how it works” part, in favour of “how to use it.”

(Computing at Schools Working, 2012, p. 2)

There is a well-publicised body of inquiry, consisting of various reports, analysis and a good measure of political rhetoric, that assert that computing education in the UK is struggling (BCS, 2012; e-skills UK, 2012; Gove, 2012; Schmidt, 2011; The Royal Society, 2012). This led to the Programme of Study for ICT being temporarily dis-applied and new initiatives to introduce what are arguably more academically rigorous Computer Science GCSEs (Computing at Schools Working, 2012).

Statistical results from e-skills UK (2012), the International Telecommunication Union (ITU, 2013) and the Office of National Statistics (2013) show that technology has become a fundamental part of the fabric of society in developed countries such as the UK. Meaning the need for such Computing education is all the more important. Of equal significance is the fact that technology integration into education is increasingly prevalent, and with special relevance to this paper, that E-Learning software can offer learning benefits in the form of a media rich interactive environment that is engaging and promotes active learning (Clark & Mayer, 2011).

The objective of the research presented in this paper is to study and synthesise leading learning theories into a single unified E-Learning pedagogy that will counteract the shortcomings identified in the ICT GCSE and support the objectives of the new Computer Science GCSEs. This pedagogy will be embodied in E-Learning software and both will be evaluated to identify their impact on student learning and engagement.

PROBLEM DOMAIN

The prevalence and ubiquitous nature of Information and Communication Technology (ICT) in developed countries and its impact on recent generations is well documented (Halse, Mallinson, & Mallison, 2009).

On the surface, the UK seems to be in good standing with a global ICT Development Index (IDI) position of 8th in 2012. However, in the 2011 MacTaggart lecture, Eric Schmidt (Google Chief Executive) lamented the UK’s failure to build upon its long history in innovation. He expressed the opinion that the UK needs to start at the very beginning with education and to reignite children’s passion for science.

This is echoed by the 2012 figures from e-skills UK, which show that from 2002 to 2010 applicants for higher education courses increased by 51%; comparatively, during the same period applicants for single subject IT related courses decreased by 28% (e-skills, 2012).

It is particularly concerning to assess the UK trend in demand for IT professionals against the drop in higher education IT applicants. e-skills UK (2012) quantifies this demand in terms of job vacancies; in 2011 there were approximately 116,000 advertised vacancies for IT & Telecoms professionals during each of the four quarters as compared with 82,000 during the whole of 2009. Furthermore, predicted growth rates up to 2020 show the IT professional workforce is expected to grow at 1.62% per annum, nearly double the predicted growth rate for UK workers overall. These findings are substantiated by the Confederation of British Industry survey which shows that businesses continue to report a shortage of people with science, technology, engineering and maths (STEM) skills and that among science, engineering and IT firms, more than 84% view the number and quality of STEM graduates as a priority concern (CBI, 2011). This is of particular interest since globalization has led to a situation where the strength of a country's IT sector has become a significant competitive factor in its global economic survival.

There are a number of contributing factors to the lack of uptake into Higher Education IT courses and its associated impact on the IT Skills shortage. One significant factor is the lack of value placed on the then existing vocational courses, GCSE in ICT and the A-Levels in ICT and Computing. Analysis from e-skills UK (2012) shows an overall decline of 43% in Computing and ICT A-Levels, between 2003 to 2011. Likewise, there is a decline of 70% from 2005 to 2011 in GCSE ICT courses. The Royal Society (2012) gives an in depth analysis of the perceived shortcomings of the ICT curriculum at that time, which were:

1. **Students were not inspired:** Most pupils felt uninspired by the existing national curriculum in ICT, especially when delivered by non-specialist teachers who interpreted and reduced the ICT curriculum to its lowest level.
2. **Lack of qualified specialist teachers:** Based on data from the inaugural Schools Workforce Census, conducted by the DfE in November 2010; of 18,400 ICT teachers in England only 35% had a relevant qualification¹ in which only 25% had both a relevant first degree and a teacher training qualifications.

¹ The Royal Study defined relevant qualifications to be those with JACS codes of G400-G700 plus G900. These codes included degrees in computer science, information systems, software engineering, artificial intelligence and other mathematical and computing degrees.

3. **Lack of subject-specific pedagogy:** The shortage of specialist teachers is further compounded by a lack of continued professional development and in particular a lack of subject-specific pedagogy in Computer Science.
4. **Lack of technical teaching resources:** There is a lack of technical teaching resources to support the innovative and inspiring teaching of ICT and Computer Science.

To overcome the challenges outlined previously, we propose to support GCSE Computing teachers with a comprehensive pedagogical strategy to guide their teaching and quality E-Learning resources that can support their instruction.

Although E-Learning software has become mainstream, one of the main concerns still remains that what is delivered often falls short (Alonso, López, Manrique, & Vines, 2005; Chan & Robbins, 2006). Unsurprisingly, course quality is the most important concern (Sun, Tsai, Finger, Chen, & Yeh, 2008). Chan and Robbins (2006) advise that E-Learning software “*require(s) an understanding of educational pedagogy and instructional design and demand(s) a considerable amount of planning and preparation.*”(p. 496). Echoing this sentiment, Hadjerrouit (2010) argues there is often a lack of “pedagogical usability” in existing E-Learning software, and a lack of alignment with education needs and standards.

One way to ensure the quality of E-Learning software is to ground it in established learning theories. There is a significant body of research into learning theories, e-learning and STEM education. However, this significant body of knowledge is somewhat overwhelming; there are complimentary and competing learning theories and differing research into the best implementation of these theories in technology (Illeris, 2009).

Illiris (2009) proposes that since learning is so complicated, any “*analyses, programmes and discussions of learning must consider the whole field if they are to be adequate and reliable.*”(p.18). He offers a deceptively simple model with 3 dimensions (refer to Figure 1).

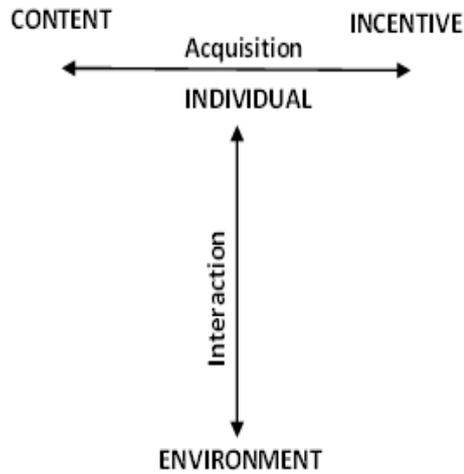


Figure 1. The fundamental processes of learning (Illeris, 2009, p. 9).

Illeris argues that learning requires the integration of two very different processes, an external interaction process between the learner and their social, cultural or material environment, and an internal psychological process of elaboration and acquisition. This internal process focuses on managing the learning content and maintaining the incentive (motivation) to devote mental energy to learn.

The learning theories under discussion and resulting principles outlined in the E-Learning pedagogy will be viewed in light of Illeris’ proposed framework and the three dimensions of Content, Incentive and Environment.

We propose to distil and synthesize this body of knowledge into a single pedagogical strategy for the Computing GCSE and specifically, to focus on pedagogical best practice and principles for developing electronic material in this subject area. Learning theories to be considered include Constructivism, Social Constructivism, Connectivism, Cognitive Load and VARK learning styles classification.

1. Constructivism, as pioneered by Piaget, either builds on or challenges current student knowledge to facilitate new learning. In essence, the learner actively constructs their own understanding (Brooks & Brooks, 1999).
2. Social Constructivism, as pioneered by Vygotsky, defines the construction of new understanding as a collaborative (social) activity where a “more knowledgeable other” mediates the learning and provides the challenge to reach new learning (Pritchard, 2009, p. 117).

3. Connectivism is a more recent and radical theory which is rooted in the new connected digital era and Web 2.0 technologies². Learning is achieved by the interconnectedness of people / resources and is acquired ad-hoc, just in time (Bessenyei, 2008).
4. Learning Style theories propose that all students have different preferences in the best way they perceive new learning material. Of interest to this research is Neil Fleming's VARK Learning Style model (Fleming & Mills, 1992), which categorises the preferred learning style(s) and then offers appropriate learning strategies (Allen, Scheve, & Nieter, 2011).
5. Cognitive Load Theory rationalises learning as the processing of inputs which are managed in short term memory and coded for long-term recall. Since short term memory is limited this means efficient instructional practices that do not overload short term memory are critical (Clark & Mayer, 2011; Vogel-Walcutt, Gebirim, Bowers, Carper, & Nicholson, 2011).

RESEARCH METHODOLOGY

This research study is broken into three main phases (Figure 2). Phase 1 is the Initial Pedagogical Strategy and Prototype, Phase 2 is the Elaboration via Action Research, and Phase 3 is the Final Mixed Methods Experiment.

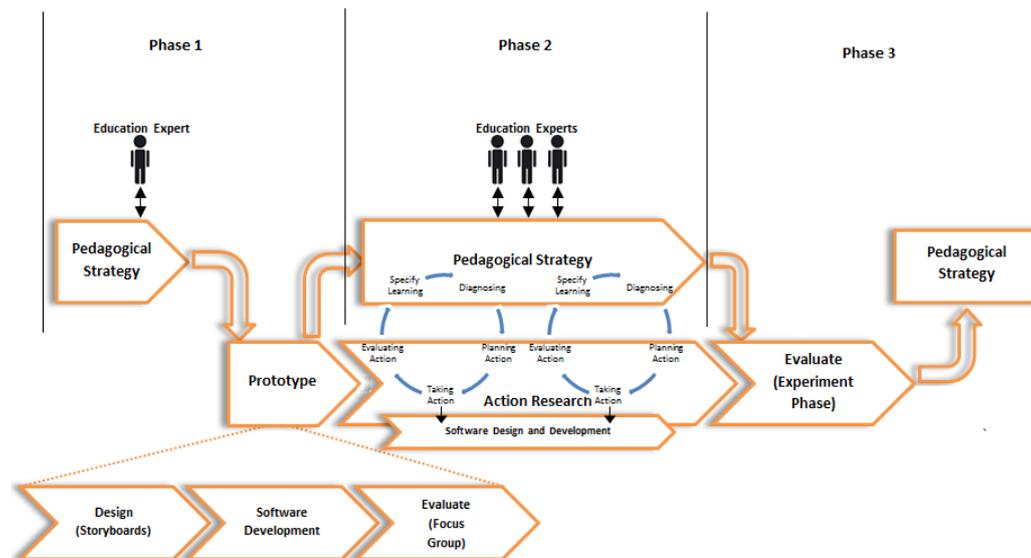


Figure 2. The three phases of research.

² Web 2.0 technologies such as blogs, forums, chats, wikis, newsgroups, e-portfolios, social networks, etc.

Phase 1: Initial Pedagogical Strategy and Prototype

The objective of Phase 1 is to set a strong foundation for the research study; to allow the early identification of shortcomings in the design and development processes and more importantly to receive early feedback on the E-Learning software and pedagogy.

The first step was to undertake a comprehensive literature review resulting in an E-Learning Pedagogical Strategy for GCSE Computing. Experienced GCSE Teachers and Education Experts are in the process of reviewing the pedagogy document and providing constructive feedback that will be analysed and incorporated.

As a proof of concept, prototype E-Learning software will be developed according to the pedagogical principles outlined in the E-Learning pedagogy document. A small number of GCSE Computing students and teachers have been recruited from local high schools and will use the software under a think aloud protocol, allowing the research investigator to observe direct feedback. Subsequently, a focus group will be held in which the participants will have a facilitated discussion where they can share their feedback and opinion. The feedback from the observation and focus group will be analysed and used to update the Pedagogical Strategy document, the E-Learning Software and the Research Methods to be used in the later Phases.

Phase 2: Elaboration via Action Research

The purpose of Phase 2 is to further refine and elaborate the E-Learning Pedagogy and software via an Action Research methodology. An Action Research approach was chosen since it links theory and practice, achieving both practical and research objectives (Susman 1983). The practical focus lies in the iterative development of the E-Learning software and the research focus on the elaboration and evaluation of the pedagogical strategy. This method follows a cyclical 5 stage process outlined in Figure 3.

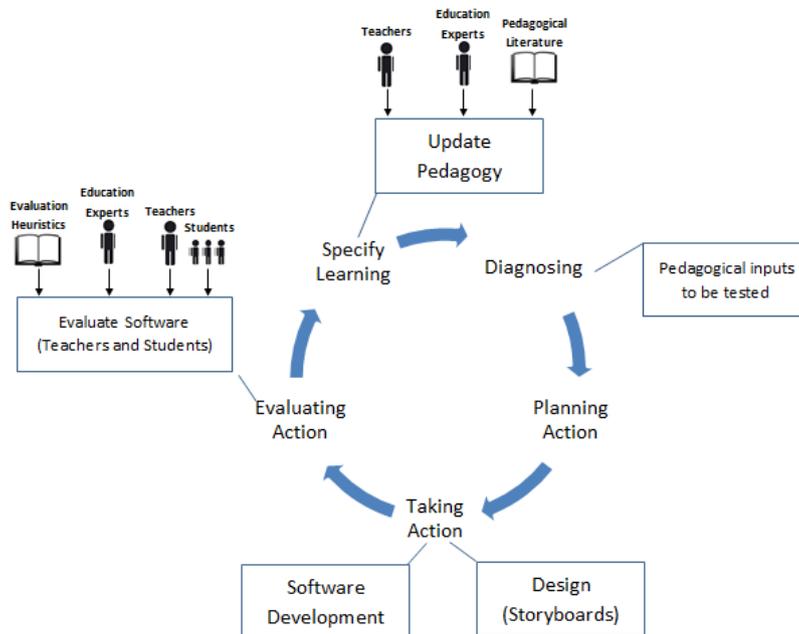


Figure 3. Action Research Cycle.

It is anticipated that two or three cycles of evaluation and update will be included in this phase.

A small number of GCSE Computing teachers and students will be recruited from local high schools to evaluate the E-Learning software and the underlying pedagogy. With each cycle of Action Research the E-Learning Pedagogy will be updated based on the input of experienced teachers, education experts and ongoing literature review. Then, aspects of the pedagogy will be represented in the E-Learning software for evaluation purposes.

The teacher and student evaluations of the E-Learning software will be collected via a combination of direct observation of software usage, associated focus groups, and structured interviews and questionnaires. The evaluation feedback will then be used to further refine the E-Learning pedagogy, which then feeds into the next cycle of action research.

Phase 3: Final Mixed Methods Experiment

Whereas the previous phases focused on qualitative feedback; Phase 3 will use both quantitative and qualitative methods to collect and analyse data, the results will then be integrated into a single view. In accordance with the classification outlined by Borrego et al (2009), the final experiment phase will use a Mixed Methods approach and specifically a Triangulation design.

The quantitative experiment will measure whether there are improved assessment results in either the E-Learning or blended learning approaches as compared to traditional learning. This in turn will indicate whether the pedagogical strategy is effective. Furthermore, results will be analysed to establish whether there is any correlation between the Learning Approaches and the student Learning Style and whether the multi-modal approach used in the software is effective.

Before the experiment execution period, the participating high school teachers will administer to their students a standardised pre-test to act as a baseline for learning, a VARK Learning Styles questionnaire to identify the preferred learning styles and a questionnaire to identify student levels of motivation and engagement in the computing subject.

The quantitative experiment will follow a Repeated Measure Design (Field & Hole, 2003); rather than using separate control groups, we will use the same participants and take a repeat measure for each experiment condition. Specifically, a Latin Squares Experiment Design will be used, which reduces order effect in a repeated measure design and safeguards an effective counterbalance for each of the experiment conditions(Field & Hole, 2003).

The experiment will focus on one independent variable (Learning Approach) and one dependent variable (Level of learning).

The quantitative results should give significant weight in proving or disproving the hypothesis that the E-Learning pedagogy and the resulting E-Learning software improve learning performance in GCSE Computing. However, they may not give clear insight into the underlying reasons for the results. This insight will be given by the qualitative methods, which will allow the triangulation of student and teacher feedback, and assessment performance; thereby putting the quantitative results in context.

DEVELOPMENT OF PEDAGOGICAL STRATEGY

In accordance with Phase 1 objectives, there follows a table listing the principles discussed in the Phase 1 pedagogy document.

Table 1.

Pedagogical principles discussed in the Phase 1 pedagogy.

Ref	Principle Title
1	Use authentic educational material, examples and activities.
2	Use constructivist approaches to increase intrinsic motivation in the learner.
3	Provoke reflective practice to support learning.
4	Utilise worked examples to support Problem Based Learning.
5	Use Problem Based Learning (PBL) approaches to facilitate learning and develop thinking skills.
6	Prepare the foundation for Problem Based Learning (PBL).
7	Make expert and learner thinking processes explicit.
8	Well-designed practice activities should be distributed across the lesson to support learning.
9	Practice activities should have explanatory feedback to promote learning.
10	Use social interaction as a basis for learning.
11	Target learning towards the learner's Zone of Proximal Development (ZPD).
12	Provide scaffolding to advance learning progress.
13	Use collaborative activities to support learning.
14	Provide structure and meaningful guidance in collaborative activities.
15	Support collaboration through mobile devices.
16	The development and nurturing of networks is a major component of learning.
17	The network can be cultivated to form a community.
18	Information is constantly changing therefore its accuracy and validity may change over time.
19	Learning Styles should be used to promote self-reflection and active management of learning.
20	VARK modal preferences are to be implemented using a Multi-Modal strategy.
21	Support learners with Visual Modal Preference.
22	Support learners with Aural Modal Preference.
23	Support learners with Read-Write Modal Preference.
24	Support learners with Kinaesthetic Modal Preference.
25	Use words and graphics together, instead of words alone.
26	Static illustrations can be better than animations.
27	Apply contiguity by aligning words with corresponding graphics.
28	When presenting text and graphical learning material simultaneously, present words as audio narration rather than on-screen text.
29	Avoid explaining visuals with words both in audio and screen text.
30	Avoid adding learning content that does not directly support your instructional goal.
31	Optimise essential processing by breaking a lesson into parts.
32	Support germane cognitive processing by providing authentic examples, and non-trivial practice and problems.
33	Screen text and audio narration should use a conversational style.
34	Limit learner control in navigating through the E-Learning software.
35	Provide navigational support and signposts for learning.
36	Use multimedia to support visualization of learning material.

PRELIMINARY RESULTS AND DISCUSSION

The research discussed in this paper is still at a relatively early stage. The first draft of the pedagogical strategy is complete and the Phase 1 observational study is in progress.

However, certain findings have become apparent even in these early stages. Initially, it was planned to deliver two separate pedagogical strategies, one for Computer Science teaching and one for E-Learning software development. However, as the research progresses this split seems quite arbitrary due to the interdependent nature of both pedagogies; hence they are now combined.

A more significant change of focus is that originally the research was focused purely in creating E-Learning software. Again, as the research matures it is clear that E-Learning software loses value as an isolated entity and that the true educational value is in how E-Learning software can be integrated within a collaborative learning environment. The E-Learning software now becomes a central learning resource within an Online GCSE Learning Community.

Such a community is already established for Computing Teachers in the UK through the Computing at School (CAS) network. This is a vibrant community of CAS master teachers exchanging pedagogical advice, effective teaching practice and learning resources. Although, it should be noted that there is a noticeable deficit of E-Learning or E-Learning software resources from CAS.

The literature survey to date confirms that there is a huge and overwhelming body of knowledge regarding learning theories, that much of it is complementary, but much is conflicting or offers different implementations. Furthermore, there does not seem to be any unified pedagogy focused on High-School Computer Science.

There are a variety of learning resources on the web that can be considered appropriate for GCSE Computing, these range from cloud IDEs (pythonfiddle, cloud9, codebox and codeanywhere), cloud IDEs designed for learning (Scratch, BYOB and appinventor) online coding references (W3Schools) and/or tutorials (code.org, codeacademy and khanacademy), simulations and animations (visualgo.net, CS Animated, and Little Man Computer etc.) that help to visualise computing concepts and videos (YouTube), etc. However, each focuses on a particular aspect of computing, from a particular perspective, and individually offer an incomplete learning experience. Their focus is on part-task instruction that does not integrate into a holistic learning experience. However, they do offer the building blocks for such a holistic computing learning experience.

There are few electronic learning resources specifically targeted towards GCSE or K12 Computing, but there are some and the number is growing. However, a preliminary analysis based on well-established learning theories and pedagogical principles gives mixed results and suggests that their subject content is accurate, but in a number of these resources, their pedagogical foundation is open to doubt. For example, these are a strong emphasis on drill and practice instruction which are then rewarded with games that have zero educational value and only serve to amuse, or educational videos that concentrate on a teacher presenting at a whiteboard.

Whilst the focus of this research is the UK it is clear that the findings are broadly transferable to other developed countries. The US, New Zealand, Israel, and Germany are all in varying stages of similar initiatives to give greater prominence to the Computer Science curriculum.

CONCLUSION

The research discussed in this paper is still at an early stage therefore it is difficult to reach any firm conclusions. However, it is certain that Information and Communication Technology is of critical importance to the economic competitive advantage of developed nations. As such, Computer Science education is fundamental, and in particular a focus on high-school Computer Science is of growing importance. E-Learning can offer significant educational benefit towards high-school Computer Science, but this educational benefit is realised and maximised by ensuring that the E-Learning is underpinned by an appropriate E-Learning pedagogy.

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CLASSROOM DISCOURSE: THE ROLE OF TEACHERS' INSTRUCTIONAL PRACTICE TO PROMOTE STUDENT DIALOGS DURING "EARLY YEARS LITERACY PROGRAM" (EYLP)

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ABSTRACT

We have an emerging understanding that classroom discourse is important for comprehension and critical thinking. The aim of the present study was to analyse what teachers say and do to promote discussion at teacher-led station in "Early Years Literacy Program" (EYLP). We are using a case study design, with video observations of two teachers in first grade. Teaching sequences are analysed from two perspectives: Ability to promote "extended discourse" and use of "all-purpose academic words". Extended discourse is characterized by decontextualized language use, promoting turn-taking and discussions of rare words. All-purpose academic words are difficult to define, but they are abstract words adults speakers use like achieve, adjust, challenge etc. The results show that both teachers have positive initiative to an extended discourse, but the time used for these activities is rare. The use of all-purpose academic words is almost missing. Knowledge about how to promote classroom discourse and its consequences for learning are discussed.

CLASSROOM DISCOURSE: LEARNING FROM TALKING

Experience with language in the preschool and early school years is central to later reading development and comprehension of text (Cunningham & Stanovich, 1997; Dickinson & Tabors, 2001).

A meta-analysis based on evaluation of nine different programs fostering classroom discussion, conclude that these programs have effect for text comprehension and critical thinking (Murphy, Wilkinson, Soter, Hennessey & Alexander, 2009).

Reznitskaya and Gregory (2013) conclude after a discussion of dialogic teaching that it contributes to critical thinking. They conclude, however, that dialogic teaching is rare, despite the fact that we know it is fostering students thinking and learning. We know that classroom discourse is characterized by teacher initiation, students' response, and ends with teachers' evaluation (IRE) (Cazden, 2001). These IRE dialogs are dominated by 'closed questions', which mostly request a one word answer or yes or no answer. Students are not encouraged to elaborate on or give a reason for their thoughts, what Webb (2009) concludes are the most effective tool for fostering children's thinking.

In their book "Exploring talk in school", Mercer and Hodgkinson (2008) have brought together researchers and practitioners who share their thoughts about how we can improve classroom talk. Hodgkinson and Mercer (2008) argue "...that classroom talk is not merely a conduit for the sharing of information, or a means for controlling the exuberance of youth; it is the most important educational tool for guiding the development of understanding and for jointly constructing knowledge" (p.xi).

EYLP is a reading program frequently used in Norway. The program is developed in New Zealand. Norwegian teachers have been travelling 'down under' to learn, and have introduced this reading method in Norwegian schools. The teaching in EYLP is organized in different stations, where one station is teacher-led. The others are self-instructed. At teacher-led station the teacher is working with a group of four to five students, using booklets with pictures. Besides working with phonological awareness and letter knowledge, they are talking about what is going on in the book. In this context, the teacher has rich opportunities to develop a discourse with the group, start a dialogic teaching and enhance the quality of talk at teacher-led station. A central idea in EYLP program is that the teachers shall be guided in their work. It is a program for enhancing teachers' competence and co-work, and cooperation between teachers and parents. Teacher guidance must originate from research and practice.

We have founded our analyses of what is happening on teacher-led station on two perspectives from international reading research: extended discourse and the use of all-purpose academic words.

Both perspectives are embedded in a broader view of a connection between language and literacy development, characterized as "*Beginning Literacy with Language*" by a Harvard group of researchers (Dickinson & Tabors, 2001). We shall have a closer look at what an extended discourse may be, and what characterize all-purpose academic words.

Learning from talking: What is an extended discourse?

Different studies have shown that there is a robust relationship between children's vocabulary development and reading development (Cunningham & Stanovich, 1997). Children with educated mothers and children from middle-class homes with larger income, usually have a larger vocabulary than children from low income families when entering school. Cunningham and Stanovich's (1997) study showed that the level of language and literacy skills in kindergarten and first grade are strong predictors of reading achievement many years later. Starting the "Home – School study" the Harvard group (Snow, Tabors & Dickinson, 2001) was interested in another aspect of language as well. They were interested in ... "children's experience with language that replicates some of the demands of literacy- that is, talk that requires participants to develop understandings beyond the here and now and requires the use of several utterances or turns to build a linguistic structure, such as explanations, narratives, or pretend. We call this type of talk *extended discourse*..." (Snow, Tabors & Dickinson, 2001, p.2).

What characterize these different kinds of talk?

Nonimmediate talk – explanatory talk- narrative talk- pretend talk.

To build an understanding beyond here and now, the use of decontextualized language or *nonimmediate talk* is necessary. Nonimmediate talk refers to information that is not immediately visible for instance in the illustrations or mentioned in the text. It typically involves longer utterances and more explicit, complex language than does labelling or yes – no questioning that constitutes most immediate talk. That is why nonimmediate talk is a kind of extended discourse (DeTemple, 2001, p.39). *Explanatory talk* is another aspect of extended discourse. It is defined "...as talk that requested and/or made a logical connection between objects, events, concepts and conclusions" (Beals, 2001, p. 86).

It is an explanation of people's actions or speech. *Narrative talk* or storytelling as part of extended discourse, tell us about an event in the past or an event that will happen in the future (Beals, 2001 s. 83). Narratives may especially be fostering children's abstract understanding of how to organize a set of events into a story, and to comprehend others narratives. Beals gives examples about how children use rhetorical questions like "Guess what" to extend the narrative, conversational fillers such as "um" and retracing such as "after school program" to compose the narrative (p.84). *Pretend talk*, the last aspect of different kinds of talk connected to extended discourse, is most frequent during play. Katz (2001) defines social pretend play as a situation where "...participants explicitly or implicitly make objects, people, places or other aspects of the here and now represent something other than what they are. That is, they make symbolic transformations" (p.56). The motivation for pretend play lies in the experience of the activity itself.

The Home – School Study (Tabors, Roach & Snow, 2001) conclude that the children bringing high level skills to kindergarten, were ...”the children who had experienced interesting talk, with lots of new words, and literacy activities such as frequent and varied book reading with different people “ (p. 136). Dickinson (2001) reports from the kindergarten part of the same study, that many teachers stated that book reading was important, but few of them approached the books in a carefully thought out manner. Some teachers used effective reading styles but used little time for books. Other teachers used more time for book reading, but failed to engage the children (p.201).

Turn-taking

To build an explanation, to tell a story or to discuss a topic, conversation requires several utterances or turns to build a linguistic structure. For children to get the opportunity to talk, to express their meaning, and to give a reason for their thoughts, we must give them the opportunity to express it. We have to ask for their opinion, and use “open questions” which tells the child that we are interested in their thoughts and their reasons for their thoughts. A yes or no answer is not sufficient. Discourse requires the participants to formulate their arguments, give a reason for their argument, and connect their arguments in a logical way to a conclusion. Listening to classmates’ thoughts and reason for their arguments, gives new perspectives. In this way discourse gives other developmental opportunities than narratives.

The use of rare words

Discussing rare words as vocabulary development could be placed as a category alone. Our reason for placing introduction of rare words as an aspect of extended discourse, is that rare words are often introduced in connection with decontextualized talk, or explanatory talk, or during book reading. What are rare words then? Tabors, Beals and Weizman (2001) define them as words that might be new words for preschool age children. They are low frequency words. We are interested in teachers’ frequent initiative to introduce and discuss words they suppose are unknown to their students, especially asking for word meaning, give a definition or find a synonym to the word. Tabors et al. found a relationship between the frequency of use of rare words at home and kindergarten vocabulary.

Summing up, extended discourse is talk characterized by several utterances, with use of decontextualized or nonimmediate talk, to build an explanation, a narrative, or pretend talk, where rare words are introduced and discussed.

Learning from talking: “All-purpose academic words”

What are “all-purpose academic words”? These words are difficult to define. They are abstract words used by adult speakers. They are not discipline-specific. Examples from *Academic Word List Coxhead* (2000) are achieve, adjust, challenge, conclude etc. These words are usually learned by listening to people who use them or through reading.

When children neither read very much, nor take part in dialogs or listen to discussions, the possibility to learn these words are reduced. Snow, Lawrence and White (2009) started a project called “*Word Generation*” to promote learning of all-purpose academic vocabulary among sixth to eight-grade students in Boston public schools. The teachers in these grades had been worried about the students’ low reading ability and limited comprehension of text. The word learning in this project adheres to research based principles of vocabulary learning. The students were taught five new words every week in classroom discussion, debates and in writing. In addition to teaching vocabulary, the program provides opportunities to develop and practice the new words introduced. The results of the study were promising. The students in the project learned more of the targeted words than students in the comparison schools. Minority students benefited more than English only students. A longitudinal follow up study of the Word Generation program, showed that the differences lasted at least one year (Lawrence et al., 2012)

RESEARCH QUESTIONS

Knowing that the quality of the discourse students take part in is important for reading development and comprehension of text, we were interested in what teachers say and do to promote discourse, especially an extended discourse, at teacher-led station in EYLP. At this station the teacher is talking with the students about booklets, and has to possibility to use decontextualized language, encourage turn-taking, talk about rare word and use all-purpose academic words during the session.

We raised the following questions;

1. How do teachers take initiative to an extended discourse at teacher-led station during EYLP?
 - a. –to foster decontextualized language?
 - b. –to encourage children to participate in the dialogs?
 - c. –to develop an understanding of rare words?
2. How representative is an extended discourse at teacher-led station?
3. What kind of all-purpose academic words are used?

RESEARCH DESIGN - METHODOLOGY

We have used a *case study design* (Yin, 2013), with two teacher in first grade as our cases. For judging the design quality, we have followed Yins validity criteria (p.45). To secure construct validity we developed a codebook for the categories we wanted to use, with examples of decontextualized language, turn-taking and rare words. For judging internal validity, discussed by Yin as making inferences in qualitative studies, we used pattern matching as a strategy (Yin, 2014,p.143) to compare teachers with themselves in different sequences, and to compare the teachers with each other.

In order to secure external validity, which is an analytic generalization back to theory in case study research (p.40), we used replication to judge similarities and differences between the two cases. When disagreement occur between the coders, the examples were discussed and recoded until an agreement of $r=.80$.

Sample

In EYLP the teachers divide their class into groups after reading level. Each class was divided into five groups of four or five children. We choose to analyse our cases teaching the two groups with the best and the second best reading level. The communication between teachers and students seemed to be richest in these groups. Our teachers were well educated, and had equal amount of experience.

Analysed sequences

We have analysed the two teachers teaching in these two groups two different days, a total of eight sequences (2 teacher x 2 groups x 2 days= 8 sequences). Each sequence lasted 10 minutes. Each teacher is analysed in two sequences for each group, a total of four sequences, which means 40 minutes per teacher. In sum, 80 minutes teaching are analysed in the present study. The analysed sequences are matched for similar activities. They were all talking about and reading small booklets.

Analysing categories

For *extended discourse* we have especially emphasized the teachers' *decontextualized language* use. Discourse around booklets is a good situation to introduce nonimmediate talk. The text and the pictures in these booklets are very limited, so to elaborate on the story, nonimmediate talk is necessary. Explanations and narratives will perhaps also occur, but these talks will be characterized by decontextualized language.

Teachers' initiative to *turn-taking*, to encourage students to elaborate on their own thoughts, is another category under extended discourse. The last category, *rare words*, is characterized by the teachers' initiative to introduce rare words, to ask for interpretations of these words or discuss their meaning with the students. We have placed rare words as an aspect of extended discourse, because rare word often occurs during decontextualized discourse of aspects introduced in books. The last analysing category is teachers' use of all-purpose academic words. We have had Academic Word List Coxhead (2000) as our guide for isolating these words. Examples are use of words like explain, encourage, attitude etc. They are all abstract words used by adult speakers. These words are difficult to define. We developed a codebook in Norwegian language to guide our work.

Analysing strategies

To answer research question 1, how teachers take initiative to an extended discourse on teacher-led station, data is transcribed and analysed in a qualitative way.

We are searching for excerpts in the dialogs between teachers and students where teachers use decontextualized language, initiative to turn-taking and introduction to rare words. To answer research question 2, if an extended discourse is representative for what is going on in the analysed sequences, we have used Videograph (Rimmele, 2000). Videograph is a program where what is said and done can be coded along a timeline, and produce frequencies of time used for different purposes. Videograph is used for pattern matching of the teachers' activities and comparison of the results between the two teachers. To answer research question 3, about use of all-purpose academic words, we planned to use frequencies through Videograph.

RESULTS

On the positive side our qualitative analyses of the excerpts of dialogs at teachers-led station, show that both our cases take some initiative to an extended discourse (RQ1). They expand the text in the booklets using decontextualized language, for instance asking for reasons for utterances and word use. We will present examples from the main categories of extended discourse; initiative to decontextualized language, turn-taking and introduction to rare words.

Initiative to decontextualized language use

Initiative to decontextualized language use is found when teacher 1 (T1) is introducing a new booklet called "*Smile!...said daddy*" (Learning Media /Cappelen 2003), starting with a look at the front picture. It shows a lady, three children and a dog against a blue background.

The teacher starts with a relative open question:

T1: What do you see here?

S1: It is a family on the beach.

T1: Why do you think it is a family?

S1: Because I think this must be a mom?, and this must be a child because she is holding it... and they are together, and then it is often a family.

T1: Why do you think they are on a beach?

S1: Because it looks like sand and water in the background.

The student is introducing the words "beach" and "family". These words are not mentioned in the booklet. The teacher takes the opportunity and asks the student for a reason of her word use. The teacher is asking for an explanation: "Why do you think...?" Discussions around word meaning are often embedded in a decontextualized language, so it is difficult to split categories of decontextualized language use and discussion of vocabulary. We have chosen to present these utterances under decontextualized language, because the discussion concerns topics that are not mentioned in the text.

Talking about the booklet “*Ready, steady, jump!* (Learning Media/Cappelen 2003), which tells a story about a spider, teacher 2 (T2) asked:

T2: Who do you think has taken the picture of the spider?

S1: The one who has written the book.

T2: Yes, perhaps ... but how has he managed to come so close?

S2: Oh, he has been zooming.

T2: Yes! He has been zooming.

The story about the spiders jump and spin activity is interesting in itself, but the teacher expands the talk beyond what is mentioned in the text. One student uses a word that can be said to be rare for the age group, “zooming”.

Introducing rare words

The dialog between the teacher and students about the spider and the photography goes on:

T2: What does it mean to zoom?

S1 & S2: It's to see things very close!

T2: To see things very close- Yes!

T2: But what do we use when we are zooming?

She is asking for a definition or an explanation of the word zooming, and uses a vocabulary beyond “here and now” to develop a deeper understanding of the word.

Encouraging turn-taking

When the students are invited to take turn in the dialog, they are expected to articulate their opinion about a topic in such a way that their classmates can understand it. The teachers are occasionally using open questions, reformulations of questions and repetition of utterances as technics to involve more students in the dialog. Talking about “*Old Tuartara*” (Learning Media/ Cappelen 2003) teacher 2 used different technics to get more students involved:

T2: Can you guess what this might be?

S1: A toad!

T2: You think it is a toad. What do you think? (to another student)

S2: A lizard?...

T2: You think it is a lizard. And you?

Teacher 2 invites the children to take part in the dialog with repeating the question and other utterances over several sequences. The repetition of “What do you think?” shows a real interest in each student's opinion, and motivates them to share their thoughts.

Use of all-purpose academic words

Our search for teachers' use of all-purpose academic words (RQ3), were not successful. These kinds of words were almost missing. We found two that could match the Coxhead (2000) list.

How representative is an extended discourse for the activities on teacher-led station?

To look for frequencies of extended discourse (RQ2), we coded the time used for the different categories, and compared the results for the teachers with themselves, and with each other. The pattern matching of the teachers with themselves, showed high stability of extended discourse over the different groups and the different days. The difference between the two teachers, however, is remarkable. The results are presented in figure 1. Time used for decontextualized language, turn-taking and introduction to rare words are summed up for all analysed sequences for each teacher, and presented in the same figure.

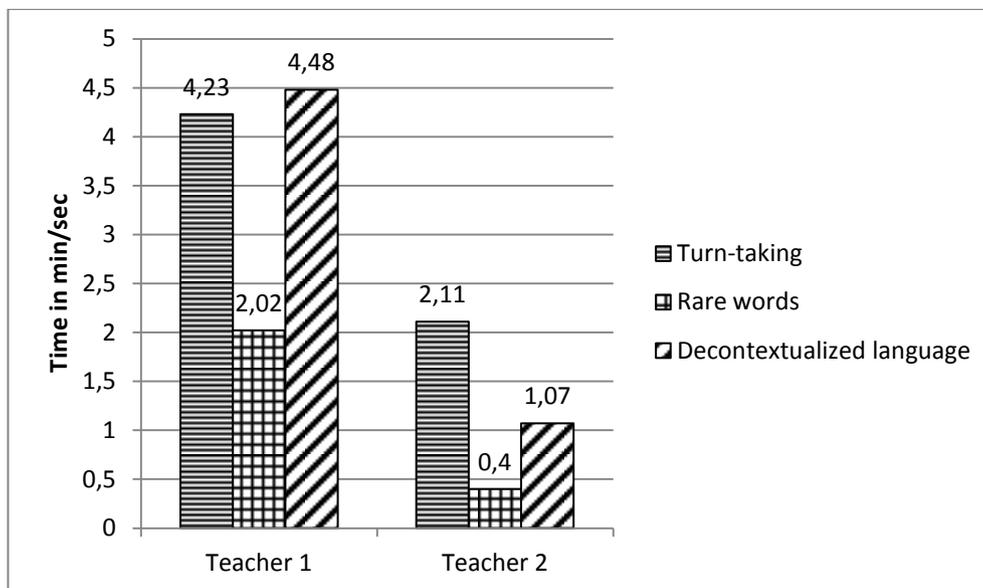


Figure 1. Frequencies of time used for extended discourse at teacher-led station for both cases.

Despite the fact that the two teachers had planned their teaching sequences together, and they were asked to do what they had planned, the difference in their interaction with the students and initiation of different aspects of expanded discourse is great. Both of them use very little time for development of rare words, only 4 seconds of 40 minutes teaching time by case 2. Also the time for use of decontextualized language differs. We must conclude that time used for extended discourse is low for both cases, and extended discourse is not representative for what is going on at the teacher-led station in the sequences we have observed.

What is going on the rest of the time?

When such a small part of the time used at teacher-led station was categorized as extended discourse, what was going on the rest of the time? The ten minutes at teacher-led station is the only time during 60 minutes work the students communicate with an adult. The other stations the students are working individual with different assignments. Teacher-led station is therefore important for students learning.

We decided to look for dialogs in a broader perspective by including traditional IRE dialogs with Initiation, Response and Evaluation as described by Cazden (2001), which we know dominate classroom talk.

In addition we wanted to look at time used for decoding. Decoding is an important issue in first grade. The results are placed in Figure 2.

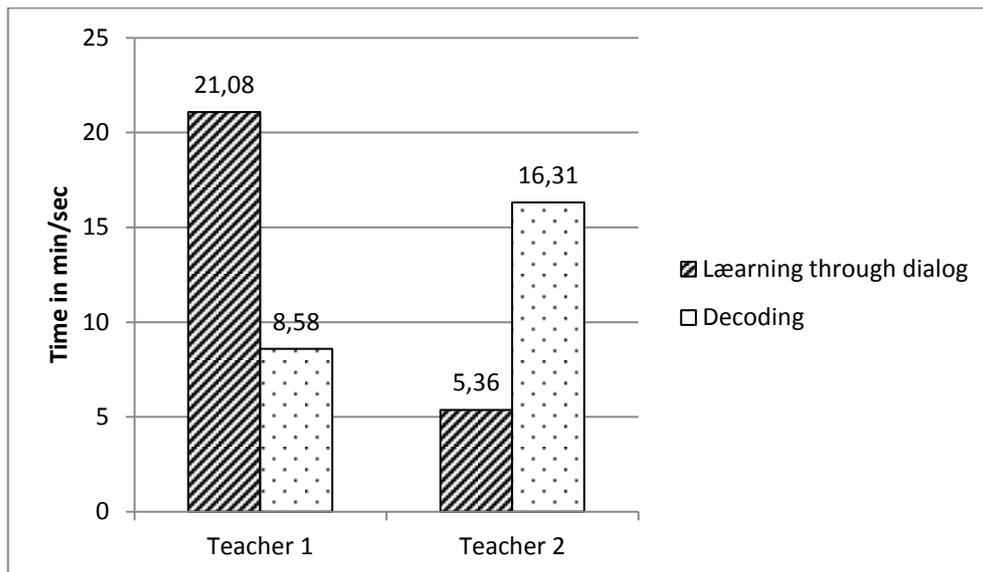


Figure 2. Sum of time used for learning through dialogs (extended discourse and IRE) and decoding exercises at teacher-led station.

Teacher 1 used half of the time at teacher-led station for dialogs in a broader perspective, summed up for extended discourse and IRE dialogs. Nearly nine minutes were used for decoding exercises. Pattern matching between the two teachers show another picture for teacher 2. Compared with teacher 1, teacher 2 used only $\frac{1}{4}$ of teacher 1s time for dialogs. When it comes to decoding she used nearly twice as much time for decoding activities than her colleague.

results are presented in figure 1. Time used for decontextualized language, turn-taking and introduction to rare words are summed up for all analysed sequences for each teacher, and presented in the same figure.

CONCLUSION AND DISCUSSION

Both teachers show positive initiative to an extended discourse at teacher-led station in EYLP. They foster students through decontextualized language use, by introducing rare words and asking students to explain their use of these words, and to take turn in the dialogs. Evaluating how representative extended discourse is for what is happening on teacher-led station, we must conclude that extended discourse is not a trend, but occurred occasionally.

The use of all-purpose academic words was nearly absent. Making teachers aware of the very best in their practice may be an incitement for improvement.

Implications for practice

It is important to use our knowledge of what kind of classroom talk is most important for children's development of language, critical thinking and comprehension in teacher education. Student teachers must be made aware of the positive consequences of discourse in the classroom, and how to promote it. Discussion is not a skill prioritized in preparing teachers (Michaels et al., 2008; Snow, 2011). Both critical thinking and comprehension of text make a difference for learning in school, and we know that discussions in the classroom foster these developments (Murphy et al., 2009).

We know from researcher like Cunningham and Stanovich (1997) and the Harvard group (Dickinson & Tabors, 2001) that experience at home and in preschool with decontextualized language use, invitation to taking part in dialogs and articulate your meaning, is very important for later success in school. Well educated and knowledgeable school teacher can make a difference (Tabors, Snow & Dickinson, 2001). Michaels et al.s (2008) work with teachers, showed that making them aware of the effect of open questions, really made a difference in encouraging students to take part in dialogs.

What can teachers do? To read books that invite to a discussion about what is going on, will make it possible for teachers to introduce decontextualized language use. Teachers must be aware of the effect of open questions, and leave the traditional classroom talk with initiation of a question, waiting for a response from the students, and end it with an evaluation of the answer as right or wrong. They have to ask the students for their opinion, ask them to give a reason for their thoughts about what is happening.

They have to be aware of giving explanations of events, and include the students to give their opinion of different events. Development of vocabulary is important and international researcher like Biemiller and Boote (2006) conclude after a lot of studies that school don't work systematically enough with vocabulary development. Both rare words and all-purpose academic words are important areas of improvement. Snow et al.s (2009) innovations study with all-purpose academic words gave positive results. Teachers are developing their practice when they get adequate information. Facilitating teachers' learning with positive examples from their own practice is a good start.

Limitations and future Research

Our study is a case study with two teachers. It has therefore clear limitations, for instance concerning generalizations. A case study research is useful for what Yin (2014) calls an analytic generalization, which means an analytic view back to theory. The question is to see if the theory used gives a knowledgeable understanding of the data. We have followed our cases in a limited time perspective, two days with work in two different groups. There will always be possibilities for influence of the interactions between students and teacher that is out of our range of understanding. We have, however, seen beautiful examples of fostering dialogs which can be stimulation for change.

It would be interesting to start an innovation project to improve classroom discourse from early grades. We have lots knowledge about how classroom talk can be improved. We also know that when we a giving teachers information in a way they understand, they change their practice in a positive way (Reeve, 2006).

As Hodgkinson and Mercer (2008) remained us..." ...classroom talk ... is the most important educational tool for guiding the development of understanding and for jointly constructing knowledge". (p.xi)

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**THE DIFFERENCES OF BEING A SCHOOL MENTOR
OR A SUPERVISING TEACHER DURING THE
TEACHER STUDENTS' PEDAGOGICAL PRACTICE
ACCORDING TO THE MENTOR AND SUPERVISING
TEACHERS**

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ABSTRACT

Reforms on teacher education programs in the recent decades have been focusing on overcoming the gap between theory and practice more efficiently. New ways of building a better collaboration between schools and university are needed. At the University of Tartu in Estonia, a mentor teacher was included into the existing pedagogical practice network in addition to the supervising teacher. The role of the mentor teacher is to support the teacher student in connecting theory and practice through reflection. In the current study the role of school mentors and supervising teachers as practical teacher educators was studied. The aim of the research was to clarify the mentor and supervising teachers own understanding of the roles and tasks in the students' pedagogical practice. The mentors were considered to have bigger responsibility in supporting the pedagogical practice. Compared to the supervising teachers their role and tasks are wider and the mentor teachers have to be aware of all the different aspects of teachers profession while supervising teacher feel more responsible for showing certain teaching methods for particular subjects or lessons. Therefore these two roles have to be taken by two separate persons. Anyhow, mentor and supervising teacher feel that they have to be in contact to follow the development of the teacher student and mutual communication has to be organised and ways to do it worked out beforehand.

Keywords: Mentor, Supervising teacher, Teacher education, Pedagogical practice, Innovation

INTRODUCTION

Several European and OECD documents and research articles in the last decades have focused on the quality and developments of teacher education (Korthagen, 2004; OECD, 2013; Onderwijsraad, 2013). Critics have pointed out the gap between theory and practice in the teacher education curriculums (Kansen, Tirri, Meri, Krokfors, Husu, & Jyrhämä, 2000, Jones, 2010) and the need to fill this gap. To overcome the gap between theory and practice, a new model for building a collaboration network of schools and teacher education institutions is needed (Pedaste, Pedaste, Lukk, Villems & Allas, 2014).

So far, in Estonia, a more traditional teacher education model has been implemented, where the responsibility has been put on the university. The 21st century teacher education programs, however, should invest less in academic preparation and more in preparing professionals in school settings, with an appropriate balance between theory and practice (Schleicher, 2011). Nowadays teacher has to be responsible for more than just the processes taking place inside the classroom. Modern teacher should have a wider view of the processes of teaching and learning (Korthagen, 1999). The University of Tartu in Estonia has implemented several developments in the past years in its teacher education programs. These adjustments have been made based on two strategic documents: the national Teachers' Professional Standard (2013) and the Estonian Strategy for Education and Lifelong Learning (2014), which put emphasis on a new approach to learning, focus on including ICT into learning and teaching processes, and indicate the competences a teacher must have in the changing society.

Powerful teacher education programs emphasize strong relationships, based upon common knowledge and beliefs, between universities and reform-minded schools (Darling-Hammond, 2006). A shared responsibility and dispersed student teacher traineeship in schools would be a possible starting point for the initial revisions of teacher education for 21st-century teachers. However, teacher education institutions and schools are not prepared for their changing roles (Pedaste et al., 2014). At the University of Estonia, a new model called the Network of Innovation Schools was developed for building a collaboration network of schools and teacher education institutions. In the model of Innovation Schools, four dimensions of collaboration between the network of schools and universities have been specified: traineeship; professional development; team teaching; and research and development (Pedaste et al., 2014). In this article the focus is on the aspect of traineeship and the possibilities of making the teacher students practice more effectively by using mentors to overcome the gap between theory and practice.

A lot of emphasis in the research has been put on mentoring and on its importance as a tool to support teachers' students and novice teachers (Hall, Draper, Smith & Bullough, 2008).

It is important for the novice teachers to get systematic mentoring during their first years of professional work to help them to embed their pedagogic identity. Regular meetings with mentors help to overcome the critical moments that novice teachers face at schools every day (Darling-Hammond, 2006).

Becoming a mentor needs training and qualifications. The need for the trainings has been acknowledged by mentor teachers themselves (Hall et al., 2008).

Mentoring has been described as a relationship between two people with the aim of purposeful mutual influence on each other (Bearman, Blake-Beard, Hunt & Crosby, 2007). The roles of the mentor are seen in modelling good teaching and in improving teaching skills (Maphalala, 2013; Nalumansi, 2011); in providing support in adapting oneself to the school environment (Hall et al., 2008); in giving feedback and supporting the reflection skills of a novice teacher or mentee (Sempowicz & Hudson, 2012); or in providing general emotional support (Kwan & Lopez-Real, 2005). Within teacher education, mentoring is often referred to as a journey (Awaya, McEwan, Heyler, Linsky, Lum & Wakukawa, 2003) and as a process of collaborative work (Feiman-Nemser, 1998). While different roles and responsibilities of mentor teachers are mentioned by different authors, the work of mentoring is generally understood to be complex (Young, Bullough, Draper, Smith & Erickson, 2005). The role of a mentor requires new knowledge and skills in mentoring and adult education and especially a positive attitude toward improving student teachers' competences (Pedaste et al. 2014a).

The design of the teacher students' practice at the University of Tartu

In a two-year pilot study a network of innovation and practice schools was tested at the University of Tartu (Pedaste et al. 2014; Pedaste, Pedaste, Murakas & Lukk, 2015). One of the main changes was the increase of school practice for students, which would be supported by mentors helping the students in their reflection during the entire study period of two years.

The framework of the new practice system was implemented in a pilot study as a model of Innovation Schools in Tartu Kivilinna Gymnasium for two full school years. Tartu Kivilinna Gymnasium was one of the biggest schools in Estonia, with more than 1,400 students from grades 1–12 and about 100 teachers³. It has served the University of Tartu for years as a partner for student teacher traineeship. Several teachers, including four school mentors, three university mentors, teacher educators from the university, and nine students who completed the new form of traineeship, participated in this piloting process.

They all gave systematic feedback on the model and recommendations for the large-scale implementation of the new form of partnership. These discussions and the participants' feedback formed the source for describing the dimensions of the model and the properties of the Innovation Schools (Pedaste et al, 2014a).

³ Since September 2014, the gymnasium was reformed into primary school due to changes in Estonian educational system.

This article focuses on of the aims of the collaboration between schools and university – the implementation of mentors in the students practice network

In the model, the teacher educator from schools is involved in observing and supervising student teachers throughout a school year and acts as a mentor (Yendol-Hoppey & Dana, 2007) for a group of two to three students during their pedagogical studies, which often last two years. One important part of the mentoring process is regular discussions between the mentor and other students. During these discussions the mentor and the students discuss the different aspects of teaching in general, the identity of the teacher from an individual and more general perspective, and the theoretical approaches and practical experience with the aim of linking these two sides. The purpose of these discussions is to reflect on one's actions as a teacher and analyse one's knowledge, skills and attitudes in the light of one's personal development.

In addition to school mentors, students also have supervising teachers who are supervising didactical and basic practice and who, different from the mentors, focus on giving specific feedback on teaching methods and have to assess the students.

In the current study the aim of the research was to explore the notions of school teachers as mentors and supervising teachers in students' pedagogical practice network. Two research questions were formulated: "How is the role of the students' pedagogical practice mentor understood by mentor teachers and supervising teachers?" and "What are the supportive factors of the collaboration between school mentors and school supervising teachers to support the students' pedagogical practice?"

METHODOLOGY

This research is part of a wider research project that focused on the new practice system from the perspective of teacher students, school mentors and supervising teachers and university mentors (Villems, Toome & Pedaste, 2014). This article focuses on the school mentors and supervising teacher's notion of the new practice system at the University of Tartu.

A qualitative approach – semi-structured interview – was chosen to answer the research questions of the study. A qualitative study enables to understand and explain situations and peoples' experience as well as investigate what kind of meaning people themselves give to their experiences (Cohen, Manion & Morrison, 2007).

Four mentor teachers (entire population) and three supervising teachers (purposive sample) were interviewed (see table 1). All the mentors had worked as supervising teachers before, but were mentors for the first time. The three supervising teachers had different experience in supervising before this project: one of them was a highly experienced supervising teacher, one had some experience and for one teacher it was the first time to supervise a student.

Long-time experience means that these teachers have supervised more than five students and have been supervising students more than three years.

Table 1.

The experience in supervising and teaching.

Interviewee	Experience in supervising	Experience in teaching
Mentor teacher 1	Long-term supervising experience	More than 25 years
Mentor teacher 2	Slight supervising experience	More than 10 years
Mentor teacher 3	Slight supervising experience	More than 20 years
Mentor teacher 4	Long-term supervising experience	More than 20 years
Supervising teacher 1	Slight supervising experience	More than 5 years
Supervising teacher 2	Long-term supervising experience	More than 25 years
Supervising teacher 3	No previous supervising experience	More than 10 years

Semi-structured interviews were conducted between 14th of January and 4th of March 2014. An e-mail was sent to the interviewees in advance with a topic list of the themes that would be under discussion during the interview. For a warm-up, interviewees were asked to talk about their supervising and teaching experience. The questions for mentor teachers and supervising teachers were largely similar, but concentrated respectively on mentoring or supervising. Mentor teachers were asked to describe their tasks and assignments that they attended during the one and a half years of being a mentor. Supervising teachers were asked about their tasks that were connected to being a supervising teacher.

All the interviewees were invited to explain the differences between the tasks and roles of mentor and supervising teacher. Also, the teachers were asked to talk about their positive and challenging experiences when being a supervisor or a mentor. Finally the interviewees were asked to describe the characteristics of mentors and supervising teachers, the teachers were advocated to point out the things they missed the most when mentoring or supervising and also to mark the things and actions they would do differently if pointed to the same task again.

All the interviews were transcribed and thematic content analysis was used to study the results. The interviews were coded according to the research questions. The relevant phrases were marked according to the codes and categorized.

RESULTS

The role of mentor teachers and supervising teachers

First, the roles and tasks and the individual and professional characteristics of mentors and supervising teachers are discussed. Likewise, the differences between these two roles are presented. The results are illustrated with extracts from the interviews, the original phrasing is kept.

In general the tasks and role of the mentor was considered wider than the tasks and roles of the supervising teachers.

The mentors said that their main task was to guide the mentor discussions with students and to support the reflection process of students during these discussions. One of the mentors pointed out that at first guiding the mentor discussion was very challenging because the students didn't have any experience and no theoretical knowledge about reflection. The task of guiding a mentor discussion was also new for the mentors themselves.

"I think that when it comes to reflection it has been a problem that they (students) have had any theoretical courses at the university about reflection and they don't know what it is then" (Mentor 3)⁴.

But the mentors valued the students' development from the first emotion drawn mentor discussions to reflective discussions at the end of the practice period.

In addition, mentors found that they had to present all the different aspects of the teachers' job and the particular school. The mentors introduced the documents of the school, the syllabus of the subjects, school own regulations, traditions and values, the conditions of working with parents and helping the pupils with special needs. The mentors explained that they themselves were forced to think over the theoretical knowledge they have of being a teacher and of teaching and learning.

"As students have been here following the teacher or one class for the whole time, then the task for me is to show all the different aspects of my work. But for the mentor discussions I had to get acquaint again with the pedagogical psychology, be aware of the general issues in education. I had to show the teacher students the real school life, how theory relates to the practice" (Mentor x)⁵.

The supervising teachers said that they planned the study process with the teacher student: discussed the lessons (the goals, activities and ways of giving feedback to the pupils), had to be acquainted with the teacher students' outline for the lessons, and had to correct, comment and add things to the outlines if necessary.

The supervising teachers had to follow and discuss the teacher students' lessons and give feedback to students about these lessons. If the practice was conducted in a different school than that of the mentors', the supervising teachers themselves had to introduce the schools' documents and values to the student. The supervising teacher taught the students about the time planning and about how to compose tests.

⁴ Refleksiooni ülesande puhul ongi ka see vist olnud probleemiks, et neil ei ole ülikooli poolelt neid konkreetseid loenguid toeks olnud, siis nad täpselt ei tea selle olemust.

⁵ Kui tudengid on olnud siin nii-öelda varjudena (õpetaja varjuna või klassi varjuna), siis ülesanne oli võimalikult mitmekülgsest oma tööd näidata, aga siis mentorarutelude jaoks tuli ennast väga kurssi viia pedagoogilise psühholoogia põhitõdedega, üle vaadata niisugused üldised haridusteema küsimused, näidata üliõpilasele, missugune tegelik koolielu on, kuidas miski teoreetiline punkt millegi praktilisega seostub.

“I presume – and in general that is the reality – that teacher students get the knowledge about the subject at the university and I don’t have to teach the subject. Maybe only what to emphasise in certain lessons. But how to set the rhythm of a lesson and to be aware that from which lesson the teacher student is coming from and in which lesson he or she is going to go. Days can be very different” (Supervising teacher 2)⁶.

The personal characteristics of mentors and supervising teachers are found to be quite similar.

The characteristics of a mentor according to the mentors themselves are positive attitude, continuity, determinedness, will power, serenity and curiosity. Mentor teachers should be able to work more hours and more intensively.

“You have to have this certain willpower meaning how much you want to do the job yourself” (Mentor 3)⁷.

The characteristics of supervising teachers are empathy, openness, honesty, flatness, ability to cooperate and extra good knowledge of the subject.

In addition the mentor teachers saw the mentoring as a mutually beneficiary process. Mentors valued the personal development that was seen as an extra bonus of the new role. They had attended trainings at the university and they highlighted the deeper knowledge that they got about the students’ theoretical studies through these trainings. The mentoring is therefore seen as a mutual learning process for both the mentor and the mentee.

“My approach to teaching has widened” (Mentor 4)⁸.

“If previously I did not know what is happening at the university in teacher education, then now, thanks to the teacher students, I know what they are learning there, what is required from them at the university” (Mentor 3)⁹.

The personal characteristics and pedagogical experience are also very important for being a good mentor. University of Tartu required at least three years of pedagogical experience from the mentors. The mentor teachers themselves saw that even more experience is needed (ten years of experience) because especially mentoring needs a longer experience.

Peaks olema küllaliski pika pedagoogilise kogemusega. Üks kümme-viisteist aastat peaks kindlasti olema (mentor 1).

The personal development of supervising teacher was different from the mentors’. Supervising teachers pointed out that all the students were motivated and therefore the supervising went well. One teacher with the long experience in supervising mentioned that supervising gives her the possibility to share her knowledge and experience.

⁶ Ma eeldan — ja üldjuhul see nii on —, et ainetundmine on ülikoolist olemas ja seda ei ole vaja õpetada, võib-olla rõhuasetusi, aga seda tunni rütmi paika panemist, et on oluline, kust [tunnist] nad tulevad, kuhu nad lähevad, et päevad võivad erinevad olla.

⁷ Endal peab olema see tahtejõud, et kui palju tõsiselt sa ise seda tööd nagu teha tahad

⁸ Vaade õpetamisele on saanud avaramaks

⁹ Kui eelnevalt ei teadnud võib-olla ülikooli poolt seda, et mis seal õpetajakoolituses toimub, siis tänu tudengitele ma nüüd tean, et mida nad õpivad, missugused on nende nõudmised ülikoolipoolselt.

The supervising teacher with no previous experience in supervising got confirmation that the ways she teaches or communicates with the pupils are correct. The third supervising teacher pointed out that she has never thought about personal development during the supervision process, but had acquired interesting worksheets from her student. The supervising teacher should have at least five years of experience in teaching.

“I would say five years is a time one has already seen all the different aspects. The teacher has seen what is the national Olympiad, the Christmas doings, the changes of curriculums or text books” (Supervising teacher 2)¹⁰.

The interviewees were asked to discuss the differences of mentor teachers and supervising teachers (see table 2).

All the mentor teachers (who had been supervising teachers before this pilot project) said that mentoring was wider than supervising. If the supervising teacher focuses on the lessons and the methods used by the teacher students, mentors have to explain everything from the juridical aspects to how to teach the pupils with special needs. According to the mentors themselves they have bigger responsibility and they see themselves as partners for the teacher student.

“I felt that the responsibility is different. When I was a supervising teacher I was a teacher with certain techniques and methods, but now I realize that it depends a lot on my doings which kind of a teacher the teacher student that I work with will turn out to be” (Mentor 4)¹¹.

Supervising teachers were asked to define and explain the role of the mentor teacher. It was a difficult question for the supervising teachers – they knew the notion of mentor, but the tasks of the mentor were hard to define for them.

“The mentor teacher is observes the teacher students during the whole day to see how the student feels. If the student feels safe, does the student have a place to sit, does he or she has a place to go the student would not feel like a stranger in the school. And that the student understands what is happening in a school life and that it is a whole not just lesson after another” (Supervising teacher 2)¹².

¹⁰ Ma pakun, et mingi viis aastat võiks ikka olla, et ta on näinud kõik asjad ära. Ütleme, et ta on näinud, mis tähendab olümpiaad, mida tähendavad jõuluaskeldused, hea on, kui ta on näinud, mis tähendab õppekava vahetus, õpikute vahetus

¹¹ Ma tajusin, et see vastutus on hoopis teist laadi, et kui praktikajuhendajana olin ma seesugune tehnikate ja meetodite õpetaja, siis nüüd tegelikult ma sain aru, et sellest, mis mina teen, sõltub suuresti see, missugune õpetaja sellest noorest inimesest kujuneb, kellega ma töötan

¹² Mentorõpetaja üldse kogu koolipäeva vältel jälgib teda [üliõpilast], et kuidas ta tunneb ennast. Tähendab, ta jälgib kogu aeg, kas ta tunneb ennast hästi, kas tal on turvaline, kas tal on koht, kuhu ta istub, et ta läheb, et ta ei tunne end koolis võõrkehana ja näiteks, et mis siin koolielus toimub ja et ta tajub, et koolielu on tervik, mitte ainult üks tund ja teine tund ja kolmas tund.

Table 2.

The differences of mentor and supervising teachers according to the interviewees.

	Mentor teachers	Supervising teachers
Pedagogical experience	10 years	5 years
Personal characteristics	Positive attitude, continuity, determinedness, will power, serenity and curiosity	Empathy, openness, honesty, flatness, ability to cooperate, extra good knowledge of the subject
Tasks	Mentor discussions and more general aspects of being a teacher	Focus on the lessons and the teaching process in these lessons
Contact with the university	Often and continuously on going	Only during the basic practice period
Responsibility	Bigger	Smaller
Relationship with the students	Partnership	Supervision

As it was hard for the supervising teachers to define the roles of mentors and supervising teachers, they were asked to propose the possible differences. Supervising teachers thought that the mentors were more in contact with the university, mentors talked more about the curriculums, the juridical aspects in education, but also about more general issues connected to the education system. They also discussed that the mentors would analyse the lessons more thoroughly and help the students to fill their practice diary. Supervising teachers, compared to mentors, are more focused on particular lessons.

The biggest obstacle of being a mentor is the time planning. It is complicated to find mutual time for mentor discussions. The mentoring as a process itself is time consuming enough so the biggest challenge is how to make the mentor discussions more effective. The supervisors do not see the lack of time as big an obstacle because they said that the students helped them to check the tests or prepare the tests for lessons and therefore the teacher students even made the working more effective. Sometimes the mentors felt that they were not up to their task and they were even afraid that they can't meet those standards that were set for them. This is connected to the huge amount of responsibility that the mentors felt.

The collaboration between supervising teachers and mentor teachers and their expectations towards the university

Secondly the factors that supported the collaboration between the mentor teacher and supervising teacher were discussed as well as the expectations towards the university.

Sometimes the mentor and supervising teacher worked in the same school, but sometimes they worked in different schools. Before the pilot project started, all the mentors and supervising teachers met at the introductory seminar, but after this the contact diminished due to different reasons.

One mentor admitted that she did not even think about contacting the supervising teacher, because she got the relevant and necessary information about the development of the basic practice from the teacher student. Second mentor teacher discussed that if there would have been problems with the students, the supervising teacher would have probably contacted the mentor teacher. The mentors were confused whether they were supposed to be the initiators of organizing meetings with supervising teachers. Anyhow, mentors brought out that collaboration with supervising teachers was necessary and meetings should be organized.

“I maybe would have wanted to ask if the things I see in the student, are true” (Mentor 4)¹³.

Supervising teachers said that cooperation with mentors was random. There were no meetings organized after the first introductory meeting, but the supervising teachers would have needed to have more contact with mentors. Two of the supervising teachers did not know the names of the students’ mentor teachers. The only possibility to contact each other was through e-mail.

To make the practice period more effective, the mentors said that they would have needed a full overview of the students’ curriculum that should have been provided by the university. It is not enough if the mentor teachers had the outline of the studies semester by semester, but having an overview of the goals and assignments of different courses makes it easier for the mentors and supervisors to support the student. Also the supervising teachers would have liked to have a clearer overview of the goals and assignments of the basic practice. They would have wanted more guidance from the university how to supervise the practice, but this could be related to the reasons that supervising teachers with less experience are not entirely sure that they were doing a good job.

Mentors were sometimes disturbed that the theoretical studies of the students at the university were not in parallel with the practical studies they were supposed to follow during their practice at school. The supervising teachers on the other hand were disturbed that the students still had courses at the university during their basic practice.

The students had to study for the exams or participate in the seminars at the university often parallel to their practice period and that left them less time to prepare the lessons they were supposed to teach at schools.

¹³ Ma võib-olla oleksin lihtsalt ise tahtnud küsida, et kas see, mida mina näen temas, et kas see vastab tõele.

CONCLUSIONS AND SUGGESTIONS

All the mentors participating in the pilot project mentioned that being a mentor is a very positive experience. All the mentors had a good relationship with their mentees that was considered a very important aspect to have mutually fruitful collaboration. Therefore it is necessary to make sure that if the relationship between the mentor and mentee is problematic, action has to be taken fast and solution that suits both parties has to be figured out.

Mentoring has been described as a relationship between two people with the aim of purposeful mutual influence on each other (Bearman et al., 2007).

The role of mentor and supervising teacher should be taken by different people because the tasks are different and are difficult to distinguish if taken by one person. As it was pointed out by the mentor teachers and also supervising teachers, mentoring is a wider and longer process, seen more as a journey (Awaya et al., 2003). The mentors also felt that they were responsible in providing support in adapting the teacher students to the school environment (Hall et al., 2008).

The mentor teachers feel a great responsibility during the period of the teacher students' practice and for being efficient and successful they also need support from the university. Also, the supervising teachers want to be in more contact with the university. To build a trusting relationship between the schools and university, sometimes new ways of collaboration have to be created, like the network of Innovation Schools at the University of Tartu (Pedaste et al. 2014, Pedaste et al. 2015).

The biggest challenges of keeping up an effective practice network that consist of so many people, is communication. It was especially the mentor teachers that hoped for more communication with supervising teachers, but also with the university. It is important to choose the most suitable ways of communication. In general, teachers are used to reading e-mails and this seems the best channel for sharing information, but other ways of communication could be discussed with the teachers.

Therefore to build a well-functioning relationship between the mentors and supervising teachers and the university, the following actions should be taken into consideration:

- Agree on the communication channels (e-mail, webpage) and use different channels for different information.
- Agree who has to organize and how often the mutual seminars where mentor teachers, supervising teachers and university members all participate.
- Organize the students' basic practice during a period when the students will not have any other obligations at the university.
- Give students the theoretical introduction about reflection processes before they start their practice period.
- Organise trainings to the mentors.
- Suggest relevant reading to the mentors, because often they don't have time to search for the materials themselves.

- Appreciate the work of mentors and supervisors.

A further research should be done to on the mentor teachers actual professional development to deeper understand the effectiveness of being a mentor as a way of professional development of the mentor teacher herself or himself.

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FROM PROPORTIONS TO FRACTIONS

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ABSTRACT

The study addresses problems with learning and understanding ratios, proportions, and fractions encountered by middle school students. The complexity of the topic is due to highly interconnected web-like system of concepts, operations, and models defining the proportional reasoning. We teach fractions beginning from the concept of proportion, which is repeatedly considered in different problem-solving contexts. Our approach draws from the Activity Theory to represent for students the most fundamental proportional relationships in various contexts during design research experiment. A typical student activity is to construct a ratio problem after a given model. A local instructional theory has been formulated and tested during the first long-term macro-cycle of our design research. As an evidence of adequate comprehension of the material, we demonstrate that our students start using fractions as a mediating tool for certain problems. Thus, a solid foundation for subsequent learning of more advanced mathematical concepts is built.

INTRODUCTION

Our research deals with the difficulties children experience when learning fractions, percent, proportions, rates, and ratios. The problem is urgent and is in the center of many studies (Artemov, Istomina, 1996; Gorbov, Mikulina, Saveljeva, 2002; Gravemeijer, 1994). School standards require a high level of students' math competences. School graduates have to master a great number of practical-oriented problems, where the application of certain math knowledge is necessary.

On the other hand, students often demonstrate poor proportional reasoning even though their skill in calculating fractions is high (Hart, Brown, Kuchemann, Kerslake, Ruddock & McCartney, 1981; Hecht, Vagi & Torgesen, 2007).

A high level of understanding fractions and their derivatives is essential for the students' progress in other disciplines. Natural sciences, for instance, investigate such ratio-based notions as density, velocity, concentration, pressure, etc. Dealing with these values differs greatly from manipulating whole numbers; for example, when two salt solutions are mixed, one cannot add their concentrations to obtain the concentration of the resulting solution. Mastering these concepts implies knowledge of certain operations to alter the given ratio in the needed direction or on the opposite – to maintain the ratio despite the change of the related quantities. Our main goal is to design a teaching strategy that lets students develop their own understanding of ratios, proportions, fractions, and operations with them in different contexts.

BACKGROUND

More than half a century ago, several Russian psychologists stated that a child's development is a derivative of his/her education. A person develops into a human through assimilation of human culture (Vygotsky, 1986). Such a development is impossible without the bearers of the culture, as human culture is not the objects and instruments, but rather the ways of handling and creating them. The assimilation of knowledge is possible only through a person's own activity (Leontiev, 1981). Later, knowledge becomes a guide of one's behavior rather than a piece of information to remember and reproduce if requested. These basic principles associate students' mistakes and difficulties with the way children are taught. The exact actions and operations that mediate mastering certain concepts, whole and fractional numbers in particular, are of major interest.

Dole, Clarke, Wright, and Hilton (2012) observe that quantities, their relations, and proportions are often studied separately, as demonstrated on an example involving similar triangles. This is considered to be the cause of students' poor proportional reasoning. Absence of an adequate link between proportions, fractions, and ratios is also typical to math textbooks in Russia (Vilenkin, 2011; Dorofeev, 2013). One of the reasons the students fail to apply math to 'real-life' situations is the adoption of some techniques without comprehension. Hart, Brown, Kuchemann, Kerslake, Ruddock, and McCartney (1981) discuss usage of the famous 'cross-multiply' method. They state that the algorithm is not itself valuable: unless the students understand its mechanisms and restrictions, they keep forgetting it and fail to use it.

At this point, students' skills in operating fractions and proportions – polished through massive exercises – appear to be no more than a set of formal 'techniques' and 'tricks'.

Whenever a new concept appears, special instruction about applying these 'tricks' has to be provided by the teacher in the corresponding domain.

In a regular school, early concepts of whole numbers are traditionally introduced via the operation of one-by-one counting of separate objects (Artemov, Istomina, 1996). These objects are not supposed to be counted in any other way, e.g., in pairs, in halves, etc. Thus, a whole number is seen as a result of natural one-by-one counting: our textbooks contain a picture with two pencils for number '2', while '5' is illustrated by five flowers. When it comes to fractions, we have a certain whole object, such as a cake or a watermelon, divided into several equal parts. Some of these parts may be painted, circled, or otherwise separated from the others and associated with the corresponding fraction. The numerator represents the number of parts 'taken', while the denominator indicates how many parts the whole was 'divided' into. These ideas are then strengthened through a series of examples. Students are given numerous tasks to find, construct, and name the needed fractions (Vilenkin, 2011; Dorofeev, 2013).

While the above is one of the most popular contexts of introducing whole numbers and fractions, different contexts are discussed by Susan J. Lamon (2006). Fractions can be introduced or used as:

1. a result of division (quotient): we get $\frac{3}{4}$ when dividing 3 by 4;
2. an "operator": $\frac{3}{4}$ commands to divide some number by 4 and take the result 3 times;
3. a quota: $\frac{3}{4}$ is what one person will get if 4 people are sharing 3 apples;
4. part of a whole unit: a watermelon or a cake is sliced into 4 pieces and someone gets 3 of them;
5. a result of measuring using a certain measure: if the quantity we measure is smaller than the measure itself, we divide our measure into quarters, say, and 3 of these quarters give the quantity we measure;
6. a description of a ratio that we need to maintain, or a 'recipe': for each 3 cups of flour take 4 spoons of sugar;
7. part of a set: 3 out of 4 similar pies in the basket appear to be cherry-pies.

The majority of textbooks support only some of these contexts. The problems that introduce students into operating fractions ask to find and/or compare parts of one 'whole', write down the result of division, or perform division and multiplication by the rule. In these cases, fraction is understood as an 'operator'. Problems based on rates and ratios are ordinarily solved avoiding and ignoring (indicated by the words such as 'keeping in mind') the nature of the concepts involved. This way, the values and quantities are rendered 'non-dimensional'.

For example, one has to find what will be the cost of 34 pencils, 50 cents each. Students are taught to multiply the amount of money for one pencil by the amount of pencils (50×34). The fact is that one cannot multiply cents and pencils, while this operation applied to the bare values is senseless. The hard part is to figure out that '34' refers not so much to the number of pencils as to the number of portions, so we have 34 portions, 50 cents each. The price for once pencil thus sets a rate: 50 cents per one pencil (aka portion). Grown-ups know and implicitly operate rates, but children are being deprived of this knowledge.

The basic principles are taught as a formal algorithm to be replicated. Then, we get a different problem: there are 34 pencils, and each pair is sold for 75 cents. The students still get 34×75 , which is of course wrong.

The right thing to do would be either to find the cost of one pencil or to measure the amount of pencils by two and thus get 17 portions of 75 cents, or 34 portions of 32.5 cents.

The context #6 in the list above, the one implying ‘maintaining some ratio’, is considered as applicable to proportions only and is vaguely related to operating fractions. Calculations of proportions and percent based on measuring values of different nature give place to numerous artificial problems of calculating parts of a whole and problems involving numbers with no physical meaning. Still, the ratio and percent are the contexts that people have to deal with most frequently in everyday-life as well as when solving natural science problems.

In our opinion, the way to form a complete concept is through integration of the mentioned concepts, while paying special attention to the less “traditional” contexts. Their educational potential is discussed by Russian and western authors. Dole, Clarke, Wright, Hilton (2012) consider the buoyancy problems where objects are balanced in liquids; Freudenthal (1991) presents fractions on number line; Gravemeijer (1994) discusses tables of proportional values.

Usually, fractions are introduced with no clear definition. Instead, the textbooks include ratios, ratio equivalence, and the missing-value problem. Fractions are used to write down the result of a “fair division”, e.g., “to share 3 pizzas among 4 children” (Freudenthal, 1991; Siegler, Carpenter, Fennell, Geary, Lewis, Okamoto, Thompson & Wray, 2010). Gorbov S.F. and his colleagues (Gorbov, Mikulina, Saveljeva, 2002) regard numbers as a means to record results of measuring, so fractions are needed to treat quantities that are smaller than the measure.

METHODOLOGY

We will apply the Activity Theory approach to teaching fractions. As a fundamental philosophical paradigm, it cannot be implemented directly. Therefore, we follow Galperin with his theory of concept and mental act’s formation (Galperin, 1992; Haenen, 1996) and Davydov with the Developmental Instruction theory (2008/1986). These scientific positions impose upon us some responsibilities. First, we consider ourselves fully responsible for the concept formation: the concepts received by the students, their understanding, their difficulties, and their efficiency are regarded as the characteristics of the quality of the organized learning process. Second, if there is a problem in the practice of math education, we start the analysis with the content. While problem solving skills are important, we put an emphasis on the detailed understanding of operations with ratios, proportions, fractions, etc. Third, we pay special attention to the early stages of concept formation. We form concepts through student’s own activity so that the knowledge we teach becomes a tool to be used.

Last, but not least, is that when we plan student’s activity and construct the local instruction theory, we carefully analyze the history of human culture in search for similar problems and the corresponding ways of solving them.

As a result, in our math classes, we often deal with problems that traditionally are considered elsewhere: density is said to belong to the physics domain, concentration is dealt with at the chemistry classes, etc. Moreover, we break with tradition by making these applications the first to be considered when we teach ratios. We have created our local instruction theory based on the Activity Approach aiming to improve the understanding of rates, ratios, and fractions. According to the principles of the Developmental Instruction (Davydov 2008/1986), one context should be selected to be the ‘genetically first’. Our choice for this role is the context of ratio-and-rates. Within this context, we design a set of problems and tasks satisfying the following requirements.

1. The settings have to reflect some socially significant human activities, thus making the problem solving activity meaningful.
2. The settings are self-sufficient in the sense that full-fledged concepts can be built by means of the development of student actions rather than introduction of an external knowledge.
3. An objective experimental verification of calculations based on the developed models is possible. Besides, there should be a possibility to manipulate each of the two parameters separately.
4. The settings should allow for construction of a rich set of tasks.

As a result, several problem templates were chosen for further analysis (Vysotskaya, Khrebtova, Yanishevskaya, 2015).

Buoyancy (or the density problem). Students construct models of ‘submarine’ consisting of ‘weights’ and ‘floats’. The task is to calculate the number of floats and/or weights for the required behavior of the vessel (sinking, floating, or suspended in the water).

Paint-mixing. The task is to make a blue paint of required shade by mixing water and ink. Additional restrictions may be imposed on the available amount of water or ink.

Marketplace. Students exchange ‘money’ at given rates. Alternatively, they try to establish the rate that the dealer keeps secret. The task is either to ‘make a profit’ or adhere to the given rate.

Reflections. The task is to find geometrical parameters of an object such as height, distance, etc., – using a mirror. Another challenge is to hit a target with a reflected beam of light). The advantage of this kind of problem is the continuity of size parameters because they can be divided (opposed to goods in the marketplace-situation, or floats and weights in the density problem).

Below, we outline the development of student actions with ratios, the models that simulate ratios, and with the related concepts. Our first goal is to create a setting where students build a compound measure.

Students are given an assignment based on the templates above.

For example, the density of ambient water may be given, and the task is to construct a vessel (i.e., to determine the number of weights and floats) such that it is neutrally buoyant. In each task, the students have to do a certain operation that is crucial for understanding proportions (and hence, fractions). The roles in pairs are assigned such that each student is responsible for only one of the two related values and cannot change the other one.

Students have to take into account the work of their partner and coordinate their actions. In small groups or individually, the 5th and 6th graders start using a compound measure, which is a measure that unites two proportionally related values. This measure is used for the resulting value, and it is compound because it involves two parameters. Besides, it extends to all pairs of values that may differ by the individual values but are equal by their ratio.

For instance, measuring diameters and circumferences, the 6th graders ‘discover’ that all circles are similar: though they all have different diameters and circumferences, the ratio is the same. So, the students draw some conclusions about the mechanisms of this ‘coordinated change’; these conclusions are related to the context with which they work.

For the reflection problem, the summary may look as follows: ‘We measure the height of the man (i1) and the distance to the mirror (i2). Then we take i2 on the opposite side of the mirror, and from that point, we go i1 upward. These measurements can be doubled, trebled, etc., but care should be taken that both numbers are multiplied by the same factor’ (see Fig. 1).

We make students work with different problem templates. For each template, students build an appropriate model that will predict the behavior of the object in a number of typical situations. Sometimes, the model build for one template cannot be directly transferred into a different context, so a modification is necessitated. Gradually, the essential core of all these models is taking shape. This common part of the aforementioned problems will develop into the rules of operations with ratio-based parameters, guides for problem solving, etc.

Students draw tables, plots, graphs, and diagrams with two bars for each value (see Fig. 2, 3). They refer to an actual context only if they have a particular hypothesis to be tested. We see that their tests are driven not by mere curiosity, but by a sound reasoning. As they move on, students become more and more confident in the result they are going to obtain, so much that they may ‘forget’ to test their idea. Their interest visibly shifts from attractive material to models.

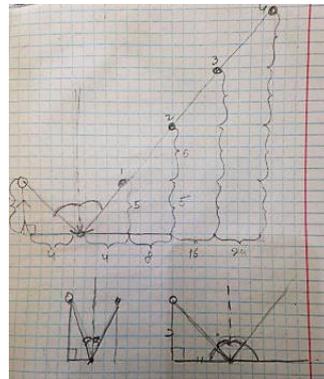


Figure 1. Reflections.

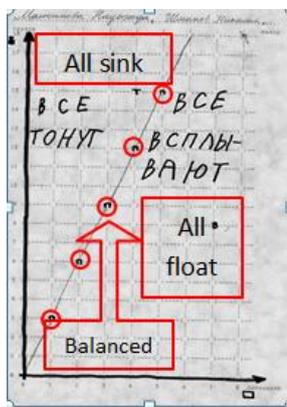


Figure 2.

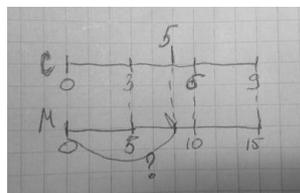


Figure 3.

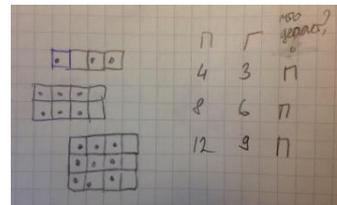


Figure 4.

Another example of a compound measure is the smallest ‘balanced vessel’. Students can make a vessel bigger – but they have to add floats and weights in proportional numbers to keep it balanced (see Fig. 4). If the smallest balanced vessel consists of 3 weights and 4 floats, then one can construct such vessels as having 6 (3+3) weights and 8 (4+4) floats, or 9 weights and 12 floats. So, all the vessels will differ by the number of their components, but will be similar in terms of the ratio and thus will exhibit the same behavior (i.e., will have neutral buoyancy). The key operation here is the simultaneous modification of a pair of parameters (in this case – volume and weight) using their ratio as opposed to modifying each parameter separately.

The paint mixing problem provides a perfect context for building a strategy to compare ratios. In simple hands-on experiments, our students can visually compare the intensity of color for different mixtures, as described below.



Figure 5.

As an example, the task may be to compare two shades of blue paint. Someone has been using a paint made of 7 volumes of water and 5 drops of ink. Now s/he is out of paint, but there is a closed tin of a paint consisting of 4 volumes and 3 drops, respectively. So, before opening the tin, the students have to decide whether the second paint will match the first. A possible option is to prepare many shades of paint using the same amount of ink but different amounts of water. This ‘preparation’

is made virtually using models (in this case, the model includes the squares that symbolize units of

water and drops of ink, see Fig.5). Adding portions of paint, we make the number of ink drops in each mixture equal to 15 (it’s 3 portions of the first paint and 5 portions of the second paint – see Tables 1,2). As we have added ink and water according to the recipe, we have got 21 volumes of water in the first paint and 20 in the second. Thus, the second paint is darker because it contains less water, and so it is not suitable to further painting.

Tables 1,2. To solve the problem, students use tables. The number in the center of the table is the number of portions. Alternatively, the students may choose to balance the amount of water and compare the number of ink drops.

Blue paint 1	
Water	Ink
7	5
21	15

Blue paint 2	
Water	Ink
4	3
20	15

Fractions appear first as an instruction addressed to the partner. It is an instruction on how to measure, and also a cooperation tool. For example, some recipe may contain a compound measure consisting of 3 eggs and 5 cups of flour.

If someone has 5 eggs, then this is one and two-thirds of a portion of 3 eggs. In this case, his/her ‘flour-partner’ has to modify the other measure accordingly, resulting in $1\frac{2}{3}$ portions of 5 cups of flour. It is important that the ‘thirds’ results not from someone’s choice, but rather from the measure that is already given (in this example, it is three eggs).

Eggs	Flour
3	5
5	?

→

Eggs	Flour
3	5
5	$8\frac{1}{3}$

Tables 3 and 4. Measuring the flour.

Next, a fraction is the result of measuring off by the instruction contained in the fraction (5 cups of flour yield $8\frac{1}{3}$). At the same time, fraction is a quota (each egg pairs with $1\frac{2}{3}$ cups of flour, thus making $\frac{1}{3}$ of the portion).

A solution of a similar problem in the buoyancy context is shown at the Tables 5 and 6.

Floats	Weights
7	4
1	?

→

Floats	Weights
7	4
1	$\frac{4}{7}$

Tables 5 and 6. A set of 4 weights and 7 floats defines a ‘buoyancy rule’: the weight of water filling one float is $\frac{4}{7}$ the weight of sinker.

Multiplication and division of fractional numbers are introduced through two proportions of three related values.

For example, besides egg and flour other ingredients are added. One person knows the recipe for eggs and flour, while his/her partner – the ratio between flour and sugar (let it be 2 cups flour and 3 cups sugar) – see Tables 7 and 8.

Partner 1.

Eggs	Flour
3	5
5	

Partner 2.

Flour	Sugar
2	3
	?

Tables 7 and 8.

The question is: ‘How many cups of sugar one should add to 5 eggs according to the recipe?’ Thus, students have to cooperate to find the ratio between the amounts of eggs and sugar. One of possible strategies is to make the amount of flour in both recipes equal and construct one recipe with three ingredients.

So, students start using the least common multiple (for 2 and 5, it is 10). With 10 cups of flour, we have 5 portions of 3 cups sugar and 2 portions of 3 eggs.

Eggs	Flour	Sugar
6	10	15
2		5
5		?

Table 9.

Then, we can simplify our ratio (eggs to sugar) by using the greatest common divisor, in this case – 3 (Table 9).

The situation is thus reduced to the previous one because we have obtained a simple proportion.

Another way of solving the problem will be, for example, to find the amount of flour needed for 5 eggs (it is $8\frac{1}{3}$ cups, see above)

and to pass this information to the partner in control of sugar – see Table 10. Here, multiplication and division come in handy. We have to find the number of portions by dividing $8\frac{1}{3}$ by 2 (it makes $4\frac{1}{6}$ portions), and then we have to multiply 3 (1 portion of 3 cups of sugar) by $4\frac{1}{6}$ (resulting in 12,5 cups of sugar).

Flour	Sugar
2	3
$8\frac{1}{3}$?

Table 10.

We would have obtained the same answer if we multiply 5 (cups of sugar – see table 9) by $2\frac{1}{2}$ (the number of portions of 2 eggs if we have 5 eggs).

Besides learning how to solve the problems, our students also learn to match texts, tables, diagrams, and calculations with each other. We challenge them to create word problems based on a given template. Furthermore, a restriction is made that in the problem statement, only the whole numbers are allowed (in other words, there can be no fractions to start with).

Another example on the next level problems is introduction of the new type of weights in the buoyancy problem. Here, two ratios are given: floats/weights and weights/new weights.

Floats	Weights	New Weights
6	5	
	4	9
?		8

Table 11. ‘How many floats do you need to transport 8 new weights?’

Floats	Weights	New Weights
6	5	
	4	9
?	$\frac{32}{9}$	8
$\frac{6}{5}$	1	

Table 12. One of possible solution strategies is: $\frac{32}{9} \cdot \frac{6}{5}$

Floats	Weights	New weights
6	5	
	4	9
24	20	45
8		15
?		8

Table 13. However, the most efficient way is ‘equating’: finding the triple proportion of all three values expressed in whole numbers. Here, the least common multiple is used.

Addition and subtraction of fractions appear in the context of work rate problems. Students usually come up with three and more ways to solve this kind of problems. Thus, in our instruction, the notion of a number is derived from the operation of constructing a ratio as opposed to the traditional action of one-by-one counting. Our approach is also different from the one where numbers result from direct measurement. Our students have to perform coordinated manipulations with two numbers and deal directly with a ratio (Vysotskaya, 1996); this, in our opinion, leads them to understanding the nature of real numbers. This understanding is the pinnacle of school math education, and it cannot be derived from mere counting flowers or slicing pizzas. Our aim is to construct an instruction that will provide the needed understanding, such that other contexts where fractions are needed can be developed on the basis that has been built.

RESULTS

We have conducted the first long-term macro-cycle of the design experiment in two urban schools; 3 teachers with 6 classrooms, 150 students in total participated in the study. Currently, the second macro-cycle is in progress. Classroom observations, students' materials, quizzes, tests, audio-taped classroom discussions, a set of questionnaires, teachers' diaries, reports, and meetings materials were used as data sources. This two-year course was monitored very closely.

The outcomes were compared to the expected outcomes in terms of understanding, engagement, progress, motivation, etc. With these data, the actual learning process was compared to the learning process that was expected in the theory-based design of the strategy.

The first macro-cycle of our design research experiment produced rather promising results: (1) most students have learned to model different types of proportional word problems and are able to explain what and why they are doing; (2) students can construct a word problem if they have only its model or its solution; they can also build a model after a given solution and check whether the model and the solution agree; (3) students can interpret fractions in different ways: as a measure, an operator, a part of the whole, a quotient, and a ratio. Students' motivation towards math classes, engagement in classroom activity, the level of homework completion, overall progress and understanding are excellent; (4) the approach proved to be effective even with students with learning difficulties.

We conclude that our local instruction theory provides students with opportunity to learn the meanings behind the operations with proportions and fractions. The situations and contexts we devised lead students to fundamental understanding of rational numbers so that they become capable of constructing ways of solving virtually any problem in this class. Students understand fractions as reduced operations that they can reconstruct if needed. Furthermore, when faced with problems in the domain of physics and/or chemistry, students recognize the ratios and can apply the models they have mastered to the new contexts. New contexts are seen as a logical development of the models that students know how to use.

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THE EDUCATIONAL LAB

Educational experiments used as a method to transform and improve practice

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ABSTRACT

This article presents the results of the three year project named The Vocational Education Lab. During this period of time, 120 educational experiments have been conducted in eight different VET educations. The aim of the project has been to develop an organisational and methodical capacity that enables educational organizations to initiate changes within their pedagogical and organisational practice. This article introduces its reader to the aim of an educational lab, and discusses how experiments and experimentation can contribute to renewal and innovation in educational practice. Furthermore, a selection of generated results is outlined in relation to educational experiments as well as the method the Experimental Cycle. Focusing on renewing practice we have worked with a baseline and five programmes addressing authentic pedagogically and didactic challenges, leadership, and cooperation with firms. The methodology emphasizes a qualitative approach by focusing on empirical data from the practice of educational fields. The results of the lab unfold on two levels: Firstly, the institutional partners of the lab have delivered findings and patterns of the experiments, wherefrom elected patterns take form as concepts ready to use in other contexts. Secondly, the lab itself has developed and adjusted a set of central methods for the experimental approach. The Experimental Cycle is now being implemented into institutional strategies.

WHY DO WE NEED EDUCATIONAL LABS?

Despite years of massive research effort and numerous development projects the present issues on education continues and seems to be reinforced. A survey among the partner institutions shows that between 50 % and 70 % of the teachers expresses that they have not changed their daily practice as a result of participating in traditional development projects (The Vocational Education Lab & Damvad 2012). Even though the need for transformations is massive we continue to practice schooling as usual, vocation as usual and internship as usual. The goal of the educational experiments is to change this in order to improve the system of educational practice. We see it as an important objective that educational institutions themselves will be able to renew and change their practices and core services and the tasks they are responsible for solving. However, this requires new ways of working, new skills and new roles, both for teachers, head teachers and students. Based on the present challenges and the newest knowledge on the educational field we see that change requires 1) breaking with existing routines and 'practice theory' and the development of new ones, 2) 'transformative learning processes' in which it is possible to develop new understandings of 'good practice', 3) leadership and the competence to translate, paving the way, stay focused, and to personify the new to make sure that sense making take place (The Vocational Education Lab 2012 & Damvad 2012). From this point of the departure we introduce Vocational Education Labs (from here, Educational Labs) working with Educational experiments as a solution.

One educational leader explains the value of an Educational Lab as:

“The Lab is able to challenge education throughout the experimental approach. To do something, you are not used to. To do something on the edge. It gives us the power of innovation, a power we have been looking for ever since, and we will keep on following. That is what it is all about. To make the intervention in the right way among students, teacher, and leaders. To answer the questions: ‘Could we do something better? Could we do something different?’ What works, what does not work? I must admit that this is hard work. It is hard work dealing with changes. But when you manage, it is indispensable.”

(Interview, July 2014)

This quote reflects the reactions we have got from the partner institutions of the Educational Lab. The experiment participants have expressed the Lab as a way to handle the challenges from the political agenda and elsewhere. The Lab has enabled educations to experiment with practice in order to find answers that make sense in the local context.

Educational Experiments as a new way to improve practice

In this paragraph we introduce Educational Experiments which constitute the core of the Educational Lab. In the Educational Lab an educational experiment is defined as a *systematically tested trial that has the aim of developing a new and improved educational practice* (Hutters & Sørensen 2013). With the experimental approach we can create and try out new ideas that direct a new practice. Thereby practice and research can work together to renew and improve the daily practice of education. The aim of creating educational experiments speaks to a tendency that social experiments are important as a method to create social innovation and practice-based solutions on actual and real problems (Ravn 2006).

In order to structure educational experiments we have developed a two-sided model of the Experimental Cycle (cf. Figure 1 & 2). The model has been designed throughout the project in collaboration between practice and research. During the process we have continuously gained feedback from teachers and leaders, who are the end-users of the model. In contexts of the development of the experiments and the experiences related here to, the model has been adjusted. The model shown in Figure 1 and Figure 2 builds on seven prototypes of the cycle.

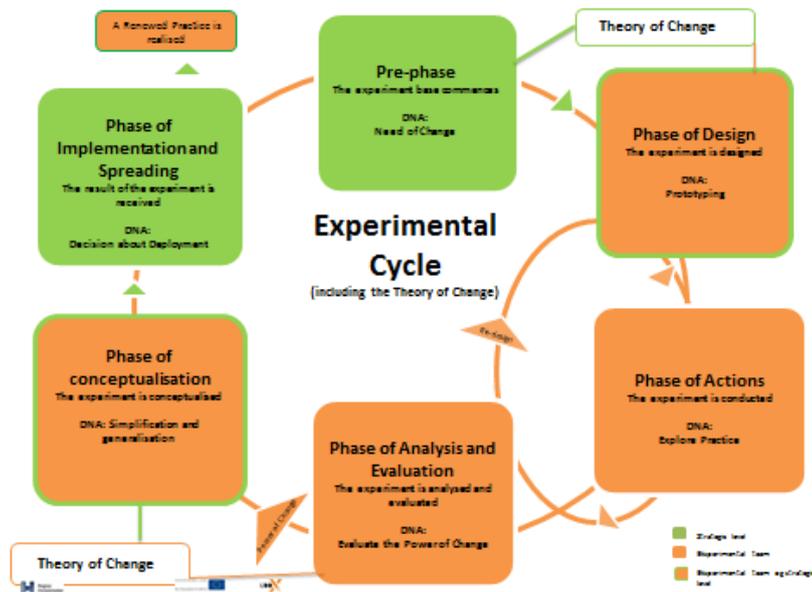


Figure 1. The Experimental Cycle (The Vocational Education Lab 2014)

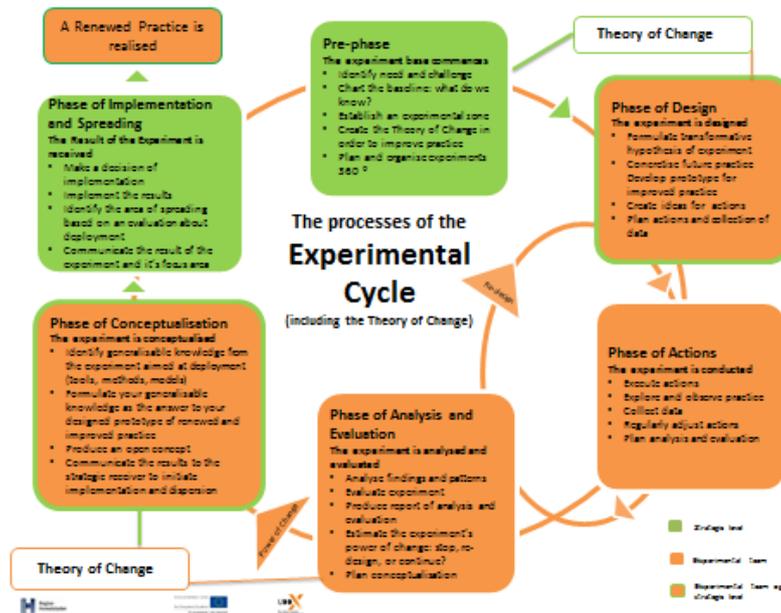


Figure 2. The Processes of the Experimental Cycle (The Vocational Education Lab 2014)

Figure 1 & 2 show that the Experimental Cycle consists of six phases: The Pre-phase, the Design-phase, the Phase of Actions, the Phase of Analysis and Evaluation, the Phase of Conceptualisation and the Phase of Implementation and Spreading. While Figure 1 shows the general model of the Experimental Cycle, Figure 2 shows an unfold version of the model including the specific processes of the six phases. In the first prototype of the Experimental Cycle there was only four phases. Based on the feedback and the experiences of practice, the Experimental Cycle has been systematically developed. The green colour illustrates, that a strategically level of the organisation should carry out the processes. The orange colour illustrates that the processes should be conducted by the Experimental Team, who execute the experiment. The Theory of Change, that is included in the model, refers to a complementary tool that can be used to measure and direct the change of the experiment, and the realisation of new practice (The Vocational Education Lab 2014). The specific processes of each phase shown in Figure 2 function as guidelines for the content of the phase, and are intended to support the development of an Educational Experiment that creates value to educational practice.

Particularly the systematic of the phases, being visualised and ordered through the model, is what experiment participants emphasizes.

As one teacher who participated in an experiment expresses:

”We want to continue using the Experimental Cycle because it ensures a systematic and it ensures progress. We will keep on asking ‘what worked’ and ‘what did not work’, and use the generated knowledge to stand on in order to meet the challeges, and need for change”.

(Interview, July 2014)

Experiments in the era of Practice Based Research

The Educational Lab enters the era of practice based research. Inside five thematic themes of the Lab, a baseline study has investigated the newest knowledge and directed the need for change and improvement in practice, cf. Figure 3 (The Vocational Education Lab & Damvad 2012). The program themes have ensured that the work of the experiments in the Lab originates from challenges in practice and focuses on deployment. Along with the experiments, the Ph.D.-student of the lab has contributed with ongoing research on didactic patterns inside a traineeship as part of the Lab for Transfer.

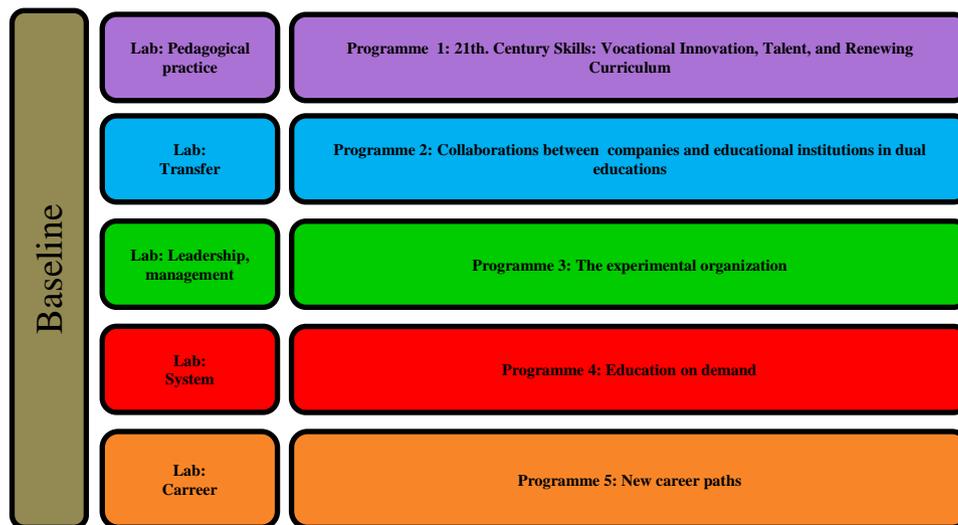


Figure 3. Organisation of the Educational Lab: Five program themes (The Vocational Education Lab 2012)

The mission of the Educational Lab has been to establish an experimental setting based on knowledge by: 1) creating a unique experimental environment , 2) connecting educational practice, development and research to ensure knowledge that works in new ways, 3) developing new structures within the organization, 4) creating sustainable and meaningful partnerships (between different educational institutions and between educations and employers), 5) providing conditions for sustainable transformations that make the educational institutions able to address the present challenges and ensure that the educations are future -proof. Combining theoretical knowledge on the educational field with experiences of teachers, leaders and students this study provides answers on how to improve and renew practice.

Collaborative development as a core value

Collaborative development between practice and research has been central in order to create the Experimental Cycle. When research unfolds in collaborative processes between researcher and practitioners, reciprocity are developed to be useful for both research and practice (Lex 2014:47). Our qualitative interviews throw lights on how the method has been useful to the educational institutions. For example expresses an educational leader:

“The experimental approach has contributed in creating a common platform. Today we can use this platform relation to our core service. It has given responsiveness and the opportunity to ask questions to what we do in our daily practice. In this way it has added value to our educational practice.”

(Interview, June 2014)

Introducing the experimental approach in the practice of the partner institutions has also caused opposition. This opposition has been characterised by an insecurity towards changes. As a project manager at one of the educational institutions explains:

“The opposition arises because we do something else than we are used to do. This can provoke a kind of anxiety. To handle the opposition we have found support in the methods.”

(Interview, June 2014)

To develop something new, that creates value, is what Educational Experiments are all about. In this sense they work similar with any other process dealing with innovation. The Anthropologist Simon Lex explains, that we, in our effort to be innovative, try to look into future and predict what people will be asking in the coming time. Innovation is in this sense about catching the potential in the actual. Therefore, a nervous state of mind is a condition when working with innovation (Lex 2013:171,175). The same applies to the work of the Experimental Cycle.

To design new practices become even more important in a time where the world is changing and the Educational system must change in order to meet new requirements and needs.

The Educational Lab sees design thinking as a way to meet the challenges. Inspired by the Danish professor Christian Bason, design thinking has been central in order to define Educational Experiments. In this sense design is about 'putting things' together to form a new whole (Bason 2010).

Design Based Research in combination with Action Research and the Science of Social Anthropology and other scientific approaches has formed the theoretical foundation of creating the Educational Lab and the development of the Experimental Cycle. Inspired by the Danish Professor Ib Ravn the Educational Lab works from the position, that research should have the explicit ambition to change and improve social conditions. Moreover, research should be based on practical problems - problems that are problems for someone and needs solutions. And similarly measured on the practical effects - what were improved / changed? The researcher should also be seen as a constructor, actively contributing to a reshaping of a societal institutions practice. In this way, change is seen as co-production and co-creation (Ravn 2010). The Educational Lab has involved practice throughout the project in order to ensure this position that Ravn identifies. Continuously, we have encouraged teachers and educational leaders to explore their educational field with curiosity and involvement.

Empirical Data throws light on the Results

In order to identify, explore, confirm and advance the results of the Educational Lab, a collection of empirical data has been carried out on the basis of a qualitative research design. During the project we carried out several action-based workshops. In the end of the project, 43 semi-structured interviews have been conducted in order to get practice based knowledge on the use of the Experimental Cycle, and the context specific findings of the 120 experiments. Besides the interviews, participant observation has been carried out among the participants of experiments on various capacity-building courses offered by the Educational Lab. At the action-based workshops cooperation between researchers and practisers has taken place. The workshops have had great importance on the development of the Experimental Cycle. An action-based workshop has for example been the Experimental Circles where we dealt with the content of the experiments. Moreover amongst other, we have had Conceptualisation Workshops where the participants conceptualised knowledge from their experiments, and a Method camp, where participants created knowledge on tools that can be used in relation to the processes of the phases (cf. Figure 2) e.g. idea generating tools during the Design-phase and tools for collecting data during the Phase of Actions. These action-based workshops have functioned as interventions which have directed the development of the Experimental Cycle. In this sense the courses have taken form as turning points where we have presented the newest development of the method wherefrom the participants continue their work with experiments in practice.

When analysing the results of the experiments a subject-specific knowledge co-worker has been coding the interviews related to one's specific field of knowledge, e.g. innovation. The coded data forms the base of an Educational Laboratory Anthology that includes findings and patterns from the experiments. The courses provided by the Educational Lab have also been intended to build up their capacity for to ensure the skills needed for working with the Experimental Cycle. During the project we have encouraged teachers and educational leaders to explore their educational field with curiosity and involvement. This has for example been supported by courses for in general anthropological thoughts and tools for educational leaders. The purpose has been to integrate research into practice in order to enable leaders to unfold the mind set and methods in their own institutions.

The results of the Educational Lab unfold on two levels: Firstly, the lab itself has developed and adjusted a set of central methods for the experimental approach where the Experimental Cycle is the primary method. Secondly, the institutional partners of the lab have delivered findings and patterns of the experiments, wherefrom elected patterns take form as concepts ready to use in other contexts.

Results from the Lab working with Innovation

In this paragraph we outline a selection of the results that have been generated throughout the experiments on vocational innovation. Vocational innovation is placed in the Lab of Pedagogical Practice (Program 1, cf. Figure 3). In the baseline study we identified the present situation in Denmark, where these challenges appeared: 1) A decrease in unskilled manual labour work, 2) Decrease of apprenticeship and internship in companies, 3) Increasing demands on the skills of apprentices, 4) Increasing demands for innovative skills. Focusing on challenge 4), two specific challenges for vocational innovation arose: *The students' ability to innovate – their competences are not satisfactory*, and *Innovation becomes a teaching subject rather than a part of all other subjects* (The Vocational Education Lab & Damvad 2012). In this theme 24 experiments worked with four focus areas:

1. Development of coherent courses that promote the students vocational innovative competencies – and work joint mono disciplinary and interdisciplinary with subjects
2. Development of task types that promotes vocational innovation and includes authentic challenges from practice
3. Development of indicators for vocational innovation in order to evaluate and asses the students' innovative competences
4. Improvement of cooperation between the educational institution and the practice to insure the students develop and train their vocational innovative competences

(The Vocational Education Lab & Damvad 2012)

The 24 experiments were structured around the Experimental Cycle. All findings from the experiments were analysed, and documented. For example, experiments dealing with focus area 1, found that it is essential that:

- The students create and practice vocational innovation in authentic contexts and deal with real problems.
- The teachers can act as a facilitator beside their traditional teaching role.
- Dialog and communication are trained and used throughout the education
- The education involve authentic cases from practice
- The students' solutions can create value among others
- The students functions as co-creators and in joint responsibility when choosing the task subject
- Understandings of innovation are explored and challenged
- The education promotes creativity and solutions (prototyping)

(The Vocational Education Lab 2014)

Findings from all four focus areas were compared, and summarized into a written prototype on renewed and improved practice. All prototypes in relation to educational experiments are created together with the Theory of Change where the prototype contributes in ensuring the potential of change in the single experiment (The Vocational Education Lab 2014). The prototype a renewed and improved practice for vocational innovation appears as:

The pedagogical and didactic practice is recognised by teachers, who develop teaching courses that promote innovation. Focus is on real life testing of pedagogic and didactic methods, processes and roles that will strengthen and develop students' innovative competences.

This implies a development of everyday teaching courses, including the core disciplinary and interdisciplinary aspects. Furthermore, a development of teaching courses across different courses and educations, e.g. camps, events and conferences.

When the teachers continuously integrate a vocational focus in the pedagogical and didactic planning of teaching courses, the students' vocational innovation skills will be developed and enhanced.

(The Vocational Education Lab 2014)

All program themes have resulted in written prototypes on renewed and improved practice. The prototype can help us when we analyse the data of the experiment in the sense that the prototype predicts the objective of the experiments. The objective contains the new practice.

Therefore it can support actions not being recognizable and part of the current practice. The prototypes made on behalf of the 120 experiments now contribute in directing the meet of challenges in the eight different educational organisations who have contributed in the project.

CONCLUSION

The main conclusion of this project is that authentic educational challenges can be met by an experimental setting, where educational experiments provide a way for a renewed and improved practice. The main method developed in the Educational Lab, the Experimental Cycle, is now being implemented into educational institutions. Furthermore, it is the ambition of the Vocational Education Lab that prototypes on renewed and improved practice developed in the experiments can be spread to other educational institutions that deal with similar challenges. Along with the Experimental Cycle we have moved from a 180 degree education tradition to 360 degree in the manner of leading development all the way to implementation. Standing on a baseline we make sure to focus our engagement in the direction of actual needs. The results of the experiments concludes that the ambition of the lab has been met - an ambition on transforming and improving vocation oriented educations in order to educate students in the best manner possible and to meet the educational needs as well as demands of the contemporary society.

The project has led to a number of findings in regard to experiments as a mean of improving practice in educational contexts:

1. Experiments can help concretize the future and act as a point of departure for prototyping future practice.
2. Experiments can contribute to the creation of a shared *Boundary Object* - in other words, a shared and interdisciplinary subject area that different departments and groups are able to explore. Experiments are thereby capable of providing both transitions within the individual institution and between the different educational organizations, when organized in a common educational lab.
3. Experiments can act as a basis for shared organizational processes of learning, where participants build an experience- and practice based knowledge by testing new and changing old practice. Thus, working with these experiments help build a systematic *knowledge culture* in the particular educational institution. This knowledge culture will consist of the qualified information gained from finding what works and what does not.
4. Experiments strengthen the possibility of a user driven education, which enables a greater ability to sense the need for new challenges and changes.
5. Experiments can be utilized in risk assessment because the experimental method enables the exploration of a new potential practice within a limited process, and thereafter the implementation of the successful elements.

However this requires that there is a managerial willingness to face the risks of such experiments. Experimenting will, per definition, never be risk-free to the organization involved because it is not entirely possible to predict the outcome. Thus it is not an easy decision made by the managerial actors involved, but at the same time, it is not risk-free *not* to experiment; especially if new needs and challenges call for renovation and innovation.

The results of the Educational Lab address a number of stakeholders, such as teachers, leaders, students, and firms. Considering the way the Educational Lab relates to the demands of the contemporary society by taking into account new educational policy reforms, the results of this study target politicians and government ministries as well. Given the results of the 120 local experiments in the way of contributing to the improvement of educational practice we now see a point of departure for communicating the experimental mind set, methods, and set of tools nationally and internationally. Teachers and leaders in the institutional partner organisations who have contributed to this project have overwhelmed us with engagement, curiosity, diligence, trust, and courage. Now more teachers and leaders should have the opportunity to implement an experimental mind set in order to improve and renew their educational practice through educational experiments.

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LEARNING ENVIRONMENTS IN THE DEVELOPMENT OF VOCATIONAL COMPETENCIES

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ABSTRACT

The competencies needed in the workplace are at the core of practice-oriented higher education in universities of applied sciences (UAS). Emphasis on collaboration with the business community and the necessity to predict workplace competence requirements and workforce needs as well as the training of a competent and expert workforce are traits that are to be taken into account in the planning and implementation of new learning environments. A key factor in the formation of an authentic learning environment and three-faceted (tripartite) development work (educational institution, student and the workplace) is user-based planning, implementation and development of the activity.

The object of interest in this paper concerns the kinds of pedagogical principles that have been employed in targeted learning environments which had been organised in various collaborative projects between UASs and workplaces. The data was gathered on learning environments by reading documents written about them and by interviewing the teachers and project managers responsible for learning environments. Nine projects were designated to participate in this assessment.

As a conclusion of the study, the characteristics of successful and poorly functioning learning environments could be named. When the preconditions of a successful learning environment are implemented in practice, UAS can create a learning space together with students and working life.

Keywords: learning environment, workplace learning, user-driven activity

INTRODUCTION

The relationship between universities of applied sciences (UAS) and working life has been discussed for quite some time in Finnish educational discourse. The implications are far-reaching if the objective is a desire to differentiate from traditional universities. In Finland, the common approaches to link the workplace with practice-oriented higher education have been work practice, on-the-job learning and thesis writing processes, all of which have been inherited from times past (e.g. Neuvonen-Rauhala 2009). In reality, it means that educational practices at UASs make use of school-like methods to try to teach workplace practices. A new kind of approach is needed throughout the whole field of practice-oriented higher education.

The number of cooperative projects between UASs and workplaces has grown while UASs have strengthened their role in regional development and increased co-operation with SMEs. Expanded and diverse collaboration in the form of different co-operative projects with business and the public sector has made the work of teachers at UASs more diverse and complex. New competences, skills and knowledge are required of the UAS staff (Maassen et al 2012), especially the teachers. Mäki (2012) unveiled in his study the two work cultures that are typical of the UAS in Finland from the teacher's perspective. These two working cultures reflect the changes in teaching and learning in higher education. In the work culture of conflicting and non-coinciding interpretations, the teachers perceived their work through various working roles. The competence requirements in teaching-focused on the ability to work collaboratively, for instance, by sharing know-how, combining competences, negotiating working styles and collaborative planning. Competence in guidance and evaluation was important to these teachers. In a substance and teaching-centered work culture, the teachers structured their work through teaching-centered work and through the work in the classroom setting. These teachers felt that they mostly needed mastering of the subject matter, which they viewed as the backbone of teaching. Communication skills and competence of mastering one's own work were less emphasized in this group. These teachers were most committed to developing students' professional competences.

Some of the collaborative actors view the close collaboration as developing and widening perspectives of the surrounding work environment among the teaching staff, management as well as students. In the tripartite of teaching staff, students and workplace representatives, all learn and develop. On the other hand, the relationship with the workplace is criticized as being subservient to market forces, in which all power and the ability to foresee the future is placed in the hands of short term-oriented business. Accordingly, teachers have been seen as only fulfilling the needs of business. The third perspective has focused on the critique of UAS teachers' claim to having established links to business, and who have seemingly created forms of collaboration between schools and business.

Stronger ties and connections between institutions and the world of work is also necessary and needed in order to implement competence-based education (Bound & Lin 2013; Wesselink et al 2010). Despite the aforementioned, the competences needed in the workplace are at the core of practice-oriented higher education. In collaboration between school and business, this core is at its most active. Collaboration can be viewed as many kinds of activities. It can be implemented as projects administrated by an education provider, apprenticeship education, work practice, thesis writing or workplace-driven study paths within degree programs. (Kotila & Mäki 2014.)

Griffiths and Guile (2003) have described four models or practices for co-operation between higher education institutions and enterprises, when aiming to achieve and accomplish mutual learning, co-operation and partnership. The first one is the practice of thinking. The second practice is dialogic inquiry. The third practice is boundary crossing, which is defined as an activity whereby workplaces and educational institutions are challenged to cross concrete boundaries between organisations or unwritten boundaries between ways of acting. The central role of the education and training provider is to develop partnerships with workplaces. The aim is to create new learning environments. The fourth practice is resituating knowledge and skills, which requires in practice planning the means of co-operation and alternative ways of acting both at the workplace and in education.

In a well-functioning workplace, learning is the mutual exchange of knowledge and competences; only in this manner can synergistic benefits be attained (Tynjälä, Välimaa & Sarja 2003). Likewise, in this kind of environment development tasks are required to have recognized general relevance in the workplace. Combining development work and learning is an essential part of the workplace-driven learning process. The objective of the activity is to not only transfer to students the knowledge, skills and attitudes needed at the workplace, but also to facilitate the development of new solution models and work habits in collaboration with representatives of the business community.

According to Miettinen and Peisa (2002), in reality only those student groups that have constructed their own study processes, mainly from real-life problems, have taken part in this kind of joint development.

The purpose of this article is to present the results of an assessment study (Kotila & Mäki 2014). The object of interest in the study concerns the kinds of pedagogical principles that have been employed in targeted learning environments. Even though a learning environment might deviate from the traditional classroom learning environment, this does not imply that the pedagogical activity would no longer be important – in fact, the reverse is true. When traditional teacher- and classroom-centered teaching- and learning methods are broken, it is crucial that matters are planned from a pedagogical perspective. For instance, student guidance counseling and support are in a pivotal role in projects where students are expected to be self-directed and accountable for their actions. All in all, it is a question of whether competence development is facilitated in learning environment.

METHOD

Research questions

The study sought to clarify the different forms of collaboration of one university of applied sciences in southern Finland and the kind of learning and competence development that took place in them in conjunction with the business community.

The research questions were:

- 1) How do a workplace-driven approach and learning manifest in the learning environment?
- 2) How to recognize the characteristics of a well or poorly functioning learning environment?

An assessment study can be viewed as a survey of the current state, the purpose of which is to explain how learning environments are constructed, how the activity within them is organized and how well the learning takes place.

Data collection and analysis

The data collection for the assessment study was completed during the period of August-October 2011. The data collection commenced upon receipt of the list of collaborative projects between the UAS and workplaces from the financiers that were to be included in the assessment study. Altogether, ten (10) people were interviewed, representing nine (9) different collaborative projects.

The data set comprised interviews with teachers responsible for the collaborative projects with workplaces as well as written documents associated with the projects. Some of the teachers sent their project documents electronically. The documents that were not received directly from teachers were found online from the UAS's web pages or from project web pages.

The interviews were planned based on the research themes. The interviews were qualitative, unstructured interviews, in which the precise order of questions and their formulation is lacking though the interviews were directed toward certain themes that were discussed (Kvale 1996, 13).

In every interview, the following seven (7) themes were covered:

- 1) Characteristics of a learning environment
- 2) Actors' roles
- 3) Collaboration with business
- 4) Pedagogical principles
- 5) Competence development
- 6) Guidance counseling and assessment
- 7) Results

In sum, the data for the assessment study was composed of the interviews with teachers responsible for projects as well as written documents associated with the project. The documents were mainly used to aid in the formulation of interview themes and questions.

The interviews varied in duration from 59 minutes to 1 hour and 48 minutes. Recorded material totaled approximately 12 hours and 24 minutes. The interviews were transliterated such that the main points for each theme were elaborated upon. The transliterated text amounted to 56 pages.

After gaining approval for the research from the executive team in HAAGA-HELIA University of Applied Sciences, the researchers contacted the teachers and project managers. Taking part in the study was voluntary.

RESULTS

General results

Some common characteristics appeared that serve to promote the development of workplace-driven learning environments. From the results, we have gathered together the criteria that make for both a successful and poorly functioning learning environment. The text can be read such that the heading for a poorly functioning learning environment can be replaced with "project pitfalls."

Characteristics of a successful learning environment:

- The structure of the teaching plan is flexible, and it is developed in conjunction with business partners.
- The teacher commands several roles: from mentor to network creator and salesperson
- Students and business partners have self-directed and developmental roles
- Role activities surpass traditional boundaries

- Strong pedagogical foundation in the project (in addition to the substance): pedagogical planning, implementation involving different methods as well as guidance counseling and assessment that are founded on the understanding of learning processes
- Clear underlying learning concept(s)
- Recognition of the challenge to coordinate the working rhythms and cycles of business, students and teachers

Characteristics of a poorly functioning learning environment (pitfalls):

- School-like activity (roles, working habits, assessment)
- Teacher-centric approach
- Technical orientation to learning, lack of a pedagogical foundation
- Role division between business, students and teachers is inflexible: Business commissions a project, students carry out the commission and teachers oversee and assess
- Working hours are perceived according to traditional teacher working hours and mindset: Continuous lack of resources
- Collaboration among the tripartite members is lacking
- Assessments are not made as a joint undertaking
- The project is not integrated into the educational function of the organization; rather it is a disjointed and isolated experiment

Flexibility as a special challenge

In addition to these criteria, the interviews revealed that working in collaborative projects was demanding for teachers in several respects.

According to the interviewees, teachers must possess certain kinds of characteristics in order to be able to take part in projects with workplaces. These characteristics include the ability to deal with uncertainty and change, flexibility, openness, courage as well as the ability to challenge oneself. Moreover, teachers should have a wide network of contacts or the ability to build one. Projects also require that teachers can forgo the need to feel like experts: one of the teacher's roles is to revert to learner status. Teachers also have to be able to share the responsibility of being a teacher with collaborative partners, as well as guiding students toward self-directed behavior and personal accountability. In addition to the aforementioned, teachers have to be aware of and acknowledge in advance that the combination of teaching and working in projects is demanding as well as being a continuous balancing act of time resources, work habits and the interests of all parties involved.

...if your work is 50 / 50 teaching and RDI, it can be difficult to see things in a new way ...

... orienting and sharing time between teaching and RDI, is demanding...

The interviews also revealed that current practices do not support working in collaborative projects. In fact, it is easier for teachers to adhere to traditional practices and teach in course-like format. As a result, there has been resistance to taking part in projects, and for some teachers the idea of engaging in a project instills fear. Consequently, all the institutional practices that lead to these feelings of project apprehension should be identified. The interviews indicated that current feedback practices are one factor for the negative reaction. Feedback practices should be reconsidered so that they encourage risk taking and not reward safe and traditional approaches. It would also be a good idea to offer an orientation to working in projects for those teachers to whom it is unfamiliar. In this way, people would gain a sense of security with the new practice.

You have to be flexible, to be ready to deal with changes. The teacher is responsible to start up co-operation with companies...

... co-operation makes work meaningful, you know that your work has influence both to the students' professional development and the success of the company...

Student roles and guidance counseling practices within a collaborative project have to be considered carefully so that it is possible for students to develop their competences. In poorly functioning projects, it was clearly visible that the student role was more often one of getting the job done than becoming a self-directed learner.

The students are taught that they have to have a right attitude, because also the companies test it.

In light of our data, undertaking collaborative projects seemed to be largely dependent upon the activity of individual teachers; the majority of the projects in the assessment are tightly bound to specific individuals. Thus, what becomes of the project if a key individual is no longer able to be part of it? The continuity of the project should be better ensured than it is currently so that it is not dependent on one person.

I am an enabler, I bring together the students, our partners, teaching staff and cases. I work as an authenticator e.g. in making the project plans realistic in order to achieve the goals.

Provided that there is the desire to improve the necessary preconditions for projects, as a first step, curricula that facilitate working in projects should be developed. The interviews revealed that the current curricula do not encourage projects; in fact, they tend to inhibit them. In successful projects, teachers have employed creativity and imagination in designing teaching plans suited for projects. However, it does not have to be like this: from the beginning teaching plans can be designed such that they facilitate projects and not act as a hindrance.

However, it must be kept in mind that teachers constituted the data set in this article, and thus it might be a question of their rigid interpretation of teaching plan implementation in the setting of the UAS. Therefore, special attention has to be paid to the interpretations made by the teaching and guidance counseling staff on teaching plans. Often the teaching plan itself does not limit tripartite collaboration; rather it is the teaching staff with their school-like interpretations and course-centered models of behavior that act as deterrents to collaboration.

DISCUSSION

Collaborative projects between school and work act as successful learning environments if the selection of key partners from business has been made with care, and in the planning phase, the independent role of the students has been developed. A genuinely collaborative and negotiating work culture prevails in the learning environment that includes teachers, students and business partners. Roles are largely self-directed, surpassing traditional role boundaries, and the collaboration in essence develops the project focus. Teachers are willing to forfeit their status as experts and shared expertise is the trademark of activity. The learning environment is designed so that it is actually possible for students to develop their competences and not only carry out given tasks.

A flexible curriculum that adapts to the needs of students and business as well as a pedagogical foundation that structures the work precedes any successful tripartite collaboration. Learning environments are developed collaboratively in real time among students, teachers and business partners.

In poorly functioning learning environment, the roles of actors are traditional. Teachers prepare lessons and teach, the business community orders services to be carried out and students complete the commissioned work. Roles are static and inflexible, and collaboration is founded solely on the teaching plan and course objectives. The perspectives of students and business partners as well as collaboration are missing. The students' personal business contacts are not used to any advantage. Teachers assess the learning environment solely on the basis of assessing student performance. Some learning environments do not contain any collaboration with business. In the least, they might be mere skeletal solutions and not actual workplace-driven learning environments.

In successful learning environment one common central factor is a solid pedagogical foundation. It can be seen in the planning, tripartite collaboration and in the developmental work approach in the learning environment. In these learning environments the teacher commands several roles such as mentor, network creator, salesperson, supporter, learner, accompanier and collaborator. Within the learning environment, guidance counseling forms a natural part of the activity and assessment tools are clear and collaborative.

In poorly functioning learning environment, the sharing and developing of competences is teacher-specific. Teachers approach learning in a technical manner and a pedagogical foundation for the learning environment is lacking. The learning environment and its activity are not integrated into teaching; rather it is an entity isolated from other activities. This solution differentiates teaching from the business community as oppositional in their principles of activity.

When the preconditions of a successful learning environment are implemented in practice, at its best practice-oriented higher education institute can create a learning space together with students and the business community (compare Tynjälä 2013). A learning space can be understood here as work habits and environments for collective learning. The tripartite members that engage in collaboration form a collective of actors in a sphere of activity where joint development, competence sharing, the creation of new ideas and the fusing of different working cultures across institutional borders takes place. The learning space offers an environment that encourages communities and individuals in the development of vocational knowhow and competencies.

Towards user-led development of workplace learning environments

A key factor in the formation of an authentic work environment and three-faceted development work (educational institution, student and the workplace) is user-based planning, implementation and development of the activity. In contrast to this approach is school-centered thinking, planning of work and collaborative activity between business, teachers and students. In the school-centered approach, the inflexible curriculum determines the type of activity. This situation affects the roles of teachers, students and workplace representatives in collaborative activities. Plans, action models, various solutions and work environments are shaped in response to school needs and objectives. If the interests of schools do not successfully mesh with those of students and workplace representatives, potential projects break away from the actual teaching and guidance work that schools are meant to provide. As such, these projects turn into isolated, one-shot undertakings that teachers and students carry out for the business community.

User-driven is a concept bound to the present time that denotes a certain kind of collaboration. It has been used extensively in conjunction with innovation policy and processes describing the generation of innovations. Broadly defined, user-led can signify customer integration that manifests itself in various ways and on various levels. The user-led, need-related approach seeks to meet end-user needs of products and services and the creation of new needs. The justification of exploiting end-users in a collaborative activity is based on the assumption that users have the relevant knowledge and skills for the development of a product or service that cannot be had elsewhere. The tools for user innovation are most effective and successful when they are made ‘user-friendly’ and enable the users to use their skills and work in their language. (von Hippel & Katz 2002.)

The significance of end-user knowledge in various stages of innovation processes varies according to the environment and the field of activity. Determining and understanding the true end-users of the activity in question is important for its success. The end-users can include various professionals, enthusiasts, light end-users or even so-called non-users. In user-led activity, traditional work roles also tend to become blurred. The roles of product and service developer, producer, supplier and consumer can vary from one to another or become mixed during the work processes. (von Hippel & Katz 2002.)

The logic of user-led activity should also give direction to the development of workplace-driven learning environments in practice-oriented higher education. In the initial phase, the objectives of the true end-users, that is, business representatives and students, need to be clarified and mapped out, and their objectives should match with those of the prospective work environment.

Once the end-user groups have been determined, it is of primary importance to establish a tripartite user-led working group already at the planning stage of the operational environment. Success factors for the establishment of an authentic learning environment are user-led planning, user-led activity and the user-led development of activity. This necessitates the scrapping of teacher-centered and school-centered thinking and activity. In accordance with user-led thinking, every actor is expected to work across different disciplines and levels throughout the duration of an activity, which naturally presupposes that traditional roles become blurred. In the workplace-driven learning environment all actors might at times shift roles to become advisors, developers, idea generators and implementers. Assessment of activity is also carried out collaboratively the whole time, not only conducted by teachers at the end of the process.

Emphasis on collaboration with the business community and the necessity to predict workplace competence requirements and workforce needs as well as the training of a competent and expert workforce are traits that are to be taken into account in the planning and implementation of teaching and learning at UASs. Teachers have to be able to bring together three broad content areas in their work, each of which demands a different competence. The content areas are substance competence, pedagogical expertise and development work. The combination of these three elements results in challenges: teachers have to be simultaneously skilled in teaching, be experts in their own field as well as being researchers and developers. (Mäki 2012)

Furthermore, the requirement that teaching and learning should have relevance in the work context brings on additional pedagogical challenges, and also the need to tighten collaboration towards partnership between education and work (Häggman-Laitila & Rekola 2011). In order to facilitate and diversify co-operation, the acting partners should create and build up learning in which individual and collective expertise, along with aspects emphasising communality, are joined together (Tynjälä 2008).

Traditional teaching methods alone are not enough if learning is to take place at the interface between work and education. Novel, non-traditional pedagogical solutions that contribute to research and development in learning are needed. (Tynjälä, Kekäle & Heikkilä 2004, 10.)

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**FROM THE DOCTORAL DISSERTATIONS OF
INSTITUTIONAL RESEARCH TO THE PRACTICE OF
THE UNIVERSITIES OF APPLIED SCIENCES**

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ABSTRACT

This article addresses the dialogue between research and practice. We are interested in how ideas and results arising from doctoral dissertations transfer back into the field of actions. Our study is situated in Finnish higher education institutes (Universities of Applied Sciences). We analysed 128 dissertations and interviewed the authors of 10 dissertations. The studies focused on the micro-level of UASs (teaching, learning) and also on the organisational level (management, quality assurance, and higher education policy). We were interested in (1) the author's role in the diffusion process and (2) channels of implementation. The paper considers what kinds of actions support a diffusion of the ideas produced in the dissertations back into the daily work of the UASs. We also lightly consider the results in light of Rogers's theory on the diffusion of innovations.

Keywords: Finnish Universities of Applied Sciences, dissertations, diffusion.

INTRODUCTION

This article examines the diffusion of ideas from dissertations written during the period 1997–2013 on a particular form of higher educational institute, namely the Universities of Applied Sciences (UASs) in Finland. The dissertations numbered 127, and included all the relevant dissertations written in Finland that have dealt with UASs. We were interested in how these dissertations were reflected back into the practices of UASs. We interviewed some of the dissertation authors (10 persons) to investigate how the ideas or other contents of the dissertations have been utilised, what methods have been used in this utilisation, and why this may or may not have succeeded.

A background to the study was recent reforms of the higher education system in Finland. The Finnish higher education system consists of two complementary sectors (a so-called dual system): traditional Universities and Universities of Applied Sciences (UASs).

The mission of traditional universities is to conduct scientific research and provide instruction and postgraduate education. The universities of applied sciences (also referred to as polytechnics) have strong ties to life or work and embody a practical orientation and ethos, and operate under the Ministry of Education and Culture (MoE) (www.minedu.fi).

In this article, section 2 introduces the Finnish higher education system, section 3 presents the theory of the diffusion of ideas, section 4 deals with the themes of the academic dissertations. Section 5 reports on the interviews and about the utilization of the dissertations' conclusions. The final section discusses and summarises the results.

THE FINNISH HIGHER EDUCATION SYSTEM

The Finnish dual higher education system is still fairly new. The first UASs began operations on a trial basis in 1991–1992 and the first universities were founded by legislation in 1996. The UAS system replaced the vocational post-secondary and vocational tertiary level of education. By 2000, all the UAS institutions already operated on a permanent basis. In 2015 there were 22 UASs, being regional multi-disciplinary and practical-oriented universities focused on contacts with working life and on regional development. (www.arena.fi).

From the perspective of education as a teaching and learning process, the most remarkable change in the activities of the new UAS institutions was the role of research and development (R&D), which was mentioned in the preliminary founding legislation (1995) alongside traditional aims for education and training. In UAS institutions, R&D was to be performed as a regional and social task and as a method of teaching and learning.

At the organisational level, the expansion of R&D led to new kinds of UAS networks not present in earlier structures. In the traditional working culture, the vocational colleges were rather isolated units in their cities. Connections with working organisations were regular and stable only in the fields of healthcare and technology due the established and regular internship. Consequently, the new R&D activity forced greater collaboration with regional actors and pressured for new practically oriented universities to seek funding outside the formal, traditional structures (Lyytinen et al. 2003).

R&D activities are often thought to parallel the so-called third task, or social task, of UASs. In the case of UAS institutions, the regional dimension is strongly highlighted in comparison to the traditional science-based universities. At the organisation level, this has meant new connections with local work organisations and, in teachers' work, challenges to create partnerships with colleagues outside their own organisation (Lambert 1999).

R&D as a new field of work has also been concretised in the staff structure. In addition to changes in the curricula for teachers to teach, there are also new actors in the UAS. The new staff members are often researchers or developers, rather than teachers, and they are mainly involved in specific projects.

Regarding the curriculum and learning and teaching methods, the UAS reform has had several consequences. The number of internship periods for students have increased along with a decrease in classroom teaching. Additionally, instead of traditional classroom teaching, e-learning has taken on an important role. Different kinds of self-directed learning skills have become more important (Suomala 2003). Given all of the above and the greater numbers of student drop-outs, student counselling now plays a more crucial role in support services at the UASs (Friman 2001).

DIFFUSION OF IDEAS

In the literature, the sharing and dissemination of innovations in organisations and networks has been well studied. Kurt Lewin (1957) encapsulated the diffusion process as follows: the organisation should first unlock the barriers to innovation, the organisation should then build a support system for the innovation and the organisation is then able to move and refreeze. Burton Clark and Michael Fullan (e.g. 1982) have utilised and applied diffusion theories in the context of higher education institutes.

According to Everett Rogers (2003) the diffusion is the process through which an innovation is communicated through special channels over time among the members of a social network. Furthermore, Rogers was interested in why some innovations spread more quickly than others. He tried to find out the characteristics that he thought determined an innovation's rate of adoption: relative advantage, compatibility, complexity, trialability, and observability (Rogers 2003.)

Rogers anchored the relative advantage to be the degree to which an innovative idea is perceived as better than the idea it supersedes. He thought that it does not matter so much if an idea or innovation has objective advantage. What does seem to matter, according to Rogers, is whether an individual perceives the innovation as advantageous. Additionally, Rogers defined compatibility to be the degree to which an idea is perceived as being consistent with existing values, past experiences, and the needs of potential adopters. Third, Rogers wrote that in his model the complexity is the degree to which an innovation is perceived as difficult to understand and use. Furthermore, the trialability of the Rogers is the degree to which an idea may be experimented with on a limited basis. Additionally, Rogers defined the observability to be the degree to which the results of an idea are visible. Thus, Rogers stated, the innovations that are observed by individuals, as having greater relative advantage, compatibility, trialability, observability, and less complexity, will be adopted more rapidly than the others. (Rogers 2002, 2003.)

Rogers obviously thought that most experts judge an innovation not on the basis of the pure scientific research, but through the subjective reviews of their colleagues who have earlier spotted the idea.

From that basis, Rogers concluded that the diffusion seems to be a social process through which experts communicating with others spread and share an idea or innovation and the decision process whether to apply is mainly a mental process through which the decision makers first passing from knowledge, then forming an attitude toward the innovation, coming to a decision to adopt, and finally implementing the ideas, and finally confirming the decision. Rogers also found five adopter models form the social networks: innovators, early adopters, early majority, late majority, and laggards (Rogers 2003.)

In this article, the focus is in two aspects of Rogers's theory: membership and channels. In this moment, in the beginning of wider study, we ignore the decision making process as well as an innovation's rate of adoption.

THE TOPICS OF THE DISSERTATIONS

A previous study reviewed dissertations written in the academic discipline of education during the period 1997–2004 (Friman & Salo 2005), analysing 33 dissertations and classifying them according to topic. Friman and Salo concluded that some 80% of the dissertations were focused on the micro-level of UAS activities: pedagogy, counselling and thesis preparation. The researches were themselves teachers in Finnish UASs.

The current study gathered data from all dissertations related to the UASs, not only those written in the discipline of education. We made use of the Melinda Union Catalogue of Finnish University Libraries. In accord with Friman and Salo, we found dissertations mainly dealt with the micro-level, such as different everyday contexts and curricula, learning, teaching, and the work of a HEI teacher. A second group of dissertations dealt with management and a third with higher education policy at the national level.

Examples of the themes in the first group of dissertations are

- e-Learning (6 dissertations)
- Development of the UAS curricula (3)
- Entrepreneurship in the curricula (2)
- Internationalisation in education (5)
- Different kinds of learning models as problem-based learning (3)

and the second group

- Strategic management and quality assurance (6)
- Research and development activities(5)
- Recruitment of students (2)
- Environmental issues (2)

and the third group

- Dual model in HE: the system, financing, collaboration (5)
- Legislation of UASs (2).

In the research data, out of 127 doctorates, about 100 had worked in a UAS during their research work. Some of the researchers (mainly in the health care sector) have worked in higher education in order to produce development in the profession through the new UAS sector. The motivation to do academic research among UAS staff was often very practical: The doctorate was an obligatory qualification to obtain a post as a principal lecturer.

RESULTS OF THE INTERVIEWS

The work of the authors we invited to interview represented all three groups: micro-level, management level, and policy level. We selected persons working both in UASs and those working outside the institutions. The outsiders are working in policy administration or as researchers in traditional universities. We asked the authors *how and where they have implemented the ideas or/and results of their dissertations* and *what they found to be good practices in the diffusion of the results back into the daily work*.

UAS member - authors

Dissertations written by authors working in the UASs all focused on the micro-level, i.e. on teaching, learning methods and R&D activities. Their studies were an attempt to gather and put into a written, theoretical form their practical experience working as a teacher over a very long period. They attempted to conceptualise their own work and to model it in order to make it more visible and to legitimise it.

These authors have used the ideas and results of their dissertations in development activities in their own work. The research process has deepened the authors own understanding and made his/her work visible, but in several cases it has not been self-evident that the ideas have been accepted and utilised more widely within the author's own organisation.

In most cases, the studies described in the dissertations are strongly connected to the authors own universities, which means that the data is collected from their own organisation, from teachers and students.

The impact arising from dissertation ideas or results has focused on very specific points in curriculum development or in student counselling. There have also been effects on the dialogue between colleagues in other UASs or between the work organisations and teachers.

Most of the authors have more or less actively supported the implementation of ideas and results arising out of their dissertations. They have co-operated in UAS networks, as a channel, or in special interest groups, sharing knowledge from their dissertations. Some of the authors have organised workshops in their own institutions, for instance concerning the issue of dropping out.

There were also examples in which a project idea had arisen from the results, for instance, in the field of work-based learning. One channel has been the Finnish Thesis competition –project, which arose from one dissertation. Another dissertation strengthened the relationship between companies and the UASs. This kind of implementation is possible when the company has been closely involved in the study, as “laboratory” data sources.

UAS non-member authors

Three of the interviewed persons were not working in a UAS. Two of the dissertations focused on the educational policy level and the main goal of the author has been to document political history and decision-making processes. Results have been used for argumentation in policy discussions and debates. At the policy level, the authors stated the dissertation process deepened their understanding of the background to and activities of UASs.

Authors have disseminated dissertation results in seminars, conferences and journals, as well as writing chapters for textbooks based on themes found in their dissertations. In one dissertation related to the micro-level, the author described her study as being very useful to the practical work in UASs but she had not yet found appropriate channels for presenting her results.

CONCLUSIONS

One feature considered in the present study was the significance of the author’s membership in different networks as a promoter of diffusion. It was important that they find suitable channels and practices for implementing the ideas and results of the dissertations.

The authors felt it was important to clarify in what kinds of scientific or expert discussions they would participate, what kinds of channels would be chosen: either through academic discourse at conferences and in journals, or through development projects or even through the daily life of UASs.

Common to each of the groups we studied was the fact that authors did not set out to discuss their findings internationally. Rather, their purpose seems to have been to develop their organisations and legitimise UASs within the national higher education sector. According to the interviewees, some of the dissertations, especially in the first years of UASs, had a remarkable role in the process of creating new concepts and models for UAS activities. In terms of the diffusion theory, there were no barriers in the first years of the UASs – rather, it was considered an open era. It has been the right time for dialogue around these topics. Membership in special interest groups or networks was an effective way to disseminate results. The innovators or early adopters were found in these groups and the fruitful co-operation between colleagues arose easily. Moreover, connections with or participation in teacher education institutions has been a successful channel to spread ideas and results arising out of doctoral dissertations.

The dissertation itself is rather a cumbersome process to diffuse or even as a form of reporting. Productising may be an easier method that would serve a larger audience. A product could be an article, a workshop, or a toolbox for actions.

Future research could focus on further use of interview data to explore the dissemination and diffusion of dissertational results and processes, augmented with data from management-level representatives within the UASs and from additional policy-level actors. In this, Rogers provides a suitable theoretical framework for this kind of analysis.

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DEVELOPMENT OF PARTICIPATORY TEACHING IN CZECH SCHOOLS: GLOBAL STORYLINES METHOD IN PRACTICE

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ABSTRACT

Global Storylines, original Scottish method of teaching through stories, reflects global dimension of the contemporary world. The active role of pupils during education and opportunity for participation in learning through group working encourage children to search for various problem solutions. A cohort of trained teachers has been piloting the first cycle of Global Storylines approach in everyday practice of Czech schools during 2013 in a framework of 3-year Global Storylines project. The aim of the contribution is to present results with an emphasis on the active role of pupils, participation, inclusive effect and the development of higher thinking skills. The results of research obtained from various observations and interviews with teachers and pupils confirmed positive impact of Global Storylines on the active role, responsibility and personal development of pupils.

GLOBAL STORYLINES

In 1965 the Scottish Education Department published The primary school in Scotland, a seminal document, giving advice to teachers how to deliver the curriculum. Scottish primary school teachers were invited to develop child-/learner- centred approaches, activity learning and discovering methods, group working and integration of all subjects in curriculum. As a result of teachers' uncertainty how to proceed in teaching, the new method, now known as Storylines was developed. Nowadays Storylines approach is a part of *A curriculum of Excellence*, key educational document in Scotland from the year 2004.

The principles of this document, personalisation and choice, relevance and depth are well-aligned with underlying philosophy of Storylines (Bell, Harkness and White, 2007).

The Storylines methodology is a structured approach to learning which uses the expressive arts to deepen learning within the social subjects, science and technology, and enhance the development of literacy, numeracy, health and wellbeing. The child is to be seen as a thinker and not a passive receptacle of knowledge. Due to the mentioned conditions could have been Storylines method used for developing of a modified form called Global Storylines method. By exploring global issues within the safe forum of the fictional community that Storyline offers and through imaginatively role-playing children develop and apply what has been taught and learned in a new different way. In a safe environment of fictive stories have children repeated opportunities to make autonomous decisions and to progress knowledge, attributes and capabilities including higher-order thinking skills (McNaughton, 2013; WOSDEC, 2014).

There are four different stories. The stories named The water source is focused on interdependence and sustainability examination. The story called The Farming Community investigates fair-trade and organic farming. The third story named Our crop, our land explores the issues of food security and land grabbing. All three stories are designed for children older than 10 years. The fourth story, The giant of Thistle Mountain focused on peace and conflicts is mentioned for children up to 10 years (Wals and Blaze Corcoran, 2012).

METHODOLOGY

The partnership 3-year project called Expanding participatory teaching of global issues through Global Storylines method has been launched in Czech Republic in 2013 as cooperation between Centre of Global Development Education NaZemi and Institute for Research in Inclusive Education of Faculty of Education at Masaryk University Brno, funded by Czech Ministry of Foreign Affairs.

All primary schools and kindergartens of the South Moravia region were addressed via emails but only a few took an opportunity to participate. The research sample contains 6 teachers from 4 different primary schools and 2 teachers from kindergarten. In a first half of the year 2013 teachers have been trained in Global Storyline technique. After that a cohort of 8 trained teachers have been piloting the first cycle of Global Storylines approach in everyday practice for a 5 months.

Within the research following qualitative research methods have been used: continuous observations of using Global Storylines method in schools (3 or 4 times in each classroom), interviews with teachers and pupils after each and every observation (and its analysis), analysis of written reflection of story episodes, artefacts such as photos, pictures of pupils and recordings collected by teachers during practical implementation.

There were settled a three main areas of research: The effect of Global Storylines on learners' participative role in learning; The supportive role of Global Storylines in global issues learning and The Global Storylines method as an instrument of inclusive education.

RESULTS OF THE RESEARCH

The aim of the contribution is to present a part of results from a first cycle of the project Global Storylines with an emphasis on the motivation and development of imagination within the changes in classrooms and participation. Motivation and development of imagination are connected with pupils' creativity and spontaneous discovering of the new skills and topics. Changes in classroom are described through the stabilization of classroom discipline and changes in teacher and pupil position. Participation is defined through independent pupils' learning, activities as well as learning to responsibility and the development of decision-making.

Motivation and development of imagination

The Storylines approach is based on idea that the most successful learning comes from the activity of pupils and sense of a meaningful education. As teachers said in interviews, working with the story and the emotional experiences motivate pupils to activity and cooperation. They seem to be changed compared to standard situations in classrooms.

„The story is a space for learning. Children have to feel the sense of the activity. All what we want to learn, we have to think about how to learn it and why. They will not lose a motivation. It is not necessary to use it everywhere, it is more or less impossible, but they have to understand that learning does not mean only grammar rules but it leads to life experiences.”

Group discussion with teachers

„I see the children in different situations – the story provides different settings, not just learning environment, they feel it differently and look forward to it. They enjoy it a lot.

They do it spontaneously, intuitively, enjoying the time at school. Children prefer to be at school when we are all in the story. It brings us a great time and moments”.

Group discussion with teachers

„I feel like at a different place than in the school”.

Interview with pupils

Global Storylines methods also enable children to use their imagination. This opportunity leads also to higher participation and spontaneous discovering of new things and skills. Children positively rated a possibility to independence in creative work (such as developing community, roles and village).

„Children really liked the giant studies. They brought many things. It was just their activity. They wanted to know, tried to find information in books. They invited many stories about giant, what he has done in the town and why”.

From an interview with a teacher

„I feel that I have underestimated the child's imagination, I am surprised that it is richer than mine“.

Teacher reflection in writing

Changes in classrooms and participation

According to teachers' opinions, Global Storylines positively affects the classroom atmosphere and discipline. The changes have been described also in connection within the change of classroom teacher position. The Global Storylines boosts changes in teacher and pupil position thus teacher becomes a part of a group (community and class afterwards).

„I am very glad that we tried it and allowed them to use different approaches and methods than they used to know. It has had a great impact at present. They treat me differently as well as I treat them and the class is immensely calm and friendly“.

Group discussion with teachers

„I am very proud of everything we did in the project, they have been learning much more quickly than usual. They were different, quicker and ingenious. They have been seeking for information in books, magazines, in families”.

Group discussion with teachers

Global Storylines allows children to lead their own education. In different situations, which children have to face, tackle the themes they should know and learn. Global themes in combination with Storylines enable to combine different knowledge from a fictive and real world which children can use in the life reality.

There has been also observed an inclusive potential of Global Storylines method in classroom. Students had an opportunity to create a role, in which they acted differently. It provides space for the inclusion of those, whose are usually excluded from the class (f.e. children with special educational need, behavioural problems, etc.).

„XY is such an introvert. He is always sitting in the corner, outside of the group. But today he was leading the debate, he's being the chief“.

Interview with teacher

Active role of students during educational process as well as equal opportunities affect the development of decision-making process and responsibility. Within the story, pupils, acting as villagers, face different situations in which they had to react as a team and tried to find a compromise between many options. It provides spaces for different ways of vote and understanding once responsibility for decision which has been made.

„They worked independently, able to discuss, be responsible for the work in the village. Two months ago they would have given it up. During the GSL children were different, quicker, smarter“.

Interview with teacher

CONCLUSION

Global Storyline method provides great opportunity for participation of children during education. According to teachers and children reports, the active role of pupils leads to higher motivation in learning and imagination development. Positive atmosphere of fictive reality offers closer communication between teacher and pupils, where teacher became a facilitator and also a part of a group. This important change of teacher's role in class can also causes an establishment of discipline and friendly atmosphere.

Participation of children in everyday learning and a various working techniques leads spontaneously to understanding of once responsibility and the development of decision-making. According to results from various countries, where Storylines has been implemented, has this method unique potential. It allows children to explore controversial issues from other perspective, positively affects their communication skills, relationships in classroom and stimulates mental development.

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BURNOUT SYNDROME IN TEACHERS OF SPECIAL SCHOOLS IN THE SOUTH MORAVIA REGION IN THE CZECH REPUBLIC

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ABSTRACT

Burnout syndrome, state of total mental and physical exhaustion, is connected with many occupations, but especially with those, which are focus on work with people. It is clearly increasing problem in the teaching profession. Long-term stress during daily inner and outer conflicts leads to gradual weakening of organism and open space for the development of burnout. The contribution presents the results of research focused on burnout syndrome manifestation in pedagogical staff in special schools in the South Moravia region in the Czech Republic. The research sample consisted of 102 participants, which were assessed by Maslach Burnout Inventory. The questionnaire deals with three burnout areas: emotional exhaustion, personal accomplishments and depersonalisation. These areas have been assessed in connection with certain characteristics, such as gender, length of teaching practice, working position, education and subjectively assessed mental state. The results of the research did not confirm burnout among the study group.

BURNOUT SYNDROME

Burnout syndrome is formally defined as a state of physical, emotional and mental exhaustion caused by long-term involvement in situations that are emotionally demanding. The emotional demands are most often caused by a combination of high expectations and chronic stress (Pines, Aronson, 1988).

Although burnout was firstly identified within people-oriented professions, it can be experienced by anyone in the position of providing extensive care for another person. This is most likely to occur when the person is suffering from a chronic and debilitating health conditions (Maslach, 2003).

Teaching profession is one of those in which may Burnout syndrome occurs. The array of symptoms such as physical depletion, feelings of hopelessness, the development of a negative self-concept and negative attitudes towards work can affect the work performance as well as a teacher-pupil relationship (Gold, Roth, 1993). Stress and burnout become particularly serious due to the consequences. It has an influence on sickness rate of teachers which is determined by neurotic and psychosomatic disorders. The significant correlation between burnout and psychological and psychosomatic symptoms has been confirmed (f.e.) by Bauer et al. (2005). The sickness rate of teacher results in high absence and affects teacher performance in school. The dissatisfaction and depressive mood increasing depersonalization and may lead to early retirement (Vanderberghe, Huberman, 1999). There are variety of factors which contribute to the stress and demoralization of teachers. These include student discipline, lack of personal support, pressures from the school, insufficient financial support, poor imagine of profession and working environment. These variables are in case of special teachers enriched by specific condition of special schools and difficult health statement of the pupils (Gold, Roth, 1993).

According to Brock, Grady (2004; Maslach, 2003) teachers suffering burnout generally exhibit symptoms in five general areas: physical, intellectual, social, emotional and spiritual. The symptoms are multifaced, with blurred distinctions and their intersections. Burnout syndrome is a cumulative process beginning with small signals which can progress. Occasional feelings such as frustration lead to depression, emotional withdrawal and health problems. Withdrawal and depersonalization advances to a more deterioration level where loss of caring about others and oneself is experienced and leads to disillusionment and near total feeling of giving up, or burnout (Gold, Roth, 1993; Potter, 2005).

According to Maslach (2003; Schaufeli, Maslach & Marek, 1993) there are three main dimensions of burnout syndrome. A pattern of emotional overload and subsequent emotional exhaustion is at the heart of the Burnout syndrome. The development of detached, callous and even dehumanized response leads to second characteristics aspects of burnout – depersonalization. Feeling negatively about the others encompasses being down on oneself. With the guilty feeling a third aspect of burnout occurs – reduced feeling of personal accomplishment.

METHODOLOGY

The survey was carried out on six special schools in South Moravia Region (Czech Republic). All special school in the South Region, which educate pupils with mental or multiple disabilities, were contacted.

The survey includes those schools whose leadership expressed interest in screening of burnout manifestation. The research sample contained 102 participants (all pedagogical staff of six special schools).

For the detection of the Burnout syndrome the quantitative research method Maslach Burnout Inventory (MBI) has been used. It is focused on three different areas relating to work - emotional exhaustion (EE), personal accomplishment (PA) and depersonalization (DP). All areas were assessed in connection with independent variables, such as a gender, educational attainment, length of teaching practice, working position and regional location (urban/rural district). The Burnout syndrome is defined through low score in the area of personal accomplishment and high score in depersonalization and emotional exhaustion.

For a data analysis the statistic methods has been used. The normality of data was assessed on the basis of histograms, which confirmed the Gaussian distribution of the data only in the field of emotional exhaustion and personal accomplishment. Relations between independent variables and outcomes in the areas of emotional exhaustion and personal satisfaction were evaluated using ANOVA and subsequent comparison of the various categories using Tukey HSD post hoc test. For the evaluation of the relations among independent variables and average values of depersonalization were used nonparametric test methods. Data were analyzed using SPSS 22.0 software.

RESULTS

According to finding, the average points in all observed areas of MBI were positive. The level of emotional exhaustion in teachers of special schools was reached in moderate level as well as in the area of personal accomplishment (17,96 p.; 36,69 p.). Moderate levels confirm the suggestion about high tolerance to stress among teachers of special schools in the South Moravia Region. It has been supported also by the level of depersonalization, which was detected as low (4,5 p.).

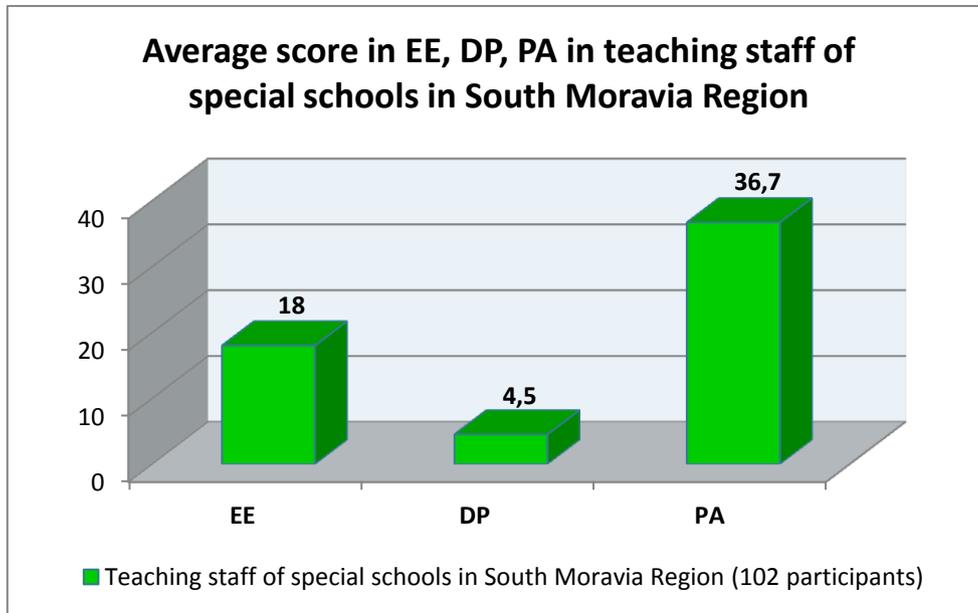


Figure 1. Average score in EE, DP, PA in teaching staff of special schools in South Moravia Region

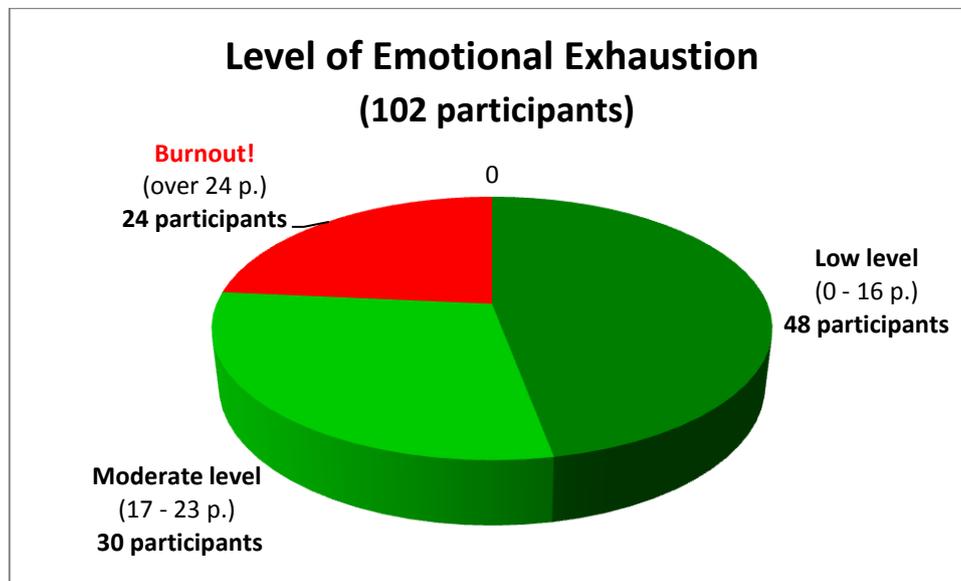


Figure 2. Level of Emotional Exhaustion

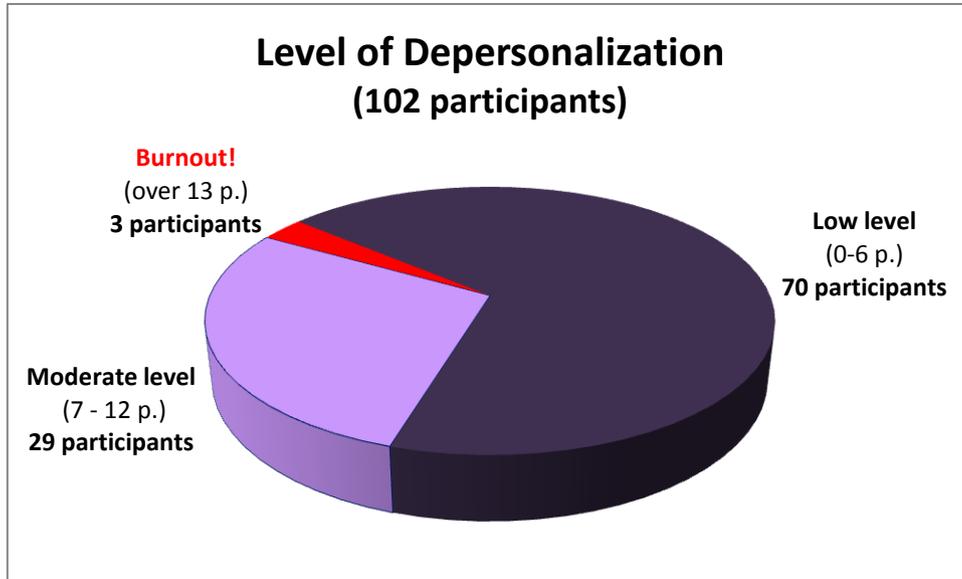


Figure 3. Level of Depersonalization

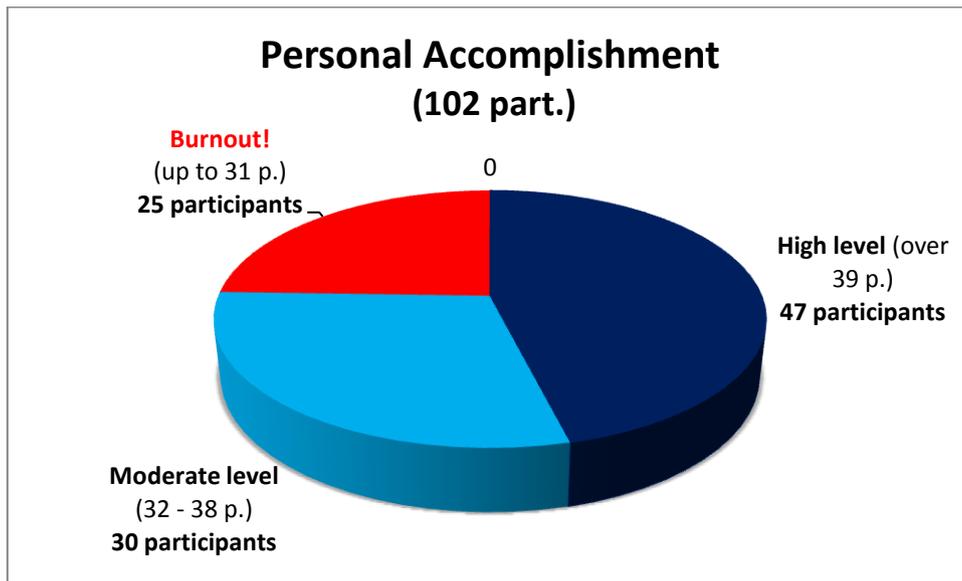


Figure 4. Level of Personal Accomplishment

The Burnout in the emotional exhaustion has been reached by 24 participants (23 %), moderate level by 30 participants (29 %) and low level by 48 participants (47 %). These results refer to emotional stability among pedagogical staff of special schools (Fig.2.).

Similar results have been detected in the dimension of personal accomplishment. Almost one third of research sample (25 participants – 25 %) appeared to be burnout. The highest number of participant (47, 46 %) was detected in high level of personal accomplishment, which refers to high motivation to work (Fig. 4). Only 3 participants reached Burnout in the area of depersonalization. The majority of teachers reached the moderate level (29 participant)s or low level (70 participants) of depersonalization (Fig.3).

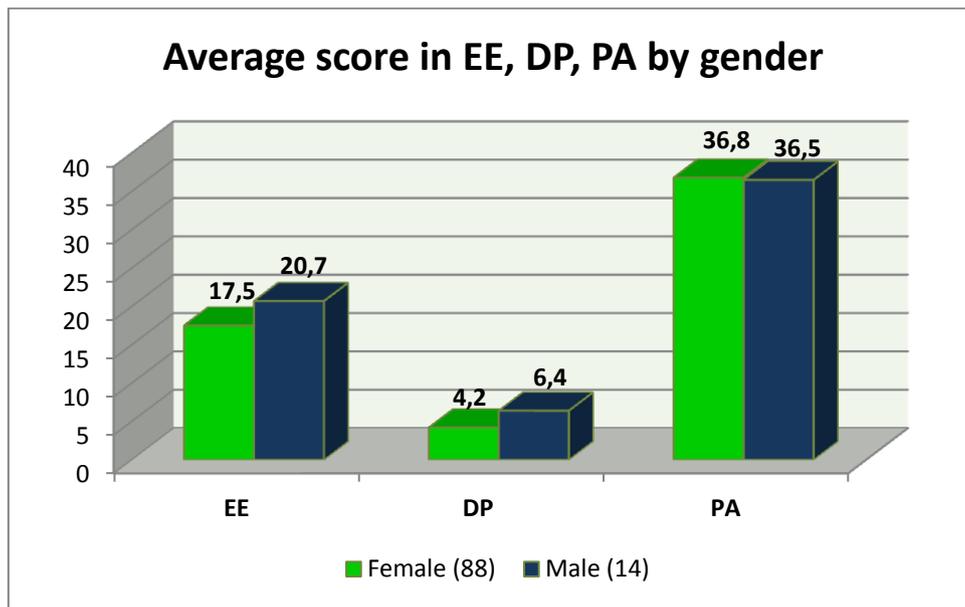


Figure 5. Average score in EE, DP, PA by gender

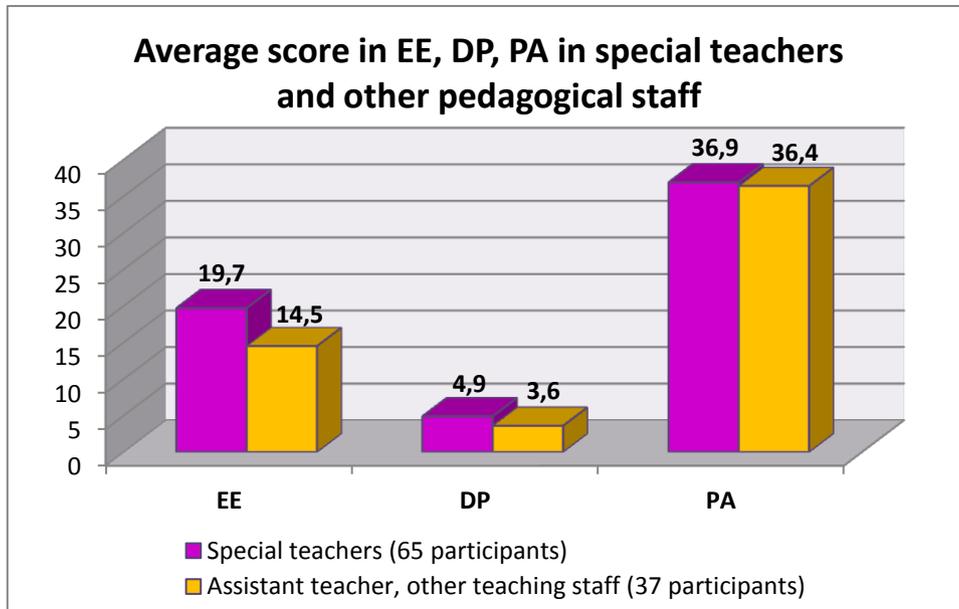


Figure 6. Average score in EE, DP, PA in special teachers and other pedagogical staff

There have been found any statistically significant differences in the areas of MBI in connection with gender. One of the possible reasons for that was a low number of male in research sample. However, according to the findings male gender reached higher score in emotional exhaustion and depersonalization (Fig. 5). Pedagogical staff on working position as special teacher gained higher score in all observed areas (Fig. 6). Despite higher level of emotional exhaustion and depersonalization, their personal accomplishment was on moderate level, even higher than the score of other teaching staff. The correlation between working position has been statistically confirmed only for the area of emotional exhaustion.

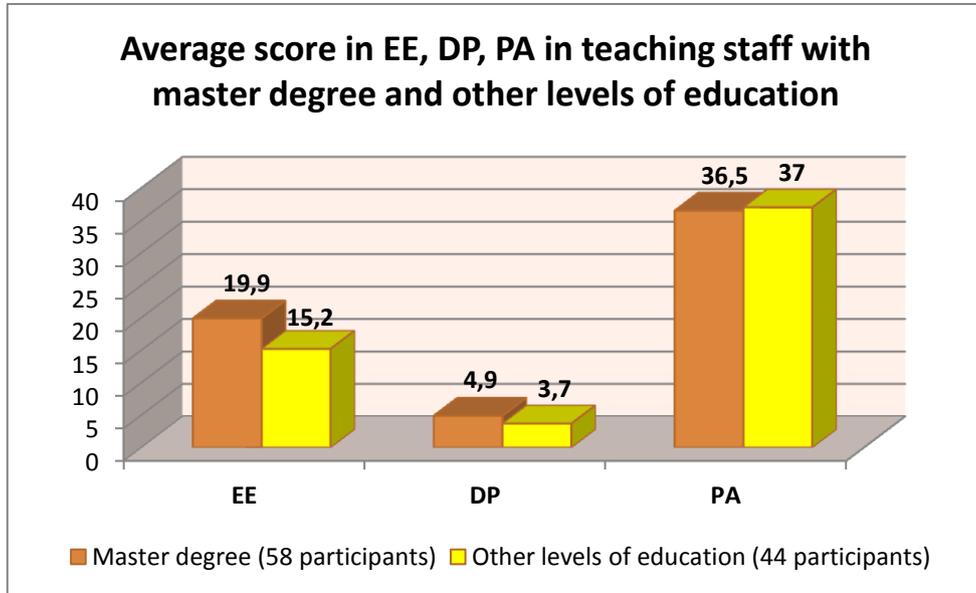


Figure 7. Average score in EE, DP, PA in teaching staff with master degree and other levels of education

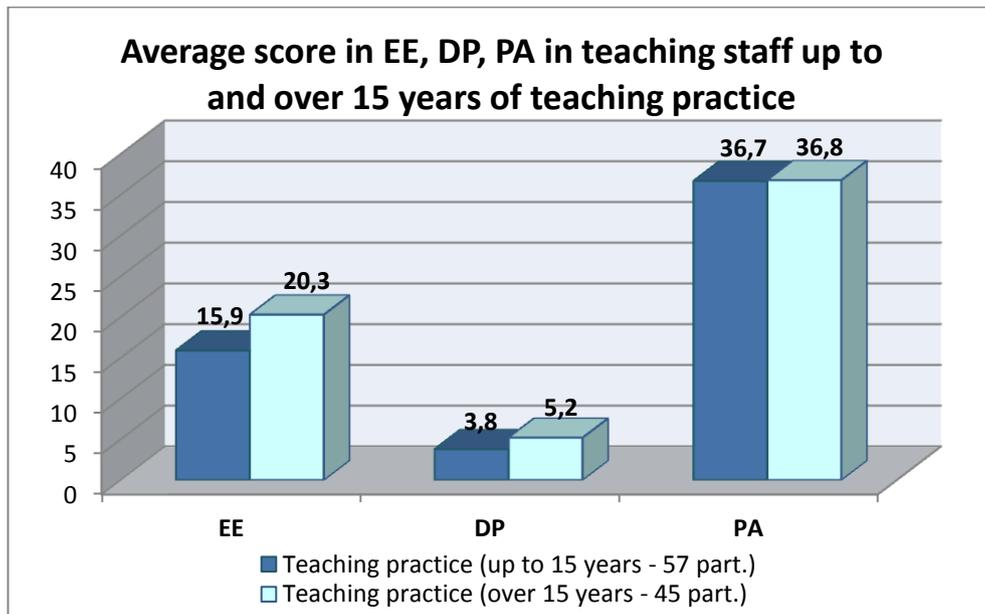


Figure 8. Average score in EE, DP, PA in teaching staff up to and over 15 years of teaching practice

Higher score of emotional exhaustion and depersonalization have been connected with educational attainment (statistically only for the area of emotional exhaustion). Pedagogical staff with master degree gained also lower score in personal accomplishment (Fig. 7). These teachers usually work on positions as class teachers in special schools in the Czech Republic.

It has been confirmed, that the level of emotional exhaustion and depersonalization is affected by the length of teaching practice. Nevertheless, in spite of these findings, teachers with practice over 15 years reached average score in moderate level of personal accomplishment (Fig. 8).

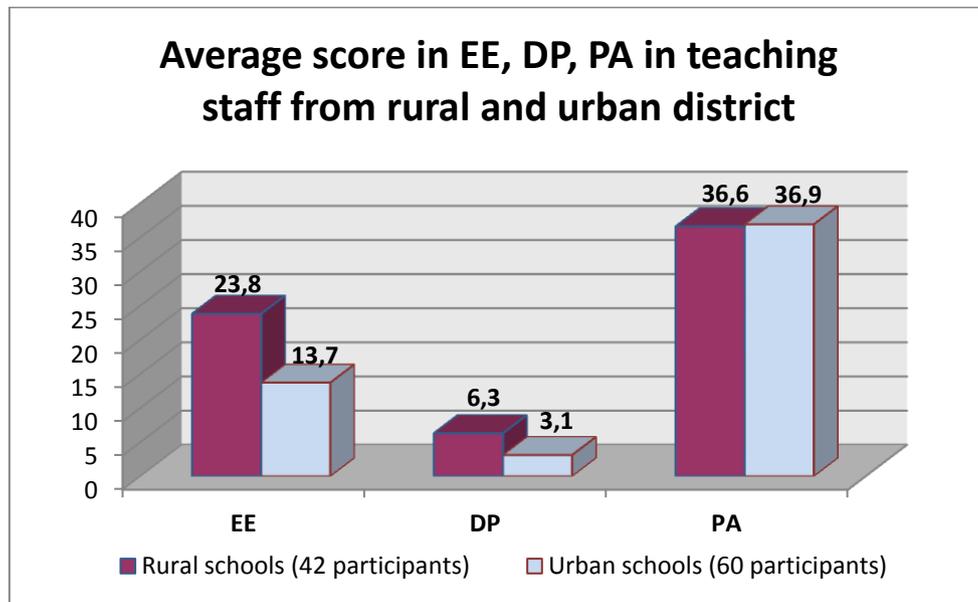


Figure 9. Average score in EE, DP, PA in teaching staff from rural and urban district

The differences between rural and urban district school have been significant in the areas of emotional exhaustion and depersonalization. Though, no differences were detected in the level of personal accomplishment.

CONCLUSION

The analysis of Burnout syndrome in special schools teachers in South Moravia Region has showed a high tolerance of teachers towards stress and Burnout. There were not detected any pathological results in monitored areas. The results of the research confirmed moderate level of emotional exhaustion and personal accomplishment and a low level of depersonalization among study group.

Despite higher score in emotional exhaustion and depersonalization the level of personal accomplishment was in all groups at least moderate.

This finding indicates high motivation and positive attitude of special teachers towards teaching despite the length of teaching practice or any other defined variable. According to statistical analysis the higher level of emotional exhaustion was connected with the four of the five established independent variables and the higher level of depersonalization only with three. No statistically significant differences in the area of personal accomplishment have been found. Further investigations in this area should have been made for more detailed information about current manifestation of Burnout syndrome in special schools in the Czech Republic.

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THE PLAYING-2-GETHER INTERVENTION IN THE CLASSROOM: TOWARDS A FEASIBLE IMPLEMENTATION IN REGULAR CLASS PRACTICE

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ABSTRACT

Playing-2-gether is an attachment and learning theory based intervention aimed at improving the quality of teacher-child interactions to decrease preschoolers' externalizing problem behavior. A large-scaled randomized controlled trial has shown the efficacy of this intervention amongst preschoolers at risk. However, issues of feasibility arised, as the intervention consisted of one-on-one play sessions between teacher and child outside the classroom. Therefore, a practice-based research was conducted to investigate whether an adaptation of the Playing-2-Gether intervention to a regular class context is effective and feasible. For this research, student teachers collaborated with experienced teachers to adapt and try-out Playing-2-gether in their classrooms (n = 17). After the intervention, qualitative data of student and experienced teacher perceptions concerning effectiveness and feasibility were collected (e.g., semi-structured interviews, open-ended questionnaires). Qualitative analysis was conducted using NVivo. The facilitating factors for feasibility of the Playing-2-gether intervention include observing the target child before implementing the intervention, setting and visualizing clear rules for non-target children concerning the teacher's availability during the intervention, implementing the intervention in a central place in the classroom, using Playing-2-gether hand puppets and pictograms to structure the intervention, and involving non-target children in the implementation of the intervention. Moreover, the results of this small-scaled study indicate that this adaptation of the Playing-2-gether intervention may lead to teacher perceptions of a better teacher-child relationship quality and increased behavioral adjustment for internalizing and externalizing preschoolers, but not for children with signs or symptoms of autism spectrum disorder.

THE PLAYING-2-GETHER INTERVENTION: THEORY, PRACTICE AND RESEARCH

Externalizing problem behavior refers to disruptive and harmful behaviors for others (e.g., talking back, being disobedient, hurting other children, taking away things from children; Matthijs & Lochman, 2010; Smidts & Oosterlaan, 2007). This type of behavior in preschool has been shown to be linked to concurrent and future child maladjustment in several domains, such as peer rejection, school failure, and mental disorders (e.g., Dodge, Coie, & Lynam, 2006; Nagin & Tremblay, 1999). As this problem behavior is not only a risk factor for the child's development, but also for the teacher's well-being and for the classroom climate (e.g., Spilt, Koomen, & Thijs, 2011), it is important to redirect this behavioral maladjustment in an early stage. Therefore it is necessary to develop and evaluate interventions that focus on changing preschooler problem behavior.

The Playing-2-together intervention was developed for preschoolers showing relatively high levels of externalizing problem behavior and their teachers (Vancraeyveldt, Van Craeyevelt, Verschueren, & Colpin, 2010). The intervention, which is built on attachment and learning theory, aims at decreasing child externalizing problem behavior through targeting teacher-child interactions. In the following sections we discuss the theoretical foundations of the intervention, the practical implications, and the research on the efficacy of this program.

The Playing-2-together intervention: Theoretical background

Attachment theory

According to attachment theory, building a secure attachment bond with a primary caregiver is important to promote child behavioral adjustment (see meta-analysis by Fearon, Bakermans-Kranenburg, van Ijzendoorn, Lapsey, & Roisman, 2010). For most children, parents are the primary attachment figures. Relationships with teachers are, in contrast with parent-child relationships, by definition time-limited and not exclusive. Moreover, teachers engage in caregiving behaviors, but the range of caregiving behaviors is more restricted compared with parents (Howes & Hamilton, 1992) and their primary role, especially in formal education, is that of an instructor (Kesner, 2000). On the other hand, children spend a lot of time with their teachers (sometimes more than with their parents) for at least one school year. Also, young children have been found to seek comfort from teachers in times of stress (Koomen & Hoeksma, 2003) and to use the teacher as a resource to regulate stress (Ahnert, Harwardt-Heinecke, Kappler, Eckstein-Madry, & Milatz, 2013). As such, research has shown that teachers may act as temporary attachment figures playing the role of secure base and safe haven (e.g., Verschueren & Koomen, 2012).

The attachment perspective conceives the teacher-child relationship quality along positive and negative affective dimensions, most often the dimensions of closeness (i.e., the amount of warmth and openness in teacher-child communications) and conflict (i.e., the disagreement and negativity in the relationship; Pianta, Hamre, & Stuhlman, 2003).

During the past two decades, research has consistently shown that the affective quality of the teacher-child relationship (as represented by the amount of closeness and conflict) longitudinally predicts children's behavioral adjustment, above and beyond relevant child and family characteristics (e.g., Buyse, Verschueren, Doumen, Van Damme, & Maes, 2008). Recently, a dyadic teacher-child intervention (e.g., Banking Time; Pianta & Hamre, 2001) that focuses on building high-quality teacher-child relationships was developed and evaluated (e.g., Driscoll & Pianta, 2010; Driscoll, Wang, Mashburn, & Pianta, 2011).

Learning theory

Learning theory stresses the importance of teacher-child interactions for children's behavioral development as well. More specifically, the operant conditioning model theorizes about how (desired and undesired) behavior is learned (e.g., Cowan & Sheridan, 2009; Hermans, Eelen, & Orlemans, 2007). In the ABC-model for example, behavior management is promoted through manipulating the antecedents and consequences of child behavior (see for example Cowan & Sheridan, 2009; Hermans et al., 2007). More specifically, the teacher should set up the conditions under which desired behavior is likely to occur (e.g., stating clear rules, using pictograms, ...), and, if the desired child behavior occurs, the teacher should reinforce this behavior (e.g., praising desired behavior, ...). If undesired child behavior still arises, this behavior may be punished (e.g., time-out, ...). Research in the school context has shown the efficacy of adequate teacher behavior management techniques for improving behavioral adjustment (e.g., Cowan & Sheridan, 2009; Leflot, van Lier, Onghena, & Colpin, 2010).

Interventions based on attachment and learning theory

As attachment theory and learning theory focus on different aspects of teacher-child interactions that are judged to be complementary in improving child behavioral adjustment, these theoretical perspectives may be combined in two-component interventions. In these interventions, a first component may be attachment-based and aimed at improving the relationship quality. The improved relationship is, in turn, expected to act as an affective base, which facilitates the effectiveness of behavior management techniques focused on in a second, learning theory based, intervention component.

Nevertheless, few two-component interventions exist that focus on improving teacher-child interactions amongst preschoolers. One notable exception is the two-component, dyadic Teacher-Child Interaction Therapy (McIntosh, Rizza, & Bliss, 2000) and its elaboration in the classroom, Teacher-Child Interaction Training (Lyon et al., 2009). In small-scaled studies, the effectiveness of these interventions in improving behavioral adjustment was shown (Gershenson, Lyon, & Budd, 2010; Lyon et al., 2009; McIntosh et al., 2000).

The Playing-2-together intervention: One-on-one play sessions outside the classroom

Building on the results of the abovementioned interventions, the Playing-2-together intervention was developed for preschoolers with relatively high levels of externalizing problem behavior (Vancraeyveldt et al., 2010). The program focuses on enhancing teacher-child interactions to decrease child externalizing problem behavior. Playing-2-together consists of two six-week components during which one-on-one play sessions with the target child take place outside the classroom. These play sessions are held for a minimum of two times a week, for approximately 15 minutes per session. During these sessions, the teacher is given the opportunity to practice skills to improve the teacher-child relationship quality (first component) and the teacher's behavior management (second component) in a safe learning environment.

In the first component, Relationship-Game, the play sessions are child-centered. More specifically, the child can choose the activity or the game, and the teacher has to follow the child's lead. During these play sessions, the teacher practices skills that improve teacher sensitivity and that focus on making a strong connection with the child. For example, the teacher observes the child during the game, imitates his play, describes his actions and labels his feelings (Driscoll & Pianta, 2010). The teacher also pays attention to the children's relational needs and tries to respond to them in an adequate manner (cf. "developing relational themes" in Banking Time; Pianta & Hamre, 2001).

In the second component, Rule-Game, the sessions are more teacher-centered. In these sessions, the teacher chooses the activity or the game, and the child has to follow the teacher's lead. Moreover, the teacher practices skills to improve child behavioral adjustment, such as giving clear commands, introducing rules and pictograms (i.e., a pictogram of a kangaroo who urges the child to act appropriately), ... (Cowan & Sheridan, 2009). If child disruptive behavior persists, the teacher can make use of time-out, but it is important that the sessions remain a positive time spent together.

The Playing-2-gether intervention: Randomized controlled trial

In a large-scale randomized controlled trial led by the School Psychology and Child and Adolescent Research Unit of the University of Leuven (Belgium), the Playing-2-gether intervention was found to be effective in improving teacher-child relationship quality and behavioral adjustment of 175 preschool boys at risk for externalizing behavior, whilst coaching and training was provided (Vancraeyveldt, Verschueren, Van Craeyevelt, Wouters, & Colpin, 2013; Vancraeyveldt, Verschueren, Wouters, Van Craeyevelt, Van den Noortgate, & Colpin, 2015).

Concerning behavioral adjustment, the results show small, but significant positive effects of Playing-2-gether in reducing (teacher-rated) child externalizing problem behavior. More specifically, intervention children, compared to control children, showed a significantly larger decrease on a general measure of child externalizing problem behavior, and on hyperactivity/inattention and conduct problems at post-test. Concerning teacher-child relationship quality, Playing-2-gether was shown to reduce teacher-child conflict. Interestingly, no intervention effect on teacher-child closeness was found. The first intervention component in itself (i.e., Relationship-Game) resulted in all abovementioned effects, and in an additional effect on closeness. The second intervention component did not yield additional effects in comparison to the first intervention component.

The Playing-2-gether intervention: Need for practice-based research

Although the effects of the intervention were found to be positive, implementing one-on-one Playing-2-gether play sessions outside the classroom was found to be difficult in practice. In several schools, it was not easy to find a teacher who could take over the class group whilst the Playing-2-gether sessions were held outside the classroom. Furthermore, several teachers did not feel comfortable about leaving their classroom to give extra attention to one child only. To ensure a sustainable implementation of the intervention in daily practice, an adaptation to the intervention was needed, without neglecting the theoretical basis of the intervention (e.g., the importance of dyadic teacher-child interactions).

Building on this, several research questions came to mind. *First*, we aimed to investigate whether the Playing-2-gether intervention could be adapted to a feasible variant which could be implemented within the classroom. And if so, would this variant be effective in improving teacher-child relationship quality and improving child behavioral adjustment? *Second*, building on research that shows a negative association between the teacher-child relationship quality and students' internalizing behavior (e.g., O'Connor, Dearing, & Collins, 2011), we intended to investigate whether the Playing-2-gether intervention would be effective in decreasing other problem behaviors, such as internalizing behavior. We also aimed to give indications for its effects for preschoolers with signs or symptoms of autism spectrum disorder.

Third, we aimed to explore whether the implementation of the intervention in the classroom would be different for experienced teachers in comparison to student teachers.

To investigate these questions, a collaboration between the University of Leuven (Belgium) and the Teacher Training Department of the University Colleges Leuven-Limburg (Belgium) was set up. This resulted in the practice-based study which is the focus of the rest of this paper.

RESEARCH GOAL

The main goal of this practice-based research was to adapt the Playing-2-gether intervention to preschool classrooms to ensure feasibility and sustainability in daily practice. To this aim, Playing-2-gether sessions were implemented within the classroom and evaluated in a practice-based research. Different formats of the intervention were tested throughout a structured case study protocol. More specifically, we intended to evaluate the effectiveness and the feasibility of different organizational formats (e.g., group play sessions, one-on-one sessions) and different Playing-2-gether activities in the classroom for children with different types of problem behavior (e.g., externalizing or internalizing behavior).

Moreover, the literature has shown that the chances of implementation, feasibility, and sustainability of an intervention are predicted by (the interplay of) multiple factors (Durlak & DuPre, 2008). However, few research to date has focused on identifying these factors in a regular education setting with an indicated intervention. Our second research goal is to give at least some insight into these factors.

RESEARCH DESIGN

A multiple case study in the context of a practice-based research was set up. Therefore, we formed a duo of an experienced preschool teacher and a student teacher who implemented Playing-2-gether in their classroom ($n = 17$). In every participating classroom, the mentor of the student teacher or the experienced teacher selected one or two children for whom they perceived problem behavior (e.g., externalizing or internalizing problem behavior, symptoms or signs of autism spectrum disorder) and collected informed consents of the parents of this child or these children. There were 18 participating children (ten boys and eight girls) between 2.5 and six years old.

In collaboration with a researcher supervisor and the mentor of the student teacher, the student teachers and experienced teachers adapted Playing-2-gether to the needs of the selected children in their classrooms.

These try-outs took six weeks. In each school, the research supervisor also held a coaching session with the student teacher and experienced teacher. After the intervention, qualitative data of student teachers and experienced teachers (e.g., bachelor theses, semi-structured interviews, open-ended questionnaires) were collected. Based on the literature (e.g., Durlak & DuPre, 2008) and on the experiences within the supervision sessions, a codebook for feasibility of the intervention was developed and discussed by the members of the research team. Building on this codebook, qualitative content analysis (e.g., Mortelmans, 2010) was conducted using Nvivo software. *First*, for every interview, questionnaire, and bachelor thesis separately, the data was linked to the different categories in the codebook. Three researchers participated in this coding process. *Second*, the main researcher compared the data in the different categories for all interviews, questionnaires and bachelor theses. A summary was written down and provided to the other researchers and some members of the field of activity (i.e., schools) for a member check. In the following, we illustrate our findings with quotes from the interviews with the experienced teachers and the bachelor theses of student teachers. These quotes are slightly adapted to ensure the readability of the text. Moreover, we anonymized the names of the student and experienced teachers.

RESULTS

Feasibility of Playing-2-gether in the classroom

In general, most student and experienced teachers found that implementing Playing-2-gether in the classroom was **feasible**, even though it was **not always easy in the beginning**.

“This research project was a positive experience for me. In the beginning, I was doubtful whether implementing Playing-2-gether in the classroom would be useful. After two sessions, I noticed that everything in my class ran smoothly and that I could really make time to play with the target preschooler. As the target preschooler was very enthusiastic during the sessions and frequently asked me when we would play again, I noticed that Playing-2-gether meant a lot for the preschooler. That made me feel good. It made me also feel that the research was worthwhile because the preschooler really enjoyed her time alone with me.” - Student teacher Eve, 4 to 5 year old preschoolers

“In the beginning of the project, I was thinking “This will be hard to implement, I don’t know if this will work”, but the student teacher in my school, Eve, explained to me one step at a time what we were going to do. And, actually, the intervention yielded good results, also in my classroom. So now I know how I can implement Playing-2-gether next year. It has been a positive experience for me.” - Experienced teacher Rianne, 5 year old preschoolers

Although Playing-2-gether was generally reported to be feasible in practice, several organizational, classroom, teacher, and child factors improved or, in contrast, reduced the feasibility of the intervention. In the following, we zoom in on the main analyses concerning **teacher factors, organizational factors and class management which improved feasibility**. A more extended version of the analyses can be found in Vancraeyveldt, Vastmans, Huyse, Colpin, Verschueren, and Bertrands (2014).

First, it is important to note that **student and experienced teachers** expressed **different concerns** before and during the implementation of the intervention. Student teachers were mainly concerned about class management (i.e., “Will I be able to handle the behavior of the other children in the class when I’m giving one-on-one attention to this target child?”), whereas experienced teachers were mainly concerned about finding the time to implement the intervention in their busy schedules.

“During Relationship-Game, the target child chose the toys he would play with and the material he would play with; he didn’t need that much guidance. In contrast, the other children in my classroom needed help to start their activities. At that moment, I found it very difficult to focus on the target child.” - Student teacher Vera, 3 to 4 year old preschoolers

“I really needed to force myself to implement Playing-2-gether on a fixed day because otherwise, I would not implement it. Afterwards, I would think: “O, I forgot it this week”. It is also important to really make time for it, because implementing Playing-2-gether in a fast and superficial manner makes no sense at all.” - Experienced teacher Dora, 5 year old preschoolers

Second, student teachers and experienced teachers **adapted Playing-2-gether to the needs of the target children**. For example, they only focused on Relationship-Game skills if they did not see the added value of extensively focusing on behavior management techniques for a particular child (for example for children with internalizing problem behavior). **Carefully observing the target child before implementing the intervention** was found to be an important part of the intervention.

Third, it was found to be important to make **agreements** with non-target children concerning **the teachers’ availability during Playing-2-gether**. For younger children and for busier classrooms, this was found to be more difficult. As mentioned before, student teachers experienced more difficulties in managing the other children in comparison to experienced teachers.

“I made clear arrangements with the other preschoolers in my internship classroom. When I was implementing Playing-2-gether, the preschoolers first needed to try to solve their little problems themselves. They could ask help from their friends. Only if they were not able to solve their problem alone or with their friends, they were allowed to come to me.” – Student teacher Eve, 4 to 5 year old preschoolers

“There were a lot of preschoolers who came and watch while I was implementing Playing-2-gether with the target preschooler. I agreed with them that they could watch us but that they had to keep their hands on their backs so they would not disturb the session.” - Student teacher Faith, 3 year old preschoolers

For most (student) teachers, it was necessary to organize the Playing-2-gether play sessions in a **central** place in the classroom, as the (student) teacher is able to easily intervene if conflicts in the classroom arise. Some student and experienced teachers also **visualized** their agreements with the preschoolers. For example, one student used a “Stop, the teacher is busy” sign, while another teacher wore a special Playing-2-gether watch to indicate that he was busy.

Fourth, Playing-2-gether **hand puppets and pictograms** were found to be useful to introduce the intervention, to help structure the Playing-2-gether sessions, and to visualize the goal of these sessions. These hand puppets and pictograms also convey messages concerning behavioral adjustment in a non-directive manner to the target child.

“It is helpful to introduce Playing-2-gether using hand puppets of an adult and a child kangaroo (i.e., the logo of Playing-2-gether). Preschoolers are very sensitive to hand puppets and they easily connect with them. For example, you can introduce Playing-2-gether by saying that Kanga (the mother kangaroo) and Roo (the child kangaroo) come to stay over in the classroom, because Roo needs to learn a lot. The teacher chooses one preschooler (the Playing-2-gether target preschooler) to take care of Roo. This preschooler is allowed to play a game with Roo in the afternoon. A small group of preschoolers can play along with the target preschooler and Roo. More specifically, the target preschooler can choose the game they will be playing, and the other preschoolers and the teacher have to follow his lead. Roo watches them play. The games and materials which they can play with are stored in a Playing-2-gether suitcase.” - Student teacher Vera, 3 to 4 year old preschoolers

"I used two pictograms to represent Relationship-Game and Rule-Game. On these pictograms, the teacher and the child kangaroo are playing together. During Relationship-Game, the target Playing-2-gether child has to stick the ball on the picture of the child kangaroo. This means that the child (kangaroo) has the ball in hands, so he can choose the game. During Rule-Game the target child has to stick the ball on the picture of the teacher kangaroo. These pictograms were hanging in the classroom on Wednesday and Friday, the days during which I would implement Playing-2-gether with the target child." - Student teacher Melissa, 4 year old preschoolers

Fifth, involving non-target children in the implementation of Playing-2-gether was found to be helpful. A useful way to do this was making small Playing-2-gether groups (see example student teacher Vera). It was important to alternate the members of these groups, so all children would have the chance to participate in Playing-2-gether.

Finally, most student teachers noted that the second, behavior management, part of Playing-2-gether was not as 'new' for them as the first, attachment-based part of the intervention.

Effectiveness of Playing-2-gether in the classroom

Concerning effectiveness, most (student) teachers in particular reported an improvement in the teacher-child relationship and/or a slight improvement in child behavioral adjustment throughout the different formats of the intervention, both for children with internalizing and externalizing problem behavior.

"I noticed that the Playing-2-gether program has an effect on the behavior of the target preschooler and the other preschoolers in the group. We did not have much time to implement the program, so the effect is rather small." - Student teacher Sarah, 5 year old preschoolers, focused on one preschooler with externalizing problem behavior, for whom she implemented Playing-2-gether in small groups of preschoolers.

"I see clear differences when I compare my observations of the behavior of Nora and Brandon before the implementation of Playing-2-gether with my observations after the implementation of Playing-2-gether. The children are more open towards me and dare to engage spontaneously in conversations. I'm very satisfied with these results." - Student teacher Faith, 3 year old preschoolers, focused on two children with internalizing problem behavior for whom she separately organized the Playing-2-gether sessions (first in small groups, then one-on-one)

"I cannot change his behavior, but my relationship with him is improved. Sometimes he has better days, but sometimes he has bad days. I cannot change his behavior. It is still there. But I still notice some improvement." - Experienced teacher Dora, 5 year old preschoolers, focused on one child with externalizing problem behavior

No improvement was reported for the children with signs or symptoms of autism spectrum disorder.

“I told the student: Relationship-Game will be difficult for you to implement with this child, because during Relationship-Game, the child experiences no structure. That is exactly what happened, it was difficult to implement Relationship-Game with this child.” - Experienced teacher, Ines, is talking about the student teacher who implemented Relationship-Game with a child with signs or symptoms of autism spectrum disorder

DISCUSSION

This qualitative study indicates that the Playing-2-gether intervention can be adapted to the regular class practice and that this adaptation may lead to a teacher-perceived increased behavioral adjustment and a better teacher-child relationship quality for internalizing and externalizing preschoolers, but not for children with signs or symptoms of autism spectrum disorder. These findings are in line with positive effects of the Playing-2-gether intervention for children with externalizing behavior (Vancraeyveldt et al., 2013; Vancraeyveldt et al., 2015) and with longitudinal studies demonstrating negative links between teacher-child relationship quality and internalizing problems of children (O’Connor et al., 2011). Several organizational, classroom, teacher and child factors were found to improve or reduce the intervention’s effectiveness and feasibility in a real-life class context (e.g., Durlak & DuPre, 2008). More specifically, it was found to be important to observe the target child before implementing the intervention, to make clear agreements with non-target children concerning the teachers’ availability during the sessions, to visualize these agreements, to hold the Playing-2-gether sessions in a central place in the classroom, to use Playing-2-gether hand puppets and pictograms to structure the sessions, and to involve non-target children in the implementation of Playing-2-gether. These factors should be taken into account when implementing Playing-2-gether and other indicated interventions in regular education in the future.

This study has several limitations and suggestions for further research. *First*, we selected preschoolers based on the teacher-perceived problem behavior. Given the focus of the intervention (i.e., improving teacher-child interactions), it may be valuable as well to select children with an initially high-conflict and non-close teacher-child relationship. Also, the results concerning effectiveness should be interpreted with caution, as we conducted qualitative analyses with small, selective samples in a practice-based research.

Second, most (student) teachers noted that the second, behavior management part of Playing-2-gether was not as innovative as the first, attachment-based part. Given these findings and the findings of the stand-alone effects of this first, intervention component (e.g., Vancraeyveldt et al., 2015), future research may focus on adapting, implementing and evaluating the attachment-based part of the intervention instead of the two-component Playing-2-gether.

Third, in this practice-based research, we involved Bachelor students Preschool education. An extensive guidance trajectory was found to be necessary to help these students in (a) adapting and implementing the Playing-2-gether intervention in the classroom, but also (b) finding their way in the classroom during their internship. In sum, working with students revealed interesting results, but it also clouded some findings concerning the implementation of Playing-2-gether in the classroom. Nevertheless, strengthening teacher-child interaction skills seems like a valuable approach for students to improve the teacher-child relationship quality with all children in their classroom (not only with children with problem behavior). Therefore, a research-based online course for students was developed (Huyse, Vancraeyveldt, Colpin, Verschueren, & Bertrands, 2015), which has been positively evaluated by the students. Moreover, some students also experience positive effects in their interaction with children during later internships (Vancraeyveldt, Huyse, Vastmans, Colpin, Verschueren, & Bertrands, 2014).

Fourth, training and guiding the implementation of Playing-2-gether throughout this project was a time-intensive process and required a lot of expertise of the researchers of UC Leuven-Limburg. For schools, it would be more cost-effective to train and coach teachers in Playing-2-gether themselves, for example under supervision of the guidance counselor or the school psychologist. At UC Leuven-Limburg we are exploring different promising options to develop a feasible coaching trajectory for the intervention.

Despite these limitations, the results of this study are valuable for researchers who intend to integrate more fundamental university research into practice-based research. The results are also an example of a strong collaboration between a university and university colleges. Moreover, the study is important for teachers and schools who are interested in the implementation of evidence-based interventions for problem behavior in their own school. Finally, this research contributes to the improvement of educational practice as it is a good example of how to implement and evaluate evidence-based interventions in a real-life school context. The results of this practice-based research, which is based on fundamental university research, may inspire more fundamental research at the university, in turn.

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**MAKE THEM LAUGH, MAKE THEM CRY;
REIMAGING THE INITIAL ASSESSMENT PROCESS OF
GCSE ENGLISH**

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ABSTRACT

The purpose of the study was to address perceived shortcomings in widely taken for granted approaches to initial assessment for students aiming to study for the General Certificate in Secondary Education in English (GCSE) in England. Of particular concern was the way in which the dominant ICT-based approach to initial assessment was not only restricting what could be measured and valued but was also serving to diminish and demotivate students whose previous experiences and achievements had led them to believe that this was a subject they had not been and could not ever be 'good at'. Another concern was that this approach to initial assessment was students' first encounter with the subject of English since their (often negative) experiences of schooling. The instrumental, decontextualized, individual and impersonal nature of this encounter in the form of the initial assessment test appeared to be operating not only to inhibit students' engagement with the subject of English but also to confirm their previous perceptions of the study of English to be irrelevant and even boring. The purpose of this paper is to explore some of the possibilities and practicalities of developing a more holistic and creative approach to initial assessment of GCSE English students.

INTRODUCTION

“All great truths begin as blasphemies”
- George Bernard Shaw (Annajanska, 1919)

The current orthodoxy would have us believe that the private companies which provide widely marketed Computer Assessment Tools (CATs) for initial assessment in the UK Further Adult and Vocational Education (FAVE) sector offer the most appropriate approach to establishing the previous achievements and the current learning needs of students of GCSE English. Further Education (FE) colleges across England and elsewhere spend thousands of pounds on computer programmes that collect data from vast numbers of students to produce readily auditable documents, which we would argue are of dubious educational value. We need to ask ourselves is this good educational practice in the initial assessment of students whose experiences and achievements in studying English may have led them to see themselves as failures and to regard the study of English as being irrelevant or even boring?

In this paper we appraise currently dominant systems of computer-based initial assessment and consider why they were seen to be sufficiently intuitively appealing to be implemented in the first place. We then propose alternative approaches to initial assessment and intervention strategies which we believe may not only be more educational but also more useful to teachers and learners alike. As educators we recognise that students are human beings who bring to our classrooms different experiences, needs and ways of learning, unique levels of ‘intelligence’ alongside distinctive personal and cultural biographies and trajectories of learning. Powell and Kusuma-Powell (2011:3) point out that it is “the most effective teachers that incorporate these factors into their instructional planning”.

LITERATURE REVIEW

Making sense of ourselves and our world is and always has been, inextricably related to our language. As Wittgenstein observes, The limits of my language mean the limits of my world (Wittgenstein, 1922).

Here Wittgenstein reminds us that the reach of our minds, the range of signs we manage to interpret, in the course of our lives is what defines the intellectual, emotional, and moral space within which we live.

Carter (2000) and Corbett (2010) point out that it is through language we can imagine other worlds and what it might be like to be other people and in this way we can begin become clearer to ourselves both in terms of what we see in others that seems familiar to us as well as that which seems unfamiliar, exotic or remote. Corbett (2010: 4) shows how language can enable us to ‘step outside the darkness of ourselves’ and that this is what makes the development of language genuinely educational.

The Education for All (EFA) Global Monitoring Report (UNESCO, 2005) draws attention to why the acquisition and development of language and literacy is regarded as being an essential human right because it is through the exercise of language and literacy that we develop a sense of agency and the ability to access our other civil rights including the right and ability to participate in a democratic society.

This is a far cry from an approach to the assessment of language acquisition and development in terms of a mechanical and instrumental encounter which the acquisition of language and literacy can be reduced to the auditing of a battery of technical skills which routinely place a crude number on learner achievement and immediately place the learner in and their learning in deficit.

The key concepts and issues in this study grew from our experiences of initial assessment practices in our own organisation which generated embryonic doubts concerning the educational value and impact of our institution's current initial assessment (IA) processes. Sixteen years before we started this study Margaret Hodge, who at the time, was chair of the House of Commons Select Committee on Education, nurtured the seeds of technical- instrumentalist views of education when she added her voice to those of her many political predecessors across the political spectrum who argued that technology can and should replace teachers:

"...we should be thinking of employing fewer teachers, not more... Over the next few years information technology will revolutionise our schools... and the use of interactive software could replace more formal lessons" (1998:10).

From a benign perspective the justifications for arriving at such a conclusion may be traced back to Skinner (1961 cited in Coffield, 2008:7), when he notes that: *"Any teacher who can be replaced by a computer, should be."* Concerns controversies and ambiguities inherent in the dominant zeitgeist regarding the unfettered use of technology in education originated in the work of Vygotsky, his associates and successors, whose research and ideologies promote and defend the indispensable role of teachers who, they argue, do what technology is unable to do in enabling learners "to operate just beyond their established capabilities and to consolidate this experience as new ability and understanding." (Mercer 2000: 141). Fielding et al (2005) and Biesta (2010) argue that education is a deeply personal, existential encounter which influences individual and collective understandings of who we think we are and what we think we are capable of now and in the future, and as such always require teachers to exercise educational judgment in complex and unfolding contexts. This is not to say that technology has no contribution to make to education. It has. It is simply to say that we need to be careful about the pedagogic purposes to which technology is put in educational contexts in order to ensure that it enhances (not replaces) good educational practice.

Coffield (2008) highlights ‘Ten principles of effective teaching and learning’. Number three is of particular interest to our study: “Recognise the importance of prior experience and learning’, the very essence of IA”. Furthermore, he goes on to discuss how effective teachers are aware that they need to take into account what learners know already, but the third principle also requires them to respond to the “Personal and cultural experiences of different groups”. Crowley (2008) suggests that:

“...if we accept the importance of prior learning and experience, then the trajectory of learning must be shaped by both the teacher and the learner; the teacher can be the source of ideas to consider, but the informed decision must be owned by the learner.”

Such interactions amount to more than just “active engagement”. Echoing the thoughts of Crowley, our research draws attention to the importance of the transition and overlap between IA and T&L. We will explore further this notion of assessing and initial learning (AIL) in our recommendations.

Coffield (2008) also asks us to consider “what practices should we as teachers be holding onto and which ones should we be abandoning?” IA is a process through which the learners’ disposition towards GCSE English are confirmed, developed, challenged or changed.

One of Piaget’s earliest breakthroughs was his realisation that the mistakes and misunderstanding of children/students provided him with an insight into misconceptions and shortcomings in thinking. This is why paying close attention to the processes of thinking and the how and why of misunderstanding is an intrinsic part of the IA process. It is our contention that this is not well served by ICT based approaches to assessment.

McNeil (2008) argues that taxonomies of human learning need to influence IA. He draws attention to the importance of attending to all three of Bloom’s (1956) domains, with a concentration on dealing with higher order verbs, such as, build, construct and value rather than solely in the lower domain of recall, as well as those in the higher levels of the affective and psychomotor domains. Johnson & Johnson (1989) draw upon the work of Deutsch (1968) for inspiration in formulating their interdependence theory on cooperative learning. It is the apparent success of this human approach that leads Slavin (1999) to suggest it is one of the greatest educational innovations of recent times. We must take note of the benefits of human interaction during the earliest stages of IA and appreciate the role of the teacher.

Let us now take stock of the critical concepts that underpin our understanding of the multidimensional relationships between IA and actual prior knowledge, and explicate the nature of IA as a formative assessment process more than just a summative judgement (Clarke, 2001).

IA comments and outcomes need to be focused on moving our students' learning forward by providing information, encouragement and diagnosis of what has been well and not so well done and with explicit guidance on what could be improved and how. Clarke (2001:2) captures the gulf between formative and summative assessment:

“If we think of our children as plants...summative assessment of the plants is the process of simply measuring them. The measurements might be interesting to compare and analyse, but, in themselves, they do not affect the growth of the plants. Formative assessment, on the other hand, is the garden equivalent of feeding and watering the plants – directly affecting their growth.”

There is merit in measuring the starting point of a student's abilities, but this alone does not provide insights into the processes which helped or hindered their previous or help to shape their future goals.

As such, formative approaches to assessment are essential to nurture the growth and wellbeing of competency in students and should be embedded in initial and continuing assessment processes.

In summary, improving our IA process calls for expansive rather than restrictive methods and assessment practices. Unwin (2007:1) discusses “the often accidental and incidental nature of learning as part of everyday human activity.” Spontaneous occurrences of learning are near impossible to replicate using a pre-programmed tool. Unwin and Fuller (2003) identify expansive characteristics in a learning environment as consisting of “mechanisms to facilitate sharing of knowledge and skills as well as boundary crossing across job lines.” Here we can see the merits of a platform of learning that is dynamic, collaborative and unpredictable in nature.

We do not want to give the impression that we are engaged in an act of idle criticism or embarked on a witch-hunt against computer assessment tools (CATs). However in the light of our experiences of the impact of these practices upon learning and teaching we strongly support Coffield (2011) when he draws attention to the value of creating friction and principled dissent in attempts to challenge taken for granted aspects of educational practice. Piaget also reminds us of the importance of challenges to complacency and the taken for granted: “I want to introduce an element of disequilibrium in the ‘continual search for a better equilibrium’ (1982: 820). To return to our opening quote at the beginning of this paper, if we want to deepen our understanding of what good IA practice in education is, then we must not be afraid to challenge what is currently widely taken-for granted.

RESEARCH METHODOLOGY

Exploration of the key questions posed was realised through:

1. Interviews with staff who conduct the computer-based initial assessments
2. Interviews with staff who deliver Functional Skills and GCSE English
3. Collating the assessment durations of randomly selected student IA results
4. Collating the IA result of students compared and corresponding FS English result
5. Analysing the instructional verb employed by questions featured in the computer assessment tool (CAT)

The first means of data collection was through interviews with four internal administration staff members responsible for the facilitation of the students' initial assessment process. Concurrently to this, we asked Functional Skills English staff to share their opinions too. Staff voice was logged anonymously using an electronic online form. In both instances, members of staff were posed the following question:

“What do you think of the college's current use of CAT and how effective do you believe these systems are?”

These were conducted on a one-to-one basis and the staff members were encouraged to be candid and write as much or as little as they deem appropriate.

In addition to staff voice, we wanted to explore the results the CAT was providing for students and staff. As such, further analysis studied IAs that had been completed by current students at the beginning of the 2013-2014 academic year. The samples used were as follows:

- **50 IA results** from students across vocations including brickwork, motor vehicle and beauty.
- **200 IA results** from students across vocations, including plumbing, carpentry, travel and tourism, electrical, beauty, ICT and motor vehicle.

These were comprised from several entire classes' IA results accessed using the CAT and were randomly selected to ensure that no one vocation was overrepresented. The sample of 50 results was studied in relation to the length of assessment. From this, a mean average time was calculated, providing the opportunity to compare the time taken by our students with the time advocated by the CAT manufacturers. The sample of 200 IA results was analysed alongside the same students' final year Functional Skills English level results to determine if the IA was producing an influential result that was influencing tutor decision in what level students are working at.

In order to explore the process the CAT used, we also studied the instructive verbs used by a random sample of 75 Entry Level 1 to Level 2 questions from the IA question bank available on the software. Analysis was conducted through categorising these verbs using the Bloom's (1956) Cognitive Taxonomy, with the intention to determine what cognitive domain level the software was challenging the student to function at.

What we planned to do

The project sought to identify and understand the limitations of the current IA practice in place in our college and determine a set of guidelines that a new IA should abide by to ensure it is of maximum benefit to students and staff. With this intervention in mind, we were reminded of Coffield et al (2004: 135) when he proposed one preliminary consideration:

“Before making any change in practice, professionals are duty bound to consider two possibilities: first, that the proposed change may make matters worse; and second, that some alternative change may be more beneficial than their preferred option.”

Rather than creating a prescribed, definitive alternative to the current IA regime it was the intention of these researchers to provide what Michael Bassey (2003) described as “fuzzy generalisations.” Alongside this, Bassey goes on to define a best estimate of trustworthiness (BET), “a professional judgement based on the experience and reading of the researcher. [...] Making a best estimate of trustworthiness demands that the researcher thinks about the empirical findings of a research project in terms of who may use it - and how useful it may be to them.” (2003: 1) It is important to note that in setting out the findings and recommendations that feature below we are not proclaiming that the approach we are trying to develop is or can be a panacea for all challenges in IA. We encourage you, the reader, to identify parallels and contrasts between your own practice and what we think we have found in ours.

Ethics

It is our intention to write as clearly and concisely as we can from a teachers' point of view. Ethical issues that have been taken into consideration are based on the British Educational Research Association (BERA) guidelines. We propose that our research contemplates and has been conducted within the ethical respect for:

1. Research population
2. Participant anonymity
3. The pursuit of rigorous research, scholarship and new knowledge
4. Democratic values
5. The protocols and moral imperatives of Educational Research and academic values
6. Academic Freedom

WHAT WE FOUND

The exploration of our key questions offer a critical appraisal of the effectiveness of the current college English IA procedures. In the context of this study we outline below positives and negatives already known about the CAT before deeper analysis began.

Positive - The current assessment is auditable, swift in its execution and easy to facilitate in large groups.

Negative - It does not measure competency in free writing or speaking and listening, two major facets of the English curriculum.

Finding 1

Assessment durations of randomly selected student IA results - The average time taken to complete initial assessment from a sample of 50 students was 11.92 minutes. A distinction can be drawn here between the mean average time we obtained and the 30 minutes per assessment the CAT developers advocate. Further analysis of individual assessment times showed that:

- 12 of the 50 students took under 5 minutes to complete the assessment
- 6 of the 50 took at least 30 minutes
- the remaining majority averaged between the 15-20 minute mark

The gulf of the difference in time taken, posits an interesting scenario, suggesting that some students were taking the assessment more seriously than others. Such disparity between the actual and recommended times taken suggest that, at least in some instances, the results garnered from such an exercise are far from accurate.

Finding 2

Analysing the instructional verb employed by questions featured in the CAT - a sample of 75 randomly selected E1-L2 English questions were analysed alongside Bloom's (1956) Cognitive Taxonomy. Of the 75 questions selected, 60 employed instructions that required students to operate at the lowest cognitive domain. Moreover, 27 of these 60 offered students a multiple choice selection of answers. The table below shows a breakdown of the verbs used.

Table 1

Bloom's cognitive domain	Frequency	Verbs used
Remembering	60	list, choose, label, name, type
Understanding	10	match, rewrite
Applying	5	produce

The swift completion of some assessments, as identified above, may be attributed to the prevalence of these lower order thinking skills. Question content sought students to 'label the verb' and 'put the following words in alphabetical order'. Whilst having some semblance of relevance in the remit of English, the merits of these questions lose their fruitfulness when considering the nature of the student audience. With the socio-economic demographic profile of the college's catchment area consisting of students who in the majority have not always had positive experiences of compulsory education, previous experiences of 'testing', negative preconceptions of themselves as learners and fears of educational failure need to be addressed and challenged in positive and educational ways by the student's first experience of GCSE English in college, not reinforced by the first approach to assessment and the first assessment instrument used to test and place yet another deficit label on the student, their lives and their achievements to date.

Whilst largely failing to stimulate students on a cognitive level, the CAT falters entirely in engaging students through Bloom's additional two taxonomic domains. The affective domain, concerned with feelings, behaviours and emotions; and the psychomotor domain, consisting of manual and physical skills, are both intrinsically linked to interaction, collaboration and discovery that can only be fully actualised through the presence of other human beings. Trends in all sectors of education in sector in England and elsewhere over recent decades have seen an inclination to adopt a more human approach to learning, a shift illustrated by the abandoning of rote and instrumental learning in favour of active learning. On the face of it, such advancements are regrettably not apparent in current IA systems. The CAT's chosen computer-based medium has led to self-imposed restrictions that compromise the core principles for assessment in exchange for an 'easier' solution which does not seem to 'solve' anything other than the need for audit.

Finding 3

Interviews with staff who deliver Functional Skills and GCSE English gave us an insight into their overwhelming distrust of CAT, with a member of staff saying "I don't believe in it". Even more worrying was that staff felt the need to adhere to the culture and practices of the IA even though they did not have confidence in the outcomes of the CATs assessment process. This need appeared to be driven by the perception that Ofsted would regard the use of the IA as 'good practice' and Internal Quality Assurance for this reason among other teams insisted upon the use of the IA across the college. Our findings suggest that such bias and unsubstantiated preferences towards CAT IA systems compromise educational values, diligence and validity in favour of a redundant box ticking exercise.

We heard sentences bandied around including "...it is quick and easy", "...you just print it out and put it in the teacher folder" and "...we make our own judgements once we know the students better".

The instrumental nature of the language used by staff suggests an open disregard for the integrity of the assessment and a concern with the commodification of the assessment process. The inconsistency means that teachers now don't know what is expected of them during the IA process. In our ideal world, we want to tell teachers that they shouldn't design themselves around the misguided perceptions of Ofsted requirements; that they should focus on what they believe to be great teaching and learning from the very point of initial assessment right through to the end of a course.

From our dialogue with the Interactive Learning department it seems thousands of pounds of money is being spent on IA because it is "...quick, easy and auditable". Coffield (2008:7) suggests "that a senior manager in each post-16 institution be asked to compare the annual cost of ICT (hardware, staff, etc) with the annual budget for staff training," as a proactive exercise in up-skilling staff rather than upgrading technology.

Finding 4

The comparison and corresponding FS English results showed disparities in 51% of a 200 randomly selected samples against the student's end of year FS achievements. Further analysis of our sample manifested different results in relation to our student's end of year achievement as follows:

- 98 student diagnosed at correct level
- 83 students misdiagnosed one levels above or below
- 19 students misdiagnosed two levels above or below

Of the 19 students that exhibited a discrepancy of 2 or more levels, one case in particular was of real interest to us. The student in question was deaf and entitled to a learning support assistant (LSA) when working on completing his Initial Assessment. The software judged him to be working at Level 2. When the academic term started and his teacher began working with the student in class it became apparent that the software had grossly over-assessed his abilities, and that he was working closer to Entry 2. It is assumed that he was guessing the answers or received considerable support from the Learning Support Assistant (LSA). Such findings fly in the face of Coffield's (2008:12) maxims of "recognising the importance of prior learning and experience" and responding to the "personal and cultural experiences of different groups." Significantly, Coffield makes the crucial point that teachers are the proponents of effective teaching and learning. He makes no mention of computer systems. The results above are so provocative because each of the sample students was assessed in class by their teacher after the IA anyway, as seen below.

Finding 5

Interviews with staff who conduct the computer-based initial assessments. Concerns previously identified by our other analyses were reiterated here, with comments including "...it's not a fully rounded assessment" and "...some students click through it and finish in 5 minutes." Contrary to what might be expected, members of staff conducting IA are not teachers but administrators. This provided us with an insight into the execution of the assessment and the environment it takes place in. Comments included:

"Students don't receive feedback after completing the assessment."

"The environment where assessments take place are not always appropriate conditions for everyone."

"The assessments are unsupervised. Some students use Google to find out the answers."

Consideration of the environment the assessment was taking place was not an area of interest to us as researchers before commencing this study, although from our analysis it is apparent that this is clearly an area of utmost importance. The use of external sources, through the internet or collusion with other candidates, rendered any assessment conclusion invalid. Furthermore, the large volumes of students completing assessments (in some instances over 100 at any one time) made the policing of student behaviour during the IA test nearly impossible.

An environment in which large numbers of students are steered into a computer suite and given a predetermined bank of computer questions seems a far cry from Crowley's (2008) call for a recognition of the importance of both the learner and teacher being engaged shaping the future trajectory of learning. In our current situation there is in fact no teacher present at all, only administrators. As English Teachers, such a scene is reminiscent of George Orwell's Nineteen Eighty-Four vision of the Ministry of Truth in which the lead character Winston Smith works, with its endless sea of computers succinctly aligned in a cold, clinical fashion.

CONCLUSION

In the light of research evidence and our findings from our small-scale study, we tentatively conclude that a summative assessment approach to IA is in need of urgent review. Our research has identified the need to treat our students as human beings and not as an instrumental means to an end (particularly whether that end is for monetary rather than educational value or simply for better test results which can privilege the needs of educational institution over those of the learner). We want to support Coffield's (2010:13) call to teachers, education leaders and managers to "challenge them [students] to appreciate the crucial difference between being good at passing tests and developing a love and understanding of their subjects".

We support Midgley's optimistic and tentative assertion that:

'The taboo on organic ways of thinking may now be lifting. It may even become possible for our species to admit that it is not some supernatural variety of Lego, but a kind of animal. This ought to make it easier to admit that we are not self-contained and self-sufficient either as a species or as individuals but live naturally in deep mutual dependence...We think as whole people, not disembodied minds, not as computers.'

(Midgley, M., 1996: 10-12)

WHAT WE RECOMMEND

In light of our findings and conclusions set out above we have developed a set of recommendations that we hope might help ourselves and others to respond to the shortcomings of current IA practice and provide some insights into how we plan to try to go about initial assessment differently in the context of our own practice.

Here we are reminded of Coffield (2008) in his closing remarks where he urges:

"If we are to improve on the status quo, then we need another vital ingredient of success: a model of change; that is, explicit theories, principles and tried and tested practices, which will enable us to achieve radical and lasting change at the different levels: the classroom, the institute and the system."

(Coffield 2008:54)

A summary of our recommendations

The IA process should not be treated as another task from the Senior Leadership Team to deal with, but becomes the central organising principle of our students' trajectory of learning.

1. Teachers and students engage as human beings and not as disembodied inputs and outputs for processing by a pre-programmed CAT (Midgely, 2006).
2. All teachers and students have the same shared values and accept a collective responsibility for IA outcomes (see Fielding, 2006).
3. Principled dissent (Shahinpoor & Matt, 2007) should not only be tolerated, it should be positively encouraged. Colleges, education institutions and most importantly our students can grow by being challenged.
4. Teachers have the intellectual and physical space in which to experiment with ideas, techniques and resources together, and to make mistakes in the constant search for improvement during the IA process.
5. Lengthening of the initial assessment process to 6 weeks - (to fall in line with institutional funding rules).

6. A smooth transition between IA and T&L (AIL Assessing Initial Learning) needs to be established and used effectively.
7. Establish a culture agreeing with Oakshott (2001:8) where he argues that education ‘is not about acquiring habits or being trained to perform tricks or functions: it is acquiring something that you can use because you understand it.’

The burden of these recommendations, however, is that the very culture and nature of IA needs to change from the overpowering desire to rely on insufficient and misdiagnosing CAT towards an empowering focus on student centred formative approaches to IA, integrated with teacher interaction, which nurture the professional competence of teachers as well improving the achievement and ensuring a comprehensive diagnosis of our students ‘starting point’ (Ofsted 2012).

As an FE institution we accept, with open arms, the young people of our communities that have lived and breathed blood, sweat and tears to ‘get through’ school. A harmful consequence of government policy and the Wolf report is that many of our students’ lives have been dominated by the preparation for, and taking of, tests; too many GCSE students now move on to FE as highly dependent learners, who expect to be spoon-fed. Coffield’s (2009:56) words resound here: “assessment is viewed as a necessary evil [...] not treated as constructive guidance about how to improve as a learner.”

If we construct our pedagogy around the flawed and inaccurate notion of CAT IA results, then the strategies adopted by our policies, colleges and teachers are ‘themselves implicated in creating and maintaining persistent patterns of differential achievement’ (Hart et al, 2004:21)

Recent developments in the job markets have seen employers complain about the fact that school leavers aren’t as skilled as they want them to be. One hypothesis to account for this is that the jobs that people need to do these days “require much higher levels of numeracy, literacy and critical thinking than the jobs that were available 50 years ago”. (Wiliam 2006:1). FE, and more specifically the English departments within our institutions, have a solution that has touted... oversold and underused technology but, as Heinz Wolff once said, the future is further away than you think. Wiliam (2006:2) sees the foreseeable future as “groups of between 20 and 40 students, with a teacher, and most of the learning is going to be in classrooms that are the size of classrooms”. He doesn’t dismiss IT of course, but the quality of the learning he believes will be “dictated by what’s going on in that classroom”. (2006:2) That is the big idea to which our small-scale research lends support—if we are serious about raising student achievement then we have to change what happens at the initial stages of learning.

THE INTERVENTION AND MODEL OF IMPROVEMENT

The forthcoming academic year (2014 - 2015) will see us implement a planned intervention to our college's IA processes. This will initially be conducted on a small-scale. We appreciate that change cannot and should not happen overnight. We are also mindful of the intuitive (but in our view, misdirected) appeal of computer based IA on the grounds of the evidence we have presented above.

It is not our intention at any point to impose the approach to IA which we are exploring on anyone in our own or any other organisation. What we do propose is to use a model of change and improvement introduced by Fielding et al (2005) in the schools sector and developed by Gregson et al (2015 forthcoming) for the FAVE sector to discover the possibilities and limitations of a different approach to IA and to make sense of what happens together, with our colleagues and with our students.

Fielding et al (2005) draw attention to the importance of exploring the potential of an innovation in microcosm. That is why we intend to take our work forward on a small scale in the first instance and then if successful use the principles of Joint Practice Development (JPD) (Fielding et al 2005, Gregson et al (2015 forthcoming) to incrementally scale up this approach to assessment and change.

Rather than viewing IA as a snapshot process, we will be conducting a four-week ongoing assessment process in the classroom with a control group of students. These classroom sessions will holistically incorporate all elements of the English curriculum and explore them using topics such as music, storytelling, communication and comedy. We hope that this platform will allow us the opportunity to appropriately induct and engage our students into English at FE level and get to know them as people. Research into how effective this strategy is, and how further revisions can be implemented will be undertaken over the first term of 2014.

We are mindful that, whilst our tentative emerging findings from this small-scale study indicate the need for and point to potentially significant opportunities for improving of our college's IA system. We are grateful for the space and encouragement we have been given by senior managers and education leaders in our college for the vision, trust and support they have given us in opening up spaces for us where we can begin to understand the issues in our practice more fully. We also appreciate the confidence and they have shown in us in encouraging us to challenge practices that we have until now taken for granted across the college and elsewhere. This has enabled us to identify how we might genuinely improve what we do in the interests of our students.

The considerable far-sightedness and on the part of the our SLT in the face of other models of education management which have more recently encouraged teachers and education leaders to be on different sides should not be underestimated. This study has also involved courage on our part of teachers and beginning practitioner-researchers in our first experiences ‘speaking truth to power’ (Coffield , 1999).

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PLAYFUL INCLUSION

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ABSTRACT

Can guided playful interaction contribute to inclusion in class? Especially in school recess, a lack of playful interaction patterns can be seen as an indicator as well as a cause of exclusion. In a practical research project, students undertook an intervention with children of two classes in primary schools, consisting of a series of guided playful interaction sequences. The play sequences were recorded and interpreted. Network data about relations within class was compiled by interviewing the children before and after the intervention. Results show that the sociograms were stable or improved over the course of the intervention. Ambiguous roles within and outside of the play frame proved to be pertinent to the intervention, leading to the following conclusion: By providing a secure frame, which is inclusive for all children, a teacher or play tutor can further the learning and habitualization of playful interaction patterns, which themselves lead to better relations in class.

INTRODUCTION

There has been a growing amount of attention towards play as a key concept in educative contexts (see e.g. Pellegrini (ed.), 2011; Hauser, 2013; Brooker et al. (eds.), 2014). Also, a medial discourse about play, especially in connection with the buzzword *gamification* (of education and society) could be observed.

But quite contrary to the perception of a play renaissance, the problem this article addresses is the lack of play, especially in school contexts (Baines & Blatchford 2011, Johnson 2014).¹⁴

¹⁴ In Switzerland, as in some other European countries, play as the central form of learning for young children has partly come into a defensive position in the education system, having to be justified against school didactics, in order to keep its position in kindergarten. In school it proves even more difficult to promote the worth of play as a key to education and as a cultural end in itself (Weisshaupt

The everyday experience of teachers in local schools differs from the discourse of play renaissance, as we learned from teachers in the local community of our institution.¹⁵ Playful interaction patterns seem to have waned in recent years, especially in school recess, where the play repertoire of children is diminished (see also Baines & Blatchford 2011). At the same time, the requirements of inclusion in schools have moved into the focus of educational politics as well as research (McLeskey 2014, Albers 2012) and inclusive peer groups in classrooms are a moral as well as a legal requirement in today's schools. However, everyday inclusion often seems hindered by the lack of inclusive interaction patterns (Campana, Weisshaupt & Scheck, 2014).

These developments and real-life experiences were the background for the intervention project "Play along!" In this project, students designed a series of playful, inclusive breaks for two classes of primary school (one 1st and one 2nd grade). During one semester, student groups attended the big break eight times. The project goals lay on three levels, which we aimed to bring together: First, the students were supposed to benefit, as methods of inclusive play tutoring should be applied and reflected in a practical setting. Second, the inclusive structures of the classes should be supported. The teachers that came forward to take part in this project obviously wanted their classes to benefit. And third, we wanted to gain answers to the following research question: Can guided play contribute to inclusion in class? There has been work concerning the usefulness of play for inclusion in heterogeneous preschool and kindergarten (see Albers, 2012), but can play prove beneficial for inclusion also in the very different setting of a primary school? This article highlights the theoretical and research framework as well as the practical course, the methods and the results of the project "Play along!"

SCHOOL CLASS, INTEGRATION AND INCLUSION

Even in early childhood, peer-groups are pertinent for developing social repertoires and common scripts, rules and habits of interaction (Vygotsky, 2012; El'konin, 2010; Göncü & Gaskins, 2011). Beginning with school, the peers in class take a central role in the life of young children. The comparatively stable group allows for the development of habits and interaction scripts which can be tried out, altered, negotiated and institutionalized among equals (Schneider-Andrich, 2011).

& Campana, 2014), despite all gamification hypes, which are in some parts rather ambiguous. Learning and playing in school have not been seen as really concurrent throughout a very long historical line (Kluge, 1999).

¹⁵ In the context of teacher training, especially for levels of education for children from preschoolers to 3rd grade of primary class, students at the School of Education – University of Applied Sciences of Northwestern Switzerland can opt for a intensive study of the subject of play and games in the seminars of the study workshop PLAY at Campus Brugg-Windisch (see also www.lernwerkstatt-spiel.ch). The seminar intervention project that this article is based on, was undertaken in this framework. In Switzerland, the preschool kindergarten is mandatory for all children from the age of four, for regularly two years before primary school.

Among their peers, children can experience the effects their own actions have on others and relate to themselves in accordance with the role expectations that others begin to form about them. For school children, some of the most important experiences are to anticipate and negotiate these expectations about oneself, to develop commonly shared chains of interrelated action patterns within a larger group (Weisshaupt, 2008), to develop personal identity and at the same time to develop a sense of community in class. These experiences in school allow, in addition to experiences in other peer communities such as sport associations, a gradual build-up of independence, which is later pertinent for adolescents freeing themselves from the socio-emotional dependence of their parents (Wahl, Weinert & Huber 2007, 133).

The school class represents, more than ever, one of the few potentially including forms of community. But organizational measures at the school cause by themselves, of course, no inclusion. The issues of belonging, recognition and inclusion arise in particular within the class and are negotiated between the children.

The school class as a socialization space does not form itself voluntarily. In it, children come together that are not already familiar with each other and they do not automatically gravitate towards community forms. In the development of relationship structures and under the regular performance pressures of school, exclusive cliques can emerge that have little or poor relations with other groups. Also, individuals can become stalled on outsider positions. Outsider positions can manifest in two different ways: Either the outsiders are simply ignored by the rest of the class, or they are actively excluded. In sociometric measurement methods, the former are distinguished by few positive responses, the latter by many negative responses.

With regard to the explanation of how outsider positions arise, one can distinguish two perspectives, which can be roughly related to the patterns of *integration* and *inclusion* respectively: The *integration* perspective emphasizes that children in outsider positions often have insufficient social skills that could help them to overcome this status. This perspective therefore centers on the inability of the individual to be integrated into the greater whole. The second perspective, referring to *inclusion*, however clarifies that a vicious circle may arise, so that "dysfunctional behavior" and negative perception of the outsiders is not necessarily the cause of isolation, but also a result of it (Wahl, Weinert & Huber 2007, 138). Experiences of social rejection can lead to uncertainty and fear of further failures. This in turn can promote avoidance of social contacts and either withdrawal or the development of aggression. Such behaviors can then reinforce the negative attitude of the peers, thereby solidifying the outsider positions.

In the inclusion perspective, the social rejection can even be seen as a cycle with no real beginning, except the general effort to distinguish between the *own* and the *other*, which is often sufficient to give rise to social discrimination. If heterogeneity is considered a cherished resource in the group, a self-reinforcing social marginalization is less likely because then mutual aid and complementarity can be seen as central values and action patterns (Campana, 2012).

Following Ainscow et al. (2006, p. 14ff.) the challenge of inclusion is to overcome social discrimination and marginalization at various levels. When seen in an inclusive perspective, interventions and support measures aim not to “integrate” the individual, but rather to focus at the level of groups or the class as a system. Interventions at the group or class level aim to increase the opportunities for positive social contacts for all persons and try to influence the overall structures and interactions instead of just the interactions of single persons.

PLAY AND RECESS AS AN OPPORTUNITY SPACE FOR NEW RECOGNITION AND INCLUSION

On first thought, it would seem relatively easy to influence group processes and peer interactions in the classroom. However, this is not always possible. Inflexible curriculum structures of the school, fixed time schedules for the class, time pressure by the syllabus and the socially transmitted pressure to perform at grades often impede work on the systemic group structures in class, despite the best intentions of individual teachers who would like to do "more".

Then again, the daily routines of schools also offer times of hiatus, times of uncontrolled social interaction, such as the school breaks. Recess can be seen as the opposite of school, the time out of time within it. It functions as a phase of freedom and transition in contrast to the highly specialized and often teacher-centered lessons. Here, children can meet, without "task", in free interaction. It enables the building of friendships and the emergence of (class) communities. These possibilities are however tied to the requirement for the children to organize themselves autonomously in recess. From the perspective of children, recess is a key element of their school day. In studies, children have emphasized the informal gathering of friends and play with others in the break (Biffi, 2011). It even seems so important that the well-being in school depends crucially on a successful design of the break. If children interact in a satisfactory way during the break and feel that they are not alone, they also show more positive attitudes toward school as a whole (Hascher, 2004).

Good interactions in the break lead to the children expressing less worry and less physical discomfort (ibid.). The break, for these reasons, should have an important function for inclusive processes.

However, the break is often the time of *exclusion*, isolation and aloneness. Especially for children in outsider positions the unguided, free break can lead to excessive demands – recess for them can become an ordeal. So the importance of playing together in the break on the one hand is realised, but on the other hand there seems to be missing a habitualization of play, a ritual knowledge of play.¹⁶

¹⁶ The reasons for this may lie in different factors. Especially the tendency of less children altogether and more only children in many societies leads to children getting more individual support, but less interaction experience in the group (apart from medial experiences), less spontaneous outdoor play, street play or play in nature. Play experience and appropriate playful scripts are therefore less shared and habitualized (Herzberg, 2001; Baines and Blatchford, 2011) Here the various kinds of reasons cannot be investigated in detail.

What is the potential advantage of experience in the game frame? When children meet in play, their "normal" class roles can be cast off and new roles are being tried. New fields of recognition are entered – recognition which might be different from the previously recognized roles in the classroom, from former bad or good performances in certain subjects, from previously (positively or negatively) perceived (dis-)abilities, from former outsider roles or from former clique affiliations. This contrasts play and game to everyday life as framework for possible change of interaction structures (Van Gennep, 1999; Turner, 2009). The variability of social interaction structures is a basic assumption of the so-called 'contact hypothesis' (Allport, 1971; Cloerkes, 1982, Kronig, Häberlin & Eckhart, 2007), claiming that more frequent contact with members of other groups helps to reduce prejudice and to develop more favorable attitudes. Not only the frequency of contact determines whether a positive change takes place, but also the contact quality and the framing conditions are crucial. Empirically, a positive effect of multiple factors has been confirmed, such as: the relative status of equality between group members, the pursuit of common goals, the realization of common tasks and the support of positive relations by representatives of the institution. Superficial, non-intense contacts, however, seem to reinforce prejudices. Contacts are especially likely to cause positive change if they are perceived by all parties as pleasant (*ibid.*). Play and games as forms of interaction therefore come into consideration as games allow children to pursue objectives together. Especially in guided play, the shyness to interact with someone of the "others", someone outside of one's own clique, can be cast off more easily within the seemingly non-serious game frame, which itself can soon inspire its own aura of solemnity (Weisshaupt & Campana 2014, 54ff.). It is indeed this ritual dimension of play, which can bring about that the old everyday roles are left behind in the game, that something new is tried and new possibilities for recognition emerge.

Play and game can be seen as forms of rites of passage in which old identities become confused and new identities arise (Van Gennep, 2005; Turner, 2009). This "liminal" experience affects all players present and ideally leads to equal status among the group members during the time of the play or the ritual.

THE PROJECT “PLAY ALONG!”

In this project, the students designed a series of playful, inclusive breaks for two classes of primary school (one 1st and one 2nd grade). During one semester, student groups attended the big break of two classes eight times. For the play sessions, the class was split into groups of four to ten children, which were deliberately composed to be heterogenous. The heterogeneity was created by grouping children that had few interaction with each other according to sociogram analysis and teacher perception, so that groups would include outsiders and members of different cliques. The teachers were encouraged to contribute their perspective on the needs of the children at all times during the project, and were involved also by the students if they needed their perspective at any time.

There was no forced play during the interventions. If children did not want to play, they could turn to other things in the break. The goal was to establish forms of play in which all children may be involved as much as possible and which promoted the cohesion of the selected group. Possible criteria for the selection of play forms were worked out in the accompanying seminar as the following:

- Action: The children should be active with their body during the break, and activate their senses. Compensation for frequent sitting in the classroom should be guaranteed.
- Intrinsic activity: All players should have the opportunity and space to act on their own initiative and in cooperation with others.
- Creative appropriation: By adapting the rules of the game by the group, a variety of play forms should be possible.
- Material: As little materials as possible, so the game can start quickly and spontaneously.
- Cooperation: The game contains elements of cooperation, so a sense of community can emerge.
- Challenge: Challenge arises through the nature of the rules and the natural, semi-natural or artificial elements of the school environment. It may be personified by a fantasy figure in the game's story, sometimes the other team, or even the play tutor.
- Rules: Simple rules should apply that can be quickly understood by everybody.
- Rituals: A ritual framing the beginning and the end can be used in order to mark the *other* kind of time – the play time – clearly.
- No formal learning goals.¹⁷

With these features, a low threshold to the game was intended that in turn was expected to lead to self-induced play action after the project. Also, we aimed to consolidate the relations that emerged during the project for the time after the intervention.

The children were guided by groups of three to four students, so at least one person was able to observe and take notes with an open protocol form, while the other students were the group's play tutors. The *passive participant observations* provided the student groups with information as to what needs the group and the individual children had, which play forms proved useful, and what kinds of further adjustments were required for the following play phases. Play tutoring is a delicate matter: on the one hand the tutor supports and sometimes leads the game, on the other hand, the game should not be controlled all the time from the outside or too directly (Hauser 2013, Heimlich 2014).

¹⁷ The game forms were not given "top-down" in detail, but designed by the students in interaction with the children. In practice, it was found that in many cases cooperative games like Robot or corresponding versions of traditional games that met most of the criteria and that could be quickly understood by all were selected, like Tag you're it-variations, rope skipping, or the Gordian Knot, where a collective effort is undertaken to solve the knot in which everybody is entangled, etc.

Methods

The project 'play along!' was designed primarily as a development project. The students however were encouraged to raise controlled data on the children and their playing processes in order to validate the process and the results (Heikkinen et al. 2012). Although the scope of the project was limited (two classes, eight interventions in about 10 weeks), the findings hopefully can provide interesting insights and also stimulate further practice and research considerations.

Children's views in sociograms

Sociograms of the classes were established at the beginning and at the end of the project by the students. The method, originated by Moreno (1974), records relationships between members of a group in a so-called sociomatrix, which can be shown graphically in sociograms, and can be compared and interpreted. Using two or more sociograms, social relations and processes, stable and changing structures within the group can be made visible methodically. These observations can also be an opportunity for teachers to revise or expand on their own observations concerning their class.

In order to create the sociograms, each child was asked some questions in a short single interview: 1) Whom from the class do you prefer as playmates, and 2) With whom don't you like to play? This was asked both before and after the intervention. The number of expected responses was not indicated, so that none, a single or many other children could be named. With the aid of a computer program ("Soziogramm-Editor 2.1"), the answers were collected and visualized in a sociogram.

This method was implemented in order to make it easier for the children to express their own views of the relationships and of the exclusive or inclusive structures and at the same time provide a systematic approach to the structure of the class.

Student observations during the game sequence

During the game sequences, interactions in the children's group were recorded by at least one observer in an open protocol form as passive participant observations. The form contained the time, the setting, activity, the description of the interactions of children (verbal and nonverbal) and any comments made by the observer.

Children assessing the games

At the end of each play phase, the children were asked how they felt during the sequence in the group. The children manifested their emotional state among other things by means of three different smileys (laughing, sad, neutral). The ratings did not have to be explained by the children in any way in order to protect them. Children's open comments and suggestions concerning the interactions that were made before, during or after the game were noted in any case by the students and implemented in the analysis and for further planning.

Case studies and group discussions with the students

In the accompanying seminar, the principles of supportive play tutoring (Renner, 2008; Heimlich, 2014) and the processes and events in the groups were discussed over the semester. In a group discussion at the end of the project, the question was addressed which settings and play forms were promoting inclusive effects best, which support measures were useful, and in which situations inclusion was difficult to improve upon.

CHILDREN'S RELATIONSHIPS BEFORE AND AFTER THE PROJECT

When creating the graphical sociograms from the sociomatrix, those children appear bright with more positive than negative responses and those dark with more negative than positive responses. The relative strength of the frame around the names reflects the accumulated positive or negative positions of individuals in responses. Thick arrows indicate a mutual choice, thin arrows a one-sided choice. In one of the two classes, no measurable improvement regarding the inclusive structure could be noted in the sociogram. The suspected reasons for this will be discussed in the subsequent sections. The sociograms for the second class (in Figure 1) show a positive development.

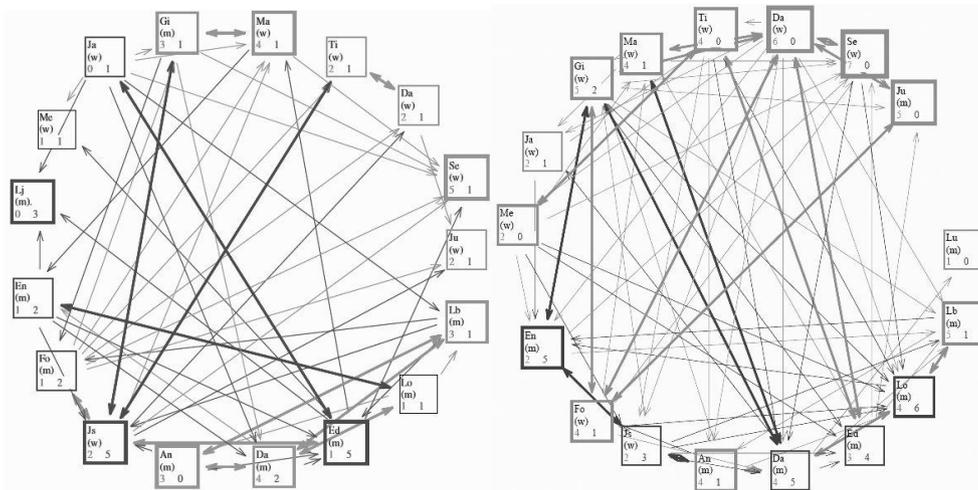


Figure 1. Sociograms of the second class before (left) and after the project (right).

In the second diagram, many more names were mentioned. Before the start of the project, 64 (positive and negative) responses were given, compared to 93 after the project. It would seem that the perception of the classmates as potential playmates could be raised in general. Also, after the intervention, there are more positive responses: The social positions have improved for 11 of 17 children, 3 remained stable and for 3, the values have changed into predominantly negative values.

Conditions promoting and impeding inclusion

Based on the observations, the assessments of children, and the sociograms, the students tried in a final group discussion to identify the factors promoting inclusion during the play sequences and also the factors that impeded inclusion.

The students concluded that the situation promoted inclusion ...

... if the play tutoring was able to create a setting where each member of the group was able to bring in their abilities.

... if there were ritual repetitions of games, interactions and known processes.

... if the play tutoring was able to stabilize the frame of the game against outside interventions.

... if it was possible to set aside old consolidated positions and class roles during play and new roles were possible.

... when socially stronger children supported others of the group.

... if all children felt that they mutually could ask for help.

... if more excluded children could play in smaller groups with others (two or three children).

The students concluded that the situation impeded inclusion ...

... if individual children, even when encouraged, could not bring themselves into play and rejected support from other children.

... if the game mechanics were too complex and were not understood by all children.

... if the play arena was too vast, not all children were within earshot, and thus the processes could not be adequately supported.

... if the play tutors knew the individual children too little and did not have enough information.

At the end of the project, children and students thanked each other and said goodbye, partially with a heavy heart.

DISCUSSION OF THE RESULTS AND LEARNING OUTCOMES OF THE PROJECT

Overall, the play interventions had a neutral to good effect in respect to the support of inclusive structures in the classes, and the children and the students both had a productive learning experience.

Two classes – two different dynamic structures

In the first of two classes, no improvement was found in the sociograms; they remained relatively stable: 4 positions improved, 5 stayed positive, 3 deteriorated. Two strongly rejected children were at least as strongly rejected in the sociograms after the intervention. They were negatively named to the same or even to an increased degree after the intervention.

Observations of the students led to the conclusion that even frictions during the play sequences can contribute to productive interaction, in the sense that the outsider positions were less ignored after the intervention, leading them to be named at all.¹⁸

The children in outsider positions had formerly built up a "prevention repertoire": When the question arose who could play with whom, they often showed a great variability of good excuses and urgent needs that prevented their participation in the games: They avoided to get into a situation of public rejection, which they had probably previously suffered. If the children, however, were simply grouped by the students in the intervention, these children in almost all cases played with pleasure and commitment. According to their teachers, these playful interaction experiences were for some of these children the only playful interactions in the break throughout the previous year, which is satisfying and saddening at the same time.

Nevertheless, it seemed that in this first class, the outsider positions were stronger fixed and more clearly differentiated in contrast to the other positions of the class.

The structure of the second class, which had a positive change during the time of the intervention according to the sociogram, was qualitatively different from the first, which could help to understand the difference in effect of the intervention.

According to our observations, a structure of several more or less exclusive small groups with few positive links between the groups prevailed before the intervention. It was not so much defined by few main outsider positions. This may be one cause for the more measurable move in the direction of inclusion in this class during the project. The two classes could thus be seen as two samples from different "populations" in the sense that the two different basic problem patterns probably require different scopes of observation and intervention. We assume that in the problem situation of few clear outsiders, further supportive measures have to take place, and also need longer to become effective. This assumption is supported by the observations of the students, since in most student groups a clearly noticeable change in the interaction climate of the children has not become apparent until the 4th or 5th of the 8 play interventions.

As the next steps in research perspective, an additional quantitative instrument and a control group might prove useful.

Ambiguous roles and learning outcomes – discussion

The central learning opportunities for the students resulted primarily from the difficult situations. For example, in one group, a boy participated who often played the clown in his "class role". For instance, he deliberately took hits in a team ball game, which endangered the game interaction for the whole group. The constraint of the "clown role" of the class, which is really only to a very limited extent pleasant for its bearer, means the opposite of real inclusion. The boy was often ridiculed by his peers. According to the observation protocol of the students, he laughed along when ridiculed, as it was the only possible way for him to be recognised by his peers.

¹⁸ It is possible to build upon irritations. On ignorance, it is not (Buchs et. al 2004).

This ambiguous role was his class role: At the border of the group, not totally ignored, but also not really inside. In the period of reflection before the next game sequence, the students decided to give the boy a positive leadership role in next play sequence, which he accepted and acted out successfully and gladly, with the others experiencing him in a new way.

Certain restricting class roles that are not consciously selected, but have consolidated in day-to-day school routines and performance pressures, offer only very limited opportunities for varied expression, for interaction, for a range of capabilities and for recognition. Examples are the clown role, the class bully, the math genius, the disabled kid, the princess, the problem child, the foreign child or generally the one from the whichever "other" group. These class roles can ideally be stripped off in the play frame and new roles and new recognition patterns can be tried.

The students' reflections, the case studies in the accompanying seminar during the interventions, and the group discussion at the end showed how particularly important it is to maintain a systemic perspective throughout: not individuals are receiving a "special treatment", but all have the opportunity to change their usual roles in the protected play framework. Thus, students avoid the risk of affirming existing exclusive structures. If the response to the observation of the clown boy seemingly laughing about himself would be:

"The boy with the clown role really is included, he obviously does not resist, he is laughing with them", then one would overlook the bitter and dear price paid by the boy for his "laughing himself into" the usual integration system.

Another example: For one girl who had very little interaction and was strongly rejected by others, a hearing impairment was diagnosed right in the middle of the intervention weeks. The students who guided this group of children reflected how this could be addressed productively. In the next play sequence, all children in the game had an "artificial" hearing impairment to create a common ground of experience for all players.

For the learning experience of the students, the crucial factors were the challenges that occurred during the intervention, the practical experiences they made, the reflection of the value of play forms and roles for inclusion.

Considering the research results, our tentative answer to the question at the start of the project is: Yes, guided play intervention can lead to positive results for the inclusive structures in class, and it does so by providing a secure frame that is inclusive for all children. Certain habitualized roles of children within class can lead to ambiguous roles within play. This can be used by school social workers, play tutors and teachers: Roles can be playfully overturned in guided play, which can lead to new experiences for children and to different perspectives towards their peers. The final goal of course would be a shared playful interaction climate in school, which would need no further guided support, in which all children could easily change the play and their roles within it.

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**HONOURS EDUCATION
EXPLORING THE FACTORS THAT INFLUENCE
EFFECTIVE HONOURS EDUCATION IN A UNIVERSITY
OF APPLIED SCIENCES**

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ABSTRACT

To date, little research has been done on the success factors of honours education in higher professional education (HBO). Honours education differs from regular Bachelor degree programmes, but it is less clear where precisely the emphasis should lie. This study seeks to gain insight into the factors that honours education must meet in order to provide students with a good education. In an empirical study conducted at Saxion University of Applied Sciences in the form of a questionnaire, we identified the factors that are important for providing a high quality of honours education. The study showed that (1) distinctiveness from the Bachelor degree programme, (2) the practical nature of the assignments, (3) the complexity of the activities, (4) high standards and (5) the quality of feedback within honours education appear to be decisive factors in the level of reflective thinking of students achieved. The quality of the selection process appears to be another key factor influencing student satisfaction.

INTRODUCTION

Honours education is becoming an increasingly important element of higher education in the Netherlands. To date, little research has been done on the specific success factors of honours education within Dutch higher education.

The introduction of honours courses offers students at many universities of applied sciences (*hogescholen*) a new perspective on education and training. However, precisely what effect it is having on the students themselves, their lecturers and their learning environment is often as yet unclear. Honours education differs from regular Bachelor degree programmes. But where exactly should the emphasis of these courses lie? This study seeks to gain insight into the criteria that honours education must meet in order to provide students with a good education. An empirical study carried out at Saxion University of Applied Sciences identified the factors that are required to achieve this.

Characteristics of honours education

This study focuses on the factors that must be in place in order to provide good honours education. The selection and operationalisation of these factors is based on their relevance for the specific educational context of this study, namely higher education in the Netherlands, in which honours education is still comparatively new. We therefore sought first to identify the factors that could potentially be of importance in this context, using a literature-based study.

Firstly, literature on the subject of honours education argues that a careful selection of honours students is a key factor determining a good standard of honours education. An evaluation of honours programmes (Van Eijl, Wolfensberger, Schreve-Brinkman & Pilot, 2007) found evidence of a negative image occasionally being associated with the selection of honours students. A selection process can have a stigmatising effect (Van Eijl, Wolfensberger, Schreve-Brinkman & Pilot, 2007). It is therefore crucial to plan such procedures carefully. Not only must the right students be selected, but all the students must be properly dealt with and given the sense that the selection process is both clear and fair. Greenberg (1987) argues that the quality of a selection process is determined by whether this procedure is honest and fair.

Fairness also implies transparency and equal treatment of the students. In our study, based on the literature we expect that the *quality of the selection process* is a decisive factor for good honours education.

Secondly, Van Eijl, Wientjes, Wolfensberger and Pilot (2005) state that honours education should be substantively different from regular Bachelor degree programmes, both in terms of the teaching methods used and in terms of their content. Maker and Nielson (1996), for example, indicate that talented students want 'open-ended' assignments, and Clark and Zubizarreta (2008) also argue that the didactic approach applied to these students should be substantively different. This study defines 'being substantively different' as *distinctive from the Bachelor degree programme* and we assume that the degree to which honours education is distinctively different from the Bachelor degree programme influences its quality. Moreover, as well as wanting different teaching methods, talented students also want a wide diversity of teaching methods (Van Eijl, Pilot & Wolfensberger, 2010).

This diversity in teaching methods motivates students to develop different learning and working strategies and ensures that honours education offers a varied programme. Moreover, in common with Van Eijl, Pilot and Wolfensberger (2010), this study assumes that *diversity in teaching methods* influences honours education. Relevant literature also assumes that the assignments given to students enrolled in honours education must be vocationally-based (Maker & Nielson, 1996). These may be either assignments derived from the world of work or assignments whose results can be directly used in work-based environments (Van Eijl, Pilot & Wolfensberger, 2010; Schutte, Weistra & Wolfensberger, 2010). This study assumes that the degree of *vocational or practical orientation in the assignments* is another factor defining good honours education. We also assume, based on relevant literature, that good honours education must embrace *complex activities* (Maker & Nielson, 1996).

Literature on the subject also shows that it is important to establish a community within honours education (e.g. Van Eijl, Pilot & Wolfensberger, 2010; Clark & Zubizarreta, 2008). The study identified *degree of community* as another characteristic of good honours education, together with *a focus on communication* within the group. Other decisive factors identified were *autonomy, the quality of feedback and high standards*.

Wolfensberger (2004) then indicates that honours students require a degree of autonomy. Other studies also emphasise the importance of freedom of choice for honours students (Wolfensberger, 2004; Wind, 2009; Schutte, Weistra & Wolfensberger, 2010; Scager, 2008; Sternberg in: Van Eijl, Pilot & Wolfensberger, 2010). This freedom of choice or autonomy should not, however, result in complete freedom. Even excellent students need structure and deadlines (Wind, 2009).

Next, literature shows that it is important for honours students to get regular feedback from their tutors (Seifert, Pascarella, Colangelo & Assouline, 2007; Van Eijl, Pilot & Wolfensberger, 2010). If students are given useful and targeted feedback both about end products and about the process itself, they can develop themselves more effectively (Van Eijl, Pilot & Wolfensberger, 2010). Although honours students often enjoy working together, according to Maker and Nielson (1996) they nevertheless like to be given individual feedback (both positive and negative). Feedback need not however by definition be given by lecturers. Peer feedback (Van Eijl, Wientjes, Wolfensberger & Pilot, 2005; Seifert, Pascarella, Colangelo & Assouline, 2007) and feedback given by people from the work-related area itself (Van Eijl, Pilot & Wolfensberger, 2010) are also considered good and meaningful forms of feedback. It is however important for lecturers to continue regularly giving feedback (Seifert, Pascarella, Colangelo & Assouline, 2007; Van Eijl, Pilot & Wolfensberger, 2010). This can have an incentivising effect, both on students and on their lecturers.

Finally, honours students also differ from regular Bachelor degree programme students in their need for a challenge (Wolfensberger, 2004). This means that lecturers must have clear criteria in mind governing what they expect of their students.

Tomlinson et al (2003) point to the importance of encouraging students to work at the next development level up. This means that they work at a slightly higher level than they are able to do independently, and are supervised, assisted and encouraged to become increasingly self-reliant. Honours students differ in this from the 'average student' in that they need a higher rate of progress, less repetition and a greater intellectual challenge (Scager, 2008). The demands that can be made of these students are therefore higher.

In sum, it can be concluded, building on the relevant literature, that the following aspects must be addressed for honours education: quality of the selection process, distinctiveness from the Bachelor degree programme, diversity in the teaching methods, practical assignments, complex activities, community, a focus on communication within the group, autonomy, high quality feedback and high standards.

RESEARCH MODEL

Good honours education is defined in this study on the basis of the profile of the Reflective Professional towards which the honours programmes (HPs) at Saxion University are designed to lead. The ability to reflect is an important skill within this process. Kember, Leung, Jones and Loke (2000) make a distinction between different levels of reflection. The constructs used in this study for measuring good honours education are derived from Kember's (2000) 'levels of reflection'. Kember et al (2000) have identified four constructs that cover reflective thinking. These comprise: habitual action, understanding, reflection and critical reflection. Habitual action is 'that which has been learnt before and through frequent use becomes an activity that is performed automatically or with little conscious thought' (p.383). Drawing on Mezirow (1991), Kember et al (2000, p.384) define understanding as thoughtful action, that 'makes use of existing knowledge, without attempting to appraise that knowledge, so learning remains within pre-existing meaning schemes and perspectives. Reflection involves 'the critique of assumptions about the content or process of problem solving. The critique of premises or presuppositions pertains to problem posing as distinct from problem solving. Problem posing involves making a taken for granted situation problematic, raising questions regarding its validity (Mezirow, 1991, p.105 as quoted by Kember, et al, 2000, p384). Finally, critical reflection involves the testing of premises. This is a profound level of reflection and Kember et al (2000) argue that it is unlikely to be observed frequently.

To explore the relationship between the characteristics of honours education and levels of reflective thinking of students we decided to measure the three highest levels of reflection: understanding, reflection and critical reflection.

Moreover, the student satisfaction with his or her honours programme is also included in this study. Level of satisfaction is an important performance indicator in higher professional education.

This study is consequently based on two output variables for defining good honours education: (1) student level of reflection and (2) the student level of satisfaction.

Based on the above, we completed the research model (fig 1, see below) for the study and the questionnaire (see below). It was assumed in doing so that if honours education satisfied these characteristics, students would think in a more reflective way and would value honours education more highly.

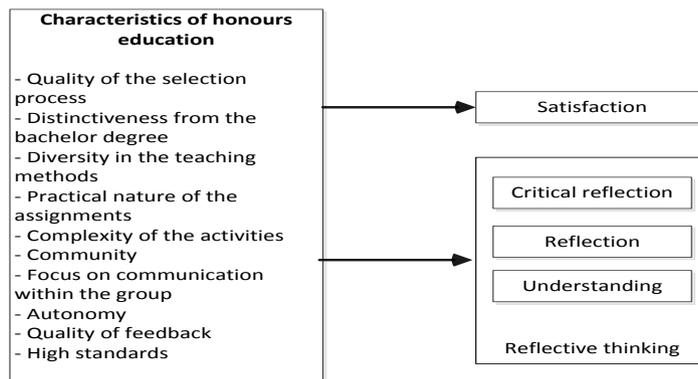


Figure 1. Relationship between the characteristics of honours education and the level of reflective thinking and satisfaction

METHOD

This study uses a questionnaire to gather information. This survey was carried out at Saxion University of Applied Sciences, and covered all honours programmes: Innovation and Business Creation, Natural Leadership, Changing Cities: People, Places and Choices, Liberal Arts & Science, Marketing & International Management: From Good to Great, Creativity in Finance & Management, Health Care & Social Work, and Teacher Leader. A total of 131 out of the 193 honours students enrolled at Saxion University of Applied Sciences took part (a response rate of 68%).

Development of instruments

The questionnaire was compiled with the help of a previous questionnaire based on two earlier surveys carried out in 2012 and 2013. The characteristics of honours education and levels of reflective thinking were operationalised through items combined with possible answers ranked on a five-point Likert scale, ranging from ‘strongly disagree’ (1) to ‘strongly agree’ (5).

An example of an item relating to the factor ‘quality of the selection process’ is: ‘*The selection process for my honours programme gave me the opportunity to prove myself*’. A factor analysis was used to help refine and make more specific the scales used in the 2012 and 2013 measurements. In order to determine the quality of the scales used in the 2014 measurement, we analysed their reliability based on Cronbach’s alpha. This showed that the scales used in this survey were reliable (alpha > .70).

Control variables

Research has shown that that gender and previous education influencing educational effectiveness. These variables were therefore included in this study as control variables. Gender and previous education were obtained from self-reports.

Analysis

We developed a cross-level model to describe the relationships between characteristics of honours education and levels of reflective thinking and satisfaction. By means of regression analyse, we subsequently gained insight into the characteristics of honours education that determine the level of reflective thinking and satisfaction.

RESULTS

Correlation analyses

We assumed a positive correlation between the characteristics of honours education, the level of reflective thinking and student satisfaction to honours education. The average scores awarded by the students to the different variables are shown in table 1. Correlations between the variables used were established as a first step in our analysis. The variables in our study do appear to correlate with each other.

Table 1.
Correlations between the characteristics of honours education, satisfaction and reflective thinking.

Dependent variables		Mean (scale 1-10)	s.d.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.
1.	Satisfaction	7.37	1.05																
Reflective thinking		Mean (scale 1-5)																	
1.	Understanding	3.78	.69	.19*															
1.	Reflection	4.12	.60	.44***	.38***														
1.	Critical reflection	3.92	.72	.48***	.24***	.55***													
Input variables																			
1.	Quality of the selection process	3.82	.78	.44***	.32***	.32***	.26***												
1.	Distinctiveness from the Bachelor degree programme	4.23	.78	.23***	.23***	.26***	.25***	.26***											
1.	Diversity of the teaching methods	3.93	.67	.37***	.09	.34***	.36***	.20*	.28***										
1.	Practical nature of the assignments	3.79	.82	.30***	.33***	.49***	.37***	.09	-.02	.31***									
1.	Community	4.16	.63	.52***	.17*	.47***	.46***	.36***	.22*	.45***	.40***								
1.	Focus on communication within the group	3.57	.82	.28***	.19*	.40*	.29***	.33***	.22*	.50***	.36***	.59***							
1.	Autonomy	3.67	.71	.10	.09	.15	.25***	.11	.18*	.23***	.22*	.16	.20*						
1.	Complexity of the activities	3.96	.60	.17	.23***	.38***	.25***	.23***	.25***	.27***	.14	.40***	.30***	.02					
1.	Quality of the feedback	4.17	.81	.39***	.17	.43***	.42***	.14	.22*	.47***	.32***	.42***	.32***	.10	.14				
1.	High standards	3.46	.61	.41***	.45***	.45***	.40***	.47***	.12	.34***	.34***	.47***	.37***	.01	.25***	.44**			
Control variables																			
1.	Gender			-.28***	-.14	-.15	-.15	-.08	-.14	-.13	-.21*	-.12	-.14	.10	.05	-.12	-.07		
1.	Previous education			-.21*	-.06	-.06	-.13	-.03	.07	-.05	-.11	-.15	.01	.05	.00	.07	-.17	.07	

** $P \leq 01$ and * $P \leq 0$

Relationship between the characteristics of honours education and levels of reflective thinking, and satisfaction

Which characteristics lead to high levels of reflection and satisfaction? Table 2 shows the relationships that are statistically significant.

Table 2.

Results of the regression analysis relationship between the characteristics of honours education – levels of reflective thinking and satisfaction

	Satisfaction	Understanding	Reflection	Critical reflection
<i>Control variables</i>				
Gender (0 = male, 1 = female)	-.30*	-.09	-.06	-.10
Previous education (0 = other, 1= basic vocational programme (vmbo), 2= senior general secondary education (havo) and 3= pre-university education (vwo))	-.11	-.00	-.03	-.06
<i>HP characteristics</i>				
Quality of the selection process	.27**	.11	.04	-.02
Distinctiveness from the Bachelor degree prog.	-.09	.21*	.15	.13
Diversity in the teaching methods	.19	-.27*	.02	-.01
Practical nature of the assignments	.07	.26**	.20**	.13
Community	.20	-.21	-.02	.20
Focus on communication within the group	-.19	.04	.07	-.05
Autonomy	-.02	.09	-.01	.09
Complexity of the activities	.10	.23*	.21*	.10
Quality of the feedback	.14	-.09	.19*	.17
High standards	.20	.47**	.08	.15
R2	.29	.33	.36	.22

** $P \leq .01$ and * $P \leq .05$, values are not standardised (β)

Level of reflective thinking: Level 1 Understanding – The first level of reflective thinking we measured was understanding. At this level, a student understands what he or she is doing, but does not refer it to other situations. The analyses show that distinctiveness from the Bachelor degree programme ($\beta = .21$, $p \leq .05$), the practical nature of the assignments ($\beta = .26$, $p \leq .01$), the complexity of the activities ($\beta = .23$, $p \leq .05$) and high standards ($\beta = .47$, $p \leq .01$) all have a significant positive effect on understanding.

This survey shows that the degree to which honours education is distinct from the Bachelor degree programme, the practical nature of the assignments in honours education, the complexity of the activities and the degree to which high standards are set for students are important for student understanding in honours education.

However, the analysis also shows that there is a significant negative effect between the diversity of teaching methods and understanding ($\beta = -.27, p \leq .05$). A high level of diversity in teaching methods therefore does not appear to have a positive effect on level 1 of reflective learning. On the contrary, the more diversity there is in teaching methods, the lower the students score on understanding. The percentage of explained variance in this model is 33%, which means that 33% of the identified differences in understanding between students can be explained by the characteristics of honours education measured in this study.

Level of reflective thinking: Level 2 Reflection - The second level of reflective thinking we measured is reflection. At this level, a student evaluates his or her own actions and looks for better ways to carry out his or her tasks. The analyses again show that work-related assignments ($\beta = .20, p \leq .01$) and complexity of the activities ($\beta = .21, p \leq .05$) have a significant positive effect on reflection. The same applies to the quality of the feedback ($\beta = .19, p \leq .05$). This study shows that the degree to which the assignments in honours education are work-related, the activities complex and the quality of the feedback good, is important for allowing students to be reflective. The percentage of explained variance in this model is 36%; hence 36% of the differences in reflection between students can be explained by the characteristics of honours education measured in this study.

Level of reflective thinking: Level 3 Critical reflection - The third (and highest) level of reflective learning that we measured is critical reflection. At this level, a student challenges assumptions and is capable of changing his/her perspective. The analyses show that none of the characteristics has a significantly positive effect on critical reflection.

Satisfaction - The regression analysis shows that there is one characteristic of honours education that has a statistically significant positive effect on students' satisfaction, and that is the quality of the selection process ($\beta = .27, p \leq .01$). In other words, the better the quality of the selection process for students in honours education, the greater the appreciation felt towards honours education. The percentage of explained variance in the model is 29%. In other words, 29% of the differences in students' satisfaction can be attributed to the characteristics of honours education measured in this study.

In summary, then, the analyses show that (1) distinctiveness from the Bachelor degree programme, (2) the practical nature of the assignments, (3) complexity of the activities, (4) high standards and (5) quality of the feedback within honours education all determine the level of reflective thinking. The quality of the selection process also influences the level of satisfaction towards honours education.

CONCLUSION

This study was carried out in response to the introduction of honours programmes in higher education in the Netherlands. The description of the structure and content of honours education in the Netherlands is still very limited and research on the subject has not fully identified the characteristics of good honours education or its envisaged effects. We are therefore justified in asking precisely what the characteristics of good honours education are. We focused on this question in the study by exploring the effect of the characteristics on honours education by means of a questionnaire. What conclusions, then, can we now draw regarding the development of honours education?

The results of the questionnaire indicate that the first level of reflective thinking (understanding) is positively influenced by the following characteristics of honours education: distinctiveness from the Bachelor degree programme, the practical nature of the assignments, complexity of the activities and high standards. The second level of reflective learning (reflection) is also positively influenced by the factors practical nature of the assignments and complexity of the activities. This level is also positively influenced by the quality of the feedback in honours education.

This implies that honours education must be substantively different from regular Bachelor degree programme. The expectation is that offering practical, work-related assignments and complex activities is an important requirement for honours education. This can include assignments based on the world of work and/or assignments whose outcomes are useable in practical situations. Students must also experience the activities as difficult and complex.

The study also shows that it is important for demands to be placed on students in honours education, and that they must be asked to meet high standards. It is also vital for them to receive good and regular feedback.

At the same time, the study concluded that there is one factor that could obstruct the student's ability to achieve understanding (level 1: reflective learning). In the interests of maintaining the level of 'understanding', the range of teaching methods in the curriculum should be limited. Moreover, the results of this study however show that the highest level of reflective thinking (critical reflection) is not influenced by any of the characteristics we have measured. Future research will need to indicate whether other characteristics of honours education might have an impact on critical reflection of students.

Finally, the study shows that there is a positive relation between the quality of the selection process and student satisfaction. In honours education, attention should be given to a careful selection process.

Reflections on the study

The purpose of our research was to gain insight into what characterises good honours education. The questionnaire we developed appeared to be reliable and yielded insights into the characteristics of good honours education. As with all research, there are some limitations to this study that need to be addressed. First of all, we relied on self-reports to gather our data. The concepts used in this study in the analyses were measured, using the reports of the same students. The issue here is not the fact that these are the perceptions of students, since it can be argued that, in this setting, students are first-hand, and therefore reliable, observers. However, the concepts were subject to internal correlation, which raises the problem of common method biases for this study. In future research, different sources for measuring concepts should be used, to reduce common method bias. For instance, for future research, it is recommended that data be collected from multiple sources, from both the lecturer and student, or more objective data be used, such as final assessments. At the time the questionnaire was given out, it was not yet sufficiently clear what criteria the students would be assessed against, so that it was also not possible to use those data in this study. Secondly, the results can be further generalised by having the questionnaire distributed at other universities of applied sciences.

At Saxion University of Applied Sciences, this was done by sending the questionnaire to students representing all the (substantially different) honours programmes. Finally, when this study was begun, empirical literature on the subject contained little information on the characteristics of good honours education in higher professional education in the Netherlands. In order to identify what makes for good honours education, we therefore examined the educational characteristics that *could* influence the quality of honours education. Other characteristics that were not examined may of course also have an influence. However, the model used and the results of this study have at least brought into sharper focus the characteristics that are necessary for good honours education.

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EXCELLENT STUDENT TEACHERS OF A DUTCH TEACHER EDUCATION INSTITUTE FOR PRIMARY EDUCATION DEVELOP THEIR ABILITY TO CREATE MATHEMATICAL PROBLEMS

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ABSTRACT

Two teacher educators at a teacher education institute for primary education in the Netherlands invited some excellent student teachers to join them in creating a website with mathematical problems for their fellow student teachers. Their 'colleagues' could then use these problems to prepare for a nationwide mathematics test. The teacher educators tried to teach the excellent student teachers how to create appropriate problems and coached them in achieving this ambitious aim. They developed a learning environment and continuously observed and evaluated the motivational and mathematical level of the student teachers to improve their learning environment if necessary. After some time the student teachers themselves participated in this cyclic reflective improvement process of their learning environment. The development of the learning environment was the object of this case study.

The student teachers who finally reached the end of the trajectory extended their mathematical knowledge for teaching considerably. A learning environment with well-balanced attention for competence, relatedness and autonomy seems valuable for the excellent student teachers to reach their aim, especially when teacher educators and student teachers work together in a continuous cyclic search for the best balance between the valuable aspects of the learning environment.

INTRODUCTION

Recent developments in teacher education in the Netherlands

At Dutch teacher education institutes for primary education student teachers have to study the subject matter knowledge and pedagogical content knowledge of all the different subjects of primary education.

To assess whether they learn enough and reach the right level to become professional teachers in all these subjects, they have to pass several assessments during their study. One of these tests is a nationwide mathematical test, introduced in 2013, in which student teachers at the end of their study have to prove that they possess enough mathematical subject matter knowledge. Pedagogical content knowledge is not addressed in this test.

Mathematical knowledge for teaching

Ball, Thames & Phelps (2008) distinguished three types of mathematical subject matter knowledge (see fig. 1). All these three types were represented in the mathematical test.

Mathematical subject matter knowledge	Description	Example from the mathematical test
Horizon Content Knowledge, HCK	HCK exceeds the mathematics of the school type the professional is teaching. It is an awareness of how mathematical topics are related over the span of mathematics included in the curriculum.	<i>Write 25 as a binary number.</i>
Specialized Content Knowledge, SCK	SCK is mathematical knowledge unique to teaching. It is professional mathematical knowledge to understand, asses and evaluate the mathematical productions of students.	<i>A primary student writes: $\frac{21}{40} \div \frac{35}{64} = \frac{3}{5} \times \frac{8}{5}$. Is this correct? Explain your answer.</i>
Common Content Knowledge, CCK	CCK is the subject-specific knowledge needed to recognize and solve mathematics problems in day-to-day-life. It is called "common" because this knowledge is not specific to teaching.	<i>In the newspaper: 'Dutch people drink 2,25 trillion litres of milk during a year. What do you think of this headline?'</i>

Figure 1. Three types of mathematical subject matter knowledge are assessed in the nationwide mathematics test.

In the mathematical test each type of mathematical knowledge is assessed at two levels, with problems given at the more basic level of reproduction and application, and at the higher level of mathematical thinking and reasoning. This higher level has to do with mathematical insight, formalizing, abstracting and generalising.

At the basic level student teachers should be able for instance to find the least common multiple of 12 and 18. At the level of mathematical thinking and reasoning they should show their ability to for instance explain why square numbers always have an odd amount of divisors.

Student teachers needed mathematical problems to practice for this test and two teacher educators from different Dutch teacher education institutes decided to create a website with appropriate mathematical problems for the three types of mathematical knowledge at the two described levels. They needed help to realise this and they invited a group of excellent student teachers to join them and to create problems. These excellent student teachers were highly motivated at the start. They wanted to learn and do more than the common curriculum and this project seemed an ideal starting point to achieve that. They were good in mathematics and felt challenged to do this task. At the start of the project these high performers were able to create reproduction and application problems, but they were not able to create problems at the higher level of mathematical thinking and reasoning (see fig. 2). This is not surprising, because this is very ambitious for student teachers. In this project the student teachers were asked to act as teacher educators in creating problems for their fellow student teachers. Assuming it would be possible to learn this, at least they would need time and support to develop this ability.

3 types of subject matter knowledge →

		Knowledge at the Mathematical Horizon	Specialized Content Knowledge	Common Content Knowledge
2 levels ↓	Reproduction and application of knowledge	+	+	+
	Mathematical thinking and reasoning	-	-	-

Figure 2. At the start of the project the student teachers could only create problems at the level of reproduction and application.

The two teacher educators involved in this project decided to create a learning environment in which these excellent student teachers could learn to create appropriate problems to practise for the nationwide mathematical test at the level of mathematical thinking and reasoning.

THEORY

The learning of excellent students

A rich learning environment is a crucial condition to reach excellent results with students (Mönks & Mason, 2000). According to Van Veen & Van der Lans (2011) excellence is the result of interaction between personal characteristics and aspects of the learning environment.

Some essential features of the learning environment are: a challenging and complex task (Scager, 2013), many and varied learning resources (Heller, Perleth & Lim, 2005), room to explore and investigate (Borasi, Fonzi, Smith, & Rose, 1999), peers challenging and supporting each other (Van Tassel-Baska, 1993; Janssen, 2012) and a teacher who can stimulate critical and creative thinking on a complex and high level (Van Tassel-Baska, 1993). The teacher must show his high expectations to the students (Scager, 2013) to stimulate them to get the best out of themselves. He should be an expert and a model for the students (Feldhusen, 2005; Subotnik & Jarvin, 2005), but on the other hand he needs to create an equal dialogue between him and his students (Swan, Holmes, Vargas, Jennings, Meier, & Rubinfeld, 2002).

Complexity, autonomy and high expectations can challenge excellent students, but these aspects can also cause feelings of uncertainty and anxiety (Scager, 2013). To achieve learning goals, the teacher should stimulate excellent students to leave their comfort zone and enter the zone of proximal development, but also support them to cope with their uncertainty. He should find the right balance between challenging and confirming the students (Bain, 2004; Hattie, 1999).

To keep excellent students actively involved in the learning process, it is essential that they remain motivated during the whole project. A complex real-life-problem can be a good start (Heller et al., 2005), but according to the ARCS model approach of Keller (2010) teachers should keep a continuous eye on the development of the attention, relevance, confidence and satisfaction of their students.

Scaffolding

Scaffolding refers to the support given by a teacher to a student when he is performing a task that he might otherwise not be able to accomplish. The teacher's support must be adapted to the student's current level of performance and should either be at the same or a slightly higher level (Van de Pol, Volman & Beishuizen, 2010). According to Stone (1993) during scaffolding the student is not a passive participant, but teacher and students are both active participants in an interpersonal process. In the beginning much support is given by the teacher (Frey & Fisher, 2010), but that support may decrease during the learning process until the student can perform the task independently (Van Geert & Steenbeek, 2005). During the fading of the support responsibility for the performance of the task is gradually transferred to the student (Pol et al., 2010). If it appears that the student cannot yet perform the task independently, the teacher can add his scaffolds again until the student is strong enough to do it on his own (Brixler, 2007). Excellent students also need enough guidance and support when it comes to a complex task and an ambitious aim (Bain, 2004).

RESEARCH QUESTION

The two teacher educators in the project defined the learning environment as a whole of aims, tasks, roles, student teachers, teacher educators, sources, meetings and appointments. They realised that it was ambitious and quite uncommon to teach excellent student teachers to create mathematical problems at the level of mathematical thinking and reasoning. To achieve this high aim it was important to develop a learning environment with a good balance between support and autonomy, instruction and room to explore. In this particular case it was not clear beforehand how they could realise that, so they decided to observe and evaluate the learning environment continuously during the whole process and change it each time if necessary. In this way the development of the learning environment became part of a cyclic and continuous process (see fig. 3). In observing the student teachers, the teacher educators focused on two aspects: the motivation of the student teachers, that is to say, their attention, relevance, confidence and satisfaction, and their mathematical development, that is to say, their ability to create mathematical problems at the level of mathematical thinking and reasoning. The teacher educators evaluated their observations, and as soon as they discovered possibilities to stimulate the motivation and/or the mathematical development of the student teachers, they improved the learning environment. They based their decisions to do this on theory and their years of experience as teacher educators.

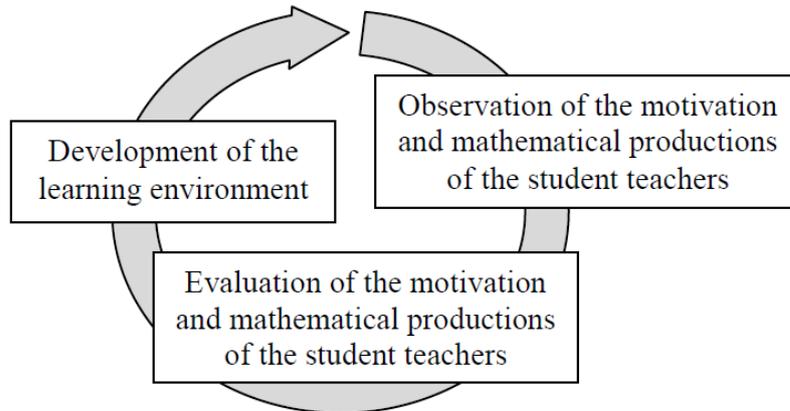


Figure 3. The learning environment was changed continuously, based on observation and evaluation of the motivational and mathematical level of the student teachers.

This continuously developing learning environment was the object of the research with the following research question:

What kind of learning environment arises after a continuous process of observation, evaluation and development, if your aim is to teach excellent student teachers to create mathematical problems at the level of mathematical thinking and reasoning?

METHOD

Several variables are involved in this research, and the research object, the experimental learning environment, is developing continuously during the project. This complex situation is the reason that the choice was made for an exploratory case study as research methodology (Yin, 2009).

The two teacher educators started the project with twelve excellent student teachers. These student teachers were good at mathematics, wanted to learn more about it, had already passed the nationwide mathematical test and were recommended by their tutors.

The collection of data about the learning environment was done using four instruments:

- observation during eight joint meetings with the student teachers;
The observation was focused on their motivation and their – growing – ability in creating mathematics problems.
- evaluation of the problems produced by the student teachers; Based on these observations and evaluations the learning environment was improved when possible.
- survey;
At the end of the project the student teachers completed a 25 item questionnaire assessed by a four-point Likert scale (1 = not at all; 4 = very much).
- group interview.

Finally the student teachers participated in a group interview that lasted one hour and was videotaped.

In the questionnaire and the group interview the student teachers were asked to evaluate aspects of the learning environment with regard to their motivation and their mathematical development during the project. What did they experience as motivating and instructive? For instance, they were asked to comment on the following statements: ‘I found it motivating and instructive that we could work with experts’; ‘... that we could discuss our productions with other student teachers’, etcetera.

The researchers analysed which aspects of the learning environment that finally resulted from the cyclic process were appreciated by the student teachers.

The story of the continuously developing learning environment was validated in a member check by the participating student teachers and this story completed with tentative conclusions was discussed in a peer review with mathematics teacher educators from other Dutch institutes.

RESULTS

Over a period of nine months, eight joint meetings of two hours each were organised. During the first meeting the student teachers were informed about the three types of mathematical subject matter knowledge and the two levels of assessing. This was not completely new for them, because they had already passed the test.

Between the meetings the student teachers worked independently in groups of two or three to create mathematical problems. In the joint meetings they presented their productions to each other, and discussed and evaluated their work. One teacher educator guided the discussion among the student teachers and also gave feedback. The teacher educators also gave advice about creating problems, they showed examples and showed how they themselves create problems.

The student teachers used the feedback they received to improve their productions. Finally the teacher educators decided if a problem was good enough to be placed on the website. Figure 4 shows an example of how student teachers improved their problems by using feedback from teacher educators.

First version of a problem:

Dice
What is the chance to throw 8 with two dice?

Final version of that problem:

Dice
Given:



During a game the players may chose if they throw a dodecahedron die with numbers from 1 to 12 or two ordinary dice. The first player who will reach 100 points in total is the winner. Eline needs 8 points to reach 100 points. She wants to win the game.

Question:
What would you advise Eline?

- a. Throw the dodecahedron die.
- b. Throw the two ordinary dice.
- c. Take what you like, it makes no difference.

Figure 4. Teacher educators gave feedback to help student teachers to improve their problems.

During the joint meetings, one teacher educator observed the learning environment and the motivation and mathematical level of the student teachers by looking at their participation in the discussion and their self-made problems, and made notes. After the meeting, the two teacher educators evaluated the motivation and mathematical growth of the student teachers and decided whether and how the learning environment should be improved.

In the next paragraphs we will present the data and provide an analysis, to explain how the data resulted in new steps in the development of the learning environment.

At the start

Observation and evaluation

At the beginning the student teachers were very motivated for their task. They felt challenged, they were actively involved in the discussion, they helped each other, and created quite a few mathematical problems.

These first mathematical problems were basic problems that could be solved by reproduction and application. None of the problems were at the level of mathematical thinking and reasoning. For instance, they presented the problem: What is the volume of a cylinder with a height of 21 cm and a diameter of 6 cm? This is a good problem to practice for the nationwide mathematics test, but it is only at the level of reproduction and application. If you know the formula, you can enter the given numbers and solve the problem in a quite standard way.

Development of the learning environment

The two teacher educators decided to focus the attention of the student teachers more on the production of mathematical problems at the level of mathematical reasoning and thinking. They chose different resources to reach this (Heller, Perleth & Lim, 2005). They showed the student teachers examples of problems at this level, pointed out collections of suitable problems to them, demonstrated how they themselves created this type of problems, and gave practical advice to create these problems. For instance they advised the student teachers to start with an existing problem and try to upgrade it to a more open problem by enriching it with more mathematical data, or – in contrast – by removing mathematical data. Figure 5 shows an example.

First version of a problem:

Amsterdam-Utrecht

Given:

Dirk drives by car from Amsterdam to Utrecht. The distance is 40 kilometres and his speed is 80 km/h.

Question:

How long will his trip last?

Final version of the problem:

Amsterdam-Utrecht

Given:

Dirk lives in Amsterdam. He has an appointment in Utrecht at 10 o'clock and he will go there by car.

Question:

At what time does he need to leave his house to arrive in Utrecht in time?

Figure 5. Teacher educators show how you can enrich a problem by removing mathematical data.

After 3 months

Observation and evaluation

The interventions by the teacher educators were not immediately successful. The student teachers tried seriously to create problems at the level of mathematical thinking and reasoning, but they failed in doing so. They even found it difficult to recognize problems at this level. They thought that the only criterion of this type of problems would be that they are hard to solve. That is why they started to create problems with long detailed confusing stories and misleading information. They used cumbersome numbers in their problems and hoped that in this way the problem would stimulate mathematical thinking and reasoning. Most of the time this was not the case (see fig. 6).

Problem made by a student teacher:

A cyclist riding a route of 136 kilometres, stops at $\frac{7}{17}$ and at $\frac{7}{16}$ part of the route. How many kilometres are there between his breaks?

Another example:

Calculate the area of this figure:

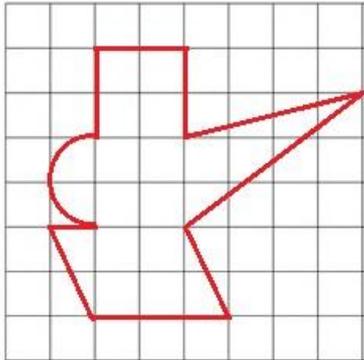


Figure 6. After three months the student teachers created problems with cumbersome numbers, long detailed confusing stories and misleading information.

The student teachers found it hard to meet the requirements, and their motivation decreased. Seven of the twelve student teachers dropped out. They said that they were too busy to continue with the project. Perhaps this was not their only reason to leave the experiment. The student teachers who stayed said that they felt uncertain. They found it frustrating that they apparently could not create problems about mathematical thinking and reasoning. They lost confidence and thought that they would never learn this.

They also said that they were frustrated by the ease with which the teacher educators created appropriate problems. They needed hours to create problems that the experts could do in a few minutes and still their work was not good enough.

Development of the learning environment

The teacher educators realised that it was urgent to deal cautiously with the remaining participants. They decided to invite the student teachers to participate in their evaluation and development of the learning environment. According to Garcia & Pintrich (1993; 1994) self-regulation of behaviour, motivation and cognition can be valuable for students because they get the opportunity to control the various resources available to them, their motivational beliefs and the choice for various cognitive strategies for learning.

The student teachers appreciated the invitation and gave a lot of information about their experiences in the project. This resulted in the following changes to the learning environment:

- The student teachers wanted to receive more frequently feedback. Two teacher educators from other institutes were invited to help in giving feedback on the work of the student teachers.

- The student teachers wanted more appreciation for their productions. The teacher educators decided to give more positive feedback and compliments for their reproduction and application problems. This was not just to please them. The positive feedback was sincere because these basic problems would also be useful on the website. In addition, the teacher educators continued to draw attention to the problems about mathematical thinking and reasoning.
- The student teachers wanted to have clear criteria of problems at the level of mathematical thinking and reasoning. The teacher educators decided to construct these in the next joint meeting.

Since the student teachers were involved in the evaluation and improvement of the learning environment the teacher educators decided to send them a report of the evaluation and new plans after each meeting. The student teachers appreciated this. After this joint meeting the teacher educators realised that the gap between the ambitious aim they wanted to reach with the student teachers and the student teachers' abilities was bigger than they thought at the beginning. They would need to give more mental and mathematical support. The creation of a list of clear criteria could be a good start. Besides that, teacher educators decided to keep their own expertise more in the background, because they had experienced that it could frustrate the student teachers.

After 5 months

Observation and evaluation

During a joint meeting the student teachers and teacher educators created a list of clear features of mathematical problems at the level of mathematical thinking and reasoning, based on many examples of problems at this level.

In general these problems:

- are (quite) open.
- provoke mathematical reasoning, for instance by asking 'Why?'
- do not always contain the necessary numbers and data. To solve these problems you need to deduce the missing information from a graph or picture, or complete the data by estimating.
- challenge student teachers to evaluate unusual or informal solution strategies, for instance solution strategies from children.
- are hard to solve with just a standard solution strategy.
- challenge student teachers to combine different strategies in solving the problems.
- challenge student teachers to look for mathematical structures (mathematical laws, rules and axioms).

We however noticed that appropriate problems did not necessarily had all these characteristics.

Based on this list and the examples, the student teachers created a few problems at the level of mathematical thinking and reasoning, for instance the problem of the Eiffel Tower (see fig. 7).



Figure 7. One of the first problems at the level of mathematical thinking and reasoning created by student teachers.

The problem in figure 7 is an interesting one because the height of the mini Eiffel Tower is not given, therefore you have to estimate this first. You can use the size of your hand as a reference. After that, you can solve the problem. This needs some mathematical thinking. Not all the created problems were at this higher level, but the quality of the productions was growing and the same happened with the confidence and motivation of the group. During the evaluation of the meeting, the student teachers said that they wanted to learn more about creating problems at the level of mathematical thinking and reasoning

Development of the learning environment

The learning environment was kept more or less the same. One of the teacher educators gave a master class in which he showed how he created mathematical problems at the level of mathematical thinking and reasoning. He wanted to inspire the student teachers and was very aware of the need not to frustrate them with too much demonstrated expertise.

The five student teachers invited two colleagues to join the group. These two newcomers were very good in mathematics and motivated for the task, but when they started in the project they struggled as much as their colleagues had in the beginning to create problems that met the requirements. The five 'expert' student teachers were eager to teach the newcomers about what they had learned during the past months. This worked very well for both groups. Boud, Cohen & Sampson (2014) claimed that students can learn a great deal by explaining their ideas to others and by participating in activities in which they can learn from their peers.

This was what happened at that moment in the project. The new student teachers learned fast and the ‘experts’ realised that they had grown during the last months. This was stimulating for their confidence and motivation.

After 7 months

Observation and evaluation

Student teachers tried hard to use what they had learned in the master class in their creation of problems. And indeed they were more successful. Finally they were able to create some mathematical problems at the level of mathematical thinking and reasoning, but it was striking that their productions only related to two parts of the mathematical subject matter knowledge and within these two parts they – inspired by the master class – only produced two specific types of problems:

1. Concerning specialized content knowledge they created problems about solution strategies of children. In these problems you have to analyse, compare and evaluate the solution strategies of the children.
2. Concerning common content knowledge they created problems on topics from daily life and newspapers. The student teachers found inspiration in newspapers and on the internet and created problems that could not be solved with standard solution strategies. You need to combine strategies and knowledge, and in many cases you need to estimate data to solve the problem.

That was a positive result, but the student teachers did not create problems involving knowledge at the mathematical horizon (see fig. 8).

3 types of subject matter knowledge →

2 levels ↓		Knowledge at the Mathematical Horizon	Specialized Content Knowledge	Common Content Knowledge
	Reproduction and application of knowledge	+	+	+
	Mathematical thinking and reasoning	-	+	+

Figure 8. Finally the student teachers could create problems at the level of mathematical thinking and reasoning for two types of mathematical knowledge.

An extra invitation by the teacher educators to do so was not effective. The student teachers said that they found it too hard to produce this kind of problem and according to them the reason was that in the regular curriculum of the teacher education institute they hardly encountered this kind of problem. They said that they were not familiar with these problems and needed more examples and more specific advice to create this specific type of problem.

Development of the learning environment

The teacher educators focused on the level of mathematical thinking and reasoning involving knowledge at the mathematical horizon. They gave some advice to create these specific problems:

- Present a solution strategy and ask why it is valid (or not).
- Present a solution strategy, mathematical rule or statement and ask if it is 'never, sometimes or always' true.
- Replace one or more numbers in a problem by letters and ask by which numbers these letters can be replaced.

Observation and evaluation

The student teachers tried to make some more problems involving knowledge at the mathematical horizon, but these were all at the level of reproduction and application.

One student teacher produced an exception:

What happens to the content of a tin of paint if you double the radius and halve the height?

In this problem you do not need to calculate the volume of a cylinder, which should be a problem at the level of reproduction and application. The formula to find the volume of a cylinder is: $\pi \times r^2 \times h$ in which r is the radius and h the height. If you enter the right numbers in the formula, you can calculate the volume. But in the given problem you do not need to calculate; you need to reflect on the formula. What happens with the volume if you enter specific numbers in this formula? This is an example at the level of mathematical thinking and reasoning. But, as was said before, this was an exception.

The final results

After nine months the student teachers had created 140 mathematics problems for the website. This site is online now and many student teachers are using it to prepare for the test. They say they appreciate the content and quality of the website. Most of the problems on the site are reproduction and application problems, but 35 problems are at the level of mathematical thinking and reasoning. These hardly involve knowledge at the mathematical horizon, but the other two types of subject matter knowledge are represented.

The data from the questionnaire and the group interview show that the student teachers are proud of what they have learned and of what they have produced.

The student teachers also evaluated aspects of the learning environment and according to them it can be instructive and motivating if excellent student teachers want to learn to create mathematical problems at a high level...

- to study and discuss examples of problems;
- to observe experts creating and improving problems;
- to produce problems yourself and receive fast and specific feedback on these productions;

- to have a list of features of problems about mathematical thinking and reasoning;
- to get advice for the creation of problems (at the level of mathematical thinking and reasoning);
- to look for inspiration for mathematical problems in newspapers and on the internet;
- to work together with fellow student teachers in small groups and in joint meetings, to be members of a learning community, to stimulate, reflect, appreciate and challenge each other's productions, to learn from each other;
- to teach fellow student teachers about what you have learned;
- to be taken seriously by the teachers. To feel responsibility for the project, to feel equal to each other;
- to have the opportunity to evaluate and improve the learning environment.

The teacher educators involved in the project confirmed that during their observations and evaluations they also saw the positive effects of these aspects.

The list of aspects of the learning environment matches the theory. Excellent students and apparently also excellent student teachers, working towards a challenging aim, need sufficient content input such as examples, advice, sources. They want to be part of a learning community, to feel responsible for the task, to determine the way in which they can reach their aim and to be taken seriously. (Van Tassel-Baska, 1993; Borasi, Fonzi, Smith, & Rose, 1999; Scager, 2013; Swan et al., 2002; Heller, Perleth & Lim, 2005; Feldhusen, 2005; Subotnik & Jarvin, 2005; Janssen, 2012;).

On the other hand they need sufficient scaffolds, like advice, modelling by experts, feedback, appreciation for their work, etcetera, to support them to perform a task that they cannot perform independently. (Bain, 2004; Van Geert & Steenbeek, 2005; Brixler, 2007; Frey & Fisher, 2010; Pol et al., 2010). This support was fading during the trajectory, but this had to be done carefully, because if students lost confidence, they lost motivation (Keller, 2010). Seven student teachers dropped out half way through. Perhaps they did not get enough scaffolds. Studying the list of criteria reveals that the aspects that were mentioned represent the three basic needs described in the self-determination theory of Deci and Ryan (2002): competence, relatedness and autonomy. It is clear that also this specific learning environment must meet these three needs.

CONCLUSIONS AND DISCUSSION

The excellent student teachers in this experiment were able to learn to create mathematical problems at the level of mathematical thinking and reasoning to a certain extent. In learning this they needed examples, knowledge, moral support, peers, teachers, discussion, feedback, room to explore and experiment, ... This all contributed to creating a learning environment based on competence, relatedness and autonomy.

In this situation it was clear that the excellent student teachers who wanted to achieve a highly complex and ambitious aim needed a rich and balanced learning environment. Teacher educators needed to be content experts, and at the same time they needed to observe, evaluate and improve the learning environment to reach the best conditions to learn. The student teachers could play an important part in this process. It seems that excellent student teachers and teacher educators, both involved in a continuous cyclic process of observing, evaluating and improving the learning environment, can create an excellent climate for mathematical and motivational growth.

It was a pity that seven student teachers left the process before the end. They said that they did so for personal reasons not connected to aspects of the learning environment, but such a large group of dropouts gives food for thought. Only a small group of student teachers remained, but these were so enthusiastic that two of them even wanted to continue in creating problems after the experiment was stopped. They joined a new group of excellent student teachers who have now to expand the number of problems. The teacher educators will use the results of this research to try to reduce the number of dropouts and to teach the student teachers to create problems at the level of mathematical thinking and reasoning for mathematical knowledge at the horizon.

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STUDENTS' BELIEFS FOR FORMATIVE ASSESSMENT IN MATHEMATICS TEACHING AND LEARNING

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ABSTRACT

This paper is about the description of the purpose and actions of a European research program (FAMT&L) about the examination of formative assessment in the teaching and learning of mathematics. The focus is on presenting our first results about students' beliefs regarding the use of formative assessment in mathematics teaching and learning. Our first results reveal factors that appear to influence the construction of students' beliefs about the purpose and the role of formative assessment.

INTRODUCTION

The National Council of Teachers of Mathematics Assessment Standard (NCTM, 1995) define assessment as “the process of gathering evidence about a student’s knowledge of, ability to use, and disposition towards mathematics and of making inferences from that evidence for a variety of purposes” (p.3). What is important, however, is that how we do this and why we do it varies tremendously (Dudley & Swaffield, 2008). Research shows that assessment must be formed for learning and not of learning, as “children have a role in assessment for this purpose since it is, after all, the children who do the learning” (Harlen, 2000, p.112). Thus, there is a need for reformation of traditional ways of assessment in education and teaching (Qassim, 2008). Our project aims at this reformation, focusing on the use of formative assessment, by providing teaching material for its effective implementation in teaching. Therefore, we try to carry out practice-based research from which schools will really benefit. Focusing at increasing the impact on educational practice, the design of this material will be based on the results of the examination of teachers’ and students’ beliefs, as the teachers’ beliefs, as reflected in their practice, influence students’ beliefs (Franke, Fennema, & Carpenter, 1997).

Furthermore, students' conceptions of assessment are very important because assessment has a significant impact on the quality of learning (Ramsden, 1997).

In fact, this contribution is about the description and discussion of the ongoing research program entitled *Formative assessment in mathematics for teaching and learning (FAMT&L)*¹⁹. The FAMT&L project proposes an innovative path that, starting from an investigation of the beliefs of the mathematics teachers (Michael – Chrysanthou, Gagatsis & Vannini, 2014) and students about formative assessment, will get to design a virtual environment (a web repository) for in-service teachers' training. This learning environment should provide a variety of tools and objects, including a guideline to be used in in-service secondary schools teachers training courses.

In this paper we mainly focus in the first part of the project, which consists of the study of the students' beliefs about the use and the role of formative assessment in the teaching and learning of mathematics. Our discussion will be based on the following research questions: (1) What are the students' beliefs for formative assessment in mathematics? (2) What are the factors influencing the students' beliefs for formative assessment in mathematics?

THEORETICAL FRAMEWORK

Definitions and Purpose of Formative Assessment

Researchers stress that assessment must be formed “for” learning and not “of” learning, as it is generally acknowledged that increased use of formative assessment (or assessment for learning) leads to higher quality learning (William, Lee, Harrison & Black, 2004). In accordance to this, Van De Walle, Karp and Bay-Williams (2013) define formative assessment as “an along the way evaluation that monitors who is learning and who is not and helps teachers to form the next lesson”. A definition accepted by the Formative Assessment for Teachers and Students (FAST) group as the most accessible to educators is the one provided by Popham (2008, p.5), who characterize formative assessment as “a process used by teachers and students during instruction that provides feedback to adjust ongoing teaching and learning to improve students' achievement of intended instructional outcomes.”

Techniques of formative assessment

Assessment practices and their outcomes on the students' learning, but also their affective domain has drawn the interest of different researchers in the last 30 years (i.e Crooks, 1988; Black & Wiliam, 1998).

¹⁹ [538971-LLP-1-2013-1-IT-COMENIUS-CMP

Cauley and McMillan (2010) provide particular techniques that should be used in teaching for the effective integration of formative assessment in instruction. Specifically, informal observations and oral questions posed to students while content is being taught or reviewed is a practice that allows ongoing formative assessment. Kyriakides and Campbell (1999) examined primary teachers' opinions about the appropriateness of particular techniques of assessment in mathematics. Performance test and structured observation were considered to be the most appropriate methods. On the other hand, unstructured observation and oral question-and-answer were seen to be the least appropriate techniques. Furthermore, Cauley and McMillan (2010) stress also the power of using the practice of providing clear learning targets to the students. They explain that formative assessment is more effective when students have a clear idea about their teachers' expectations of them, because providing clear expectations enables students to set realistic and attainable goals. Clark (2010) provides a richer list of sixteen formative assessment teaching techniques, suggesting that these techniques engage students in reflective thinking and problem solving. Among these sixteen techniques, higher order questioning techniques, feedback for students as comments and not grades, oral feedback to students, sharing assessment criteria with students, peer assessment and collaborative goal setting with and by students are included. It is obvious that the techniques suggested by Clark are also found in the previous suggestions that were discussed.

The effective use of formative assessment results

The use of feedback

Feedback is an important dimension of formative assessment, either as provided by teachers to students through questions peer-assessment practices. The power of feedback becomes evident in different definitions of formative assessment that highlight the importance of integrating feedback in instruction. According to such definitions, formative assessment refers to assessment that is specifically intended to provide feedback on performance for improving and accelerating learning (Sadler, 1998). Cauley and McMillan (2010) add to this by defining formative assessment as a process through which assessment elicited evidence of students' learning is gathered and instruction is modified in response to feedback. In the same sense, for Nicol and Macfarlane-Dick (2004) formative assessment, can generate feedback that can be used by students to enhance learning and achievement and by teachers for adjusting their teaching practices in order to correspond to their students' needs. However, Sadler (1998) raises an important issue regarding the use of feedback, turning the focus on the way the students can benefit from feedback. He actually claims that we cannot simply assume that when students are given feedback they will know what to do with it. Therefore, students should also be trained in how to interpret feedback, how to make connections between the feedback and the characteristics of the work they produce, and how they can improve their work in the future.

The formative use of mathematical errors

The use of students' errors is an important dimension of formative assessment, as it helps teachers modify their practices for helping their students correcting them, but also helps students in identifying their weaknesses and try overcoming them. Cauley and McMillan (2010) explain that by showing the students specific misunderstandings or errors that frequently occur in a content area or a skill set, and showing them how they can adjust their approach to the task, students can see what they need to do to maximize their performance. As a result, when feedback to students focuses on developing skills, understanding, and mastery, and treating mistakes as opportunities to learn, it is then particularly effective for their progress in learning and gives students hope and positive expectations for themselves. Therefore, the students' errors can have a formative use, as the teachers can exploit this information for modifying their future actions (Gagatsis & Kyriakides, 2000). Future decisions about the next learning steps follow from the formative identification of pupils' errors (Desforges, 1989). And this is particularly important, because a teaching plan which is organized in such a way, might help teachers to plan class and individual programs of work according to the different performance levels of the pupils (Gagatsis & Kyriakides, 2000).

METHODOLOGY

For the purpose of our study, a questionnaire for examining students' beliefs for formative assessment was developed. Based on our literature review, various authors' opinions and research results were transformed to statements to be included in our questionnaire. Previous relevant research instruments were also traced, parts of which were taken as examples for forming some of our statements. The questionnaire comprises of two parts. In the first part (Part A) the participants' demographics (gender, age-class and school) are asked. Part B includes 44 statements for which students had to express their agreement or disagreement on a 4-point Likert scale (1=strongly disagree, 4=strongly agree). In fact, these statements reflected not only beliefs about formative assessment, but also about particular assessment practices used by the teacher or/and the students. This structure allows not only tracing the students' beliefs for formative assessment, but also to examine the relations between particular practices and the formation of positive or negative beliefs. The 44 statements were grouped according to four dimensions of formative assessment, as defined based on the results of our literature review. In fact, in the first group there were 10 statements about the purpose (P) of formative assessment. The second group included 8 statements about the use of different formative assessment techniques (T). In the next group there are 6 statements regarding the use of the results (R) of formative assessment, emphasizing on the use of students' mathematical errors.

The last group includes 20 statements regarding the role of each stakeholder (S) in the formative assessment (students, teachers, parents). Representative examples of statements in each group are provided in the presentation of results.

The questionnaire was administered by all partner countries, after it was translated to the language of each country. However, the results presented in the next session are only about the data from the Cypriot students. The participants were 308 lower secondary school students, aged 12-15. The questionnaire was administered by their teachers for 30 minutes, during school time. For tracing the relations between the students' beliefs and the practices they or their teachers use, the implicative statistical analysis was performed using the software CHIC (Classification Hiérarchique, Implicative et Cohésitive) (Bodin, Coutourier, & Gras, 2000). The implicative statistical analysis (Gras, Régnier, Marinica & Guillet, 2013) aims at giving a statistical meaning to expressions like: "*if we observe variable A in a subject, then in general we observe variable B in the same subject*". Thus, the underlying principle of the implicative analysis is based on the quasi-implication: "*if A is true, then B is more or less true*". An implicative diagram represents graphically the network of the quasi-implicative relations among the variables of the set V.

RESULTS

The implicative diagram (Figure 1) presents the implications between particular statements of the questionnaire, either expressing a belief or a practice. These relations provide indications about the way specific factors or practices influence the construction of students' beliefs about formative assessment. The relations between the variables in the diagram allow the identification of five distinguished implicative chains. Each chain is described separately. To shed more light in these results, the percentages of the students' answers in some of the statements are also provided.

Implicative chain 1

The first implicative chain starts with a statement relating to the involvement of parents in the assessment procedure. Actually, the statement refers to the teachers' practice of inviting the parents for discussing with them, either before (S10a: *My math teacher uses to call my parents to make a discussion before my assessment*) or after the students' assessment (S10b: *My math teacher uses to call my parents to make a discussion after my assessment*).

The parents' participation in such a discussion appears to motivate students for participating also in the assessment process, by defining a check list for assessing themselves (S19: *I usually create a personal check list in order to assess myself in math*) and by making comments on their own corrected work, for defining what they have succeeded (S3: *On my corrected work in math, I make comments that tell me what I have done well.*). Also, the involvement of parents through discussing with teachers, especially before the assessment (S10a), seems to influence the use of differentiated practices from the teacher after the students' assessment (T18: *After an assessment my teacher uses to give different mathematical activities at each student, in order to help us promote our good skills in math* / T19: *After an assessment my teacher differentiates the activities that he gives us according to our interests*). Therefore, we could say that the information that teachers collect from parents before they conduct an assessment can be used as a source for helping teachers differentiate their feed-forward practices according to their students' needs and characteristics. These relations end up with a statement, according to which the students discuss and get informed about their teachers' expectations before an assessment practices (S14: *I use to discuss with my teacher his/ her own expectations before an assessment in math*). We could thus claim that when students develop and use self –assessment they realize the importance of having a clear idea about their teachers' expectations. And this probably help students set new goal and define the direction of their future efforts.

Table 1

Percentages of students' answers to the statements of the 1st implicative chain

	No answer	Never	Rarely	Sometimes	Often
My math teacher uses to call my parents to make a discussion <i>before</i> my assessment.	5,5	50,3	21,1	14,6	8,4
My math teacher uses to call my parents to make a discussion <i>after</i> my assessment.	4,2	31,5	25	25,3	14
I usually create a personal check list in order to assess myself in math.	4,2	40,3	24	17,5	14
On my corrected work in math, I make comments that tell me what I have done well.	1,3	39,9	22,4	21,8	14,6
After an assessment my teacher uses to give different mathematical activities at each student, in order to help us promote our good skills in math.	3,2	46,4	22,1	20,8	7,5
After an assessment my teacher differentiates the activities that he gives us according to our interests.	3,6	45,8	25,6	17,2	7,8
I use to discuss with my teacher his/ her own expectations before an assessment in math.	2,9	26,3	31,8	23,7	15,3

The results of the students' answers (Table 1) provide more indications about the students' practices related to assessment. First of all, almost a third of the students appear to apply self-assessment techniques sometimes or often and this is encouraging. Also, the results show that teachers should also focus more on differentiation, as almost half of the students reply that their teaches never or rarely involve differentiation in their teaching. Almost half of the students reply also that their teachers never or rarely discuss with them their expectations, although it was found as an important practice in the implicative diagram. This is also the case for teachers discussing with parents before or after the assessment.

Implicative chain 2

What occurs from the second implicative chain is that having teachers discussing their criteria and expectations with their students before an assessment (S14: *I use to discuss with my teacher his/ her own expectations before an assessment in math*) and focussing on the formative use of errors (R5: *My math teacher wants to be with me while I am correcting my mistakes*) for planning their next lesson (R4: *My teacher uses our mistakes and interests to plan the next mathematics lesson*) and for helping students with their difficulties, are factors that can help teachers verify if their students have understood their mistakes (R3: *After an assessment in math, my teacher wants to verify if I have understood the mistakes that I have made*). This knowledge is important for helping the students who fail, as teachers have the chance to adjust their next lessons according to their students' needs (T15: *For improving students who fail in mathematics, the teacher explains again a mathematical topic*).

Complementary to these results, the percentages of the students' answers (Table 2) indicate that their teachers show interest for knowing whether their students understand their mistakes and thus try to explain again the lesson. However, almost two thirds of the students say that their teachers never or rarely use their mistakes or observe them during correcting their mistakes.

Table 2

Percentages of students' answers to the statements of the 2nd implicative chain

	No answer	Never	Rarely	Sometimes	Often
After an assessment in math, my teacher wants to verify if I have understood the mistakes that I have made.	3,2	15,6	24,4	32,8	24
My teacher uses our mistakes and interests to plan the next mathematics lesson.	2,9	32,8	28,6	24	11,7
My math teacher wants to be with me while I am correcting my mistakes.	3,6	35,7	30,5	21,1	9,1
For improving students who fail in mathematics, the teacher explains again a mathematical topic.	1,3	11	19,8	33,4	34,4

Implicative chain 3

At the left part of the implicative diagram most of the assessment techniques for which the students had to define their importance are related between them, creating a separate implicative chain. In this chain two groups of techniques can be distinguished. In fact, the techniques about assessment through tests are separated from other more open and less commonly used techniques (according to our experience from the Cypriot classes). Actually, at the top of the chain the group with the less commonly used assessment techniques is situated, such as individual interviews (T9), projects (T5), presentation of different works, reports etc. (T6) and mainly group works (T11), portfolio (T3), self-assessment (T8) and peer-assessment (T7). At the bottom of the implicative chain the second group of techniques is formed from the relations between the different types of tests, which are the tests with completion tasks (T1a), tests with multiple choice tasks (T1b), tests with true – false tasks (T1c) and tests with matching tasks (T1d).

The discrimination of the aforementioned assessment techniques into two groups indicate that the students are in position and do distinguish the different assessment techniques used by their teachers, attributing a differentiated significance for each of them. This is also evident from the results in table 3, which reveal that participation in class (T4) is the most important way for assessing them in mathematics. The importance of this way of assessment occurs also for the implicative diagram, in which all the relations of the first group of techniques end at. Furthermore, the fact that using tests are at the lower part of the chain shows that the tests are more important for the students, which is also indicated by the percentages in table 3. This can be attributed to the students' assessment experiences at school, as it is well known that test is a basic and very commonly used way for students' assessment in Cyprus. On the other hand, the group of less commonly used techniques is situated at the upper parts of the chain, indicating that these techniques are slightly less important for the students (as shown also in table 3). However, the placement of these techniques at this position reveals their influence of the students' beliefs about the use of tests.

According to the students' answers (Table 3), as mentioned test is the most important assessment technique for the students. The next most important technique is the participation in class. Homework is also among the techniques students consider as important. Portfolio and individual interviews are the less important for the students. Furthermore, near half of the students find important self-assessment and peer-assessment.

Table 3

Percentages of students' answers to the statements of the 3rd implicative chain

How important do you think are the following methods of assessment in math?	No answer	1	2	3	4
Test with Completion tasks	5,5	14,3	29,5	29,9	20,8
Test with Multiple choice tasks	4,2	13,6	24,7	30,5	26,9
Test with True – False tasks	3,9	8,4	25,6	27,6	34,4
Test with Matching tasks	7,1	14	28,6	27,3	23,1
Participation in class	1,3	8,8	12,3	33,8	43,8
Portfolio	10,1	28,9	29,5	17,2	14,3
Homework	3,9	8,4	20,8	38	28,9
Project	5,8	36,4	23,4	19,8	14,6
Presentation of works, reports etc	6,2	27,3	28,6	23,7	14,3
Peer-Feedback	7,5	18,5	26,9	30,5	16,6
Self- assessment	8,4	18,8	29,2	28,2	15,3
Individual interviews	8,4	40,9	24	14,9	11,7
Group activities	10,7	18,2	24,4	26,9	19,8

Note: 4 represents the highest degree of importance

Implicative chain 4

Related to the statement about the importance of self-assessment (T8), a new implicative chain begins from the statement about the benefits of continuous feedback (P5: *When feedback is continuous I feel I have a foundation that helps me to understand what I am learning in math*). The relations in this implicative chain indicate that continuous feedback (P5) and the students' knowledge about their teachers' expectations (S16: *When it is clear to me what and how to learn in a mathematics class, I become a more motivated and engaged learner*) enhances their intrinsic motivation and fosters their understanding in maths. Continuous feedback (P5) is also linked to a positive belief about the purpose of assessment (P1: *Assessment helps me identifying my good skills in math*), which relates to the identification of the students' strong points.

These statements are also related with statements indicating that continuous feedback increases students' self-confidence (P7: *I feel more confidence about myself when I have more frequent feedback about my progress in a mathematic subject*) and increase motivation and effort (P9: *When I am not satisfied about the grades that I have received for my working in math, I have to try harder*).

Implicative chain 5

The last implicative chain includes a group of statements indicating the students' positive perspective towards understanding and not grading (S18: *It's more important for me to understand the mathematical knowledge I am taught than to get high grade*). These beliefs are related to considering assessment as a mean for detecting the students' strong points (P1: *Assessment helps me identifying my good skills in math* / T2: *importance of participation in class*). This information seems to help the students set new goals (P8: *Assessment information motivates me to set new goals in learning math*). Students appear also to be positive about the use of errors, thus they are in favour of exploiting their mistakes in a formative way (R1: *Correcting my mistakes helps me to understand better a mathematical concept*). Also, having comments from their parents (S11: *My parents make comments about my corrected tests or works in math, even if I get low or high grades*) and knowing the criteria of their assessment (S15: *I prefer to know the criteria that my teacher uses for my assessment in math*) helps the students realize that they have to increase their effort (P9: *When I am not satisfied about the grades that I have received for my working in math, I have to try harder*).

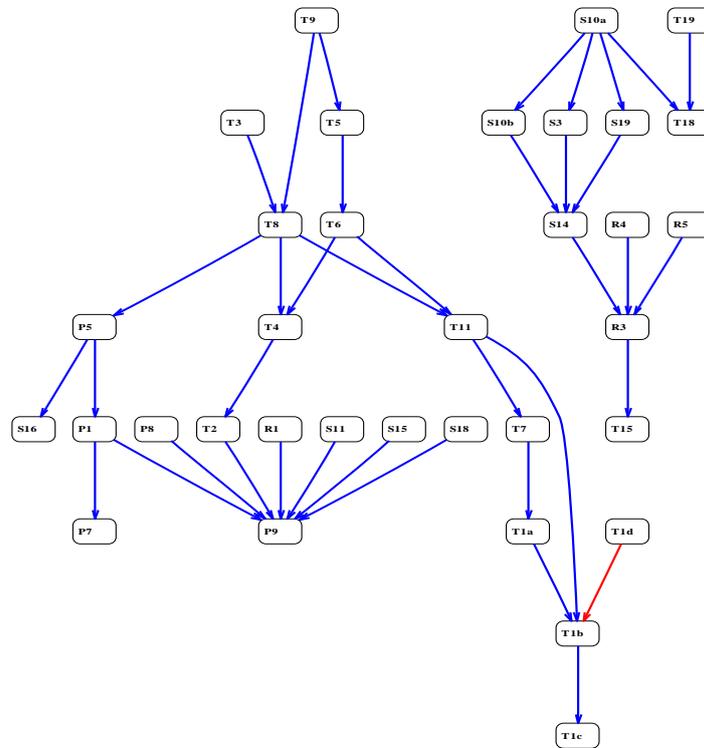


Figure 1. Implicative diagram

CONCLUSIONS – DISCUSSION

According to the implicative relations formed between the different statements of the questionnaire, several indications occur about factors that can have an important role in implementing formative assessment in the teaching and learning of mathematics. First of all, giving parents the chance to participate in their children assessment can have positive effects both on teachers and students. Actually, involving parents in assessment can benefit the students in developing self-assessment practices, but also the teachers in adopting feed-forward actions based on differentiation. Students appear to become more engaged assessors when they have their parents' comments, when they set their own assessment criteria and when they discuss about their teachers' expectations. These factors seem to help the students defining themselves as learners in a more complete way, by providing them the information for creating a more accurate self-image.

Continuous feedback has also a positive impact on the students' cognitive and affective domain, as it relates to the creation of positive beliefs about the purpose of assessment. Feedback provides students information about what they are expected to learn and how, and this knowledge seems to create them security and stability and thus to increased intrinsic motivation. This is in accordance to Nicol and Macfarlane-Dick (2004), who suggest that good feedback practice facilitates the development of self-assessment (reflection) in learning, encourages teacher and peer dialogue around learning, helps clarify what good performance is (goals, criteria, expected standards), provides opportunities to close the gap between current and desired performance, delivers high quality information to students about their learning, encourages positive motivational beliefs and self-esteem and provides information to teachers that can be used to help shape the teaching.

In relation to the above, self-assessment can also be considered as a source for feedback for students. Thus, if students develop their self-assessment abilities they will be able to provide themselves continuous feedback and benefit at a cognitive and an affective level. However, besides the focus on the positive effects of providing feedback to students, researchers emphasize also on gaining feedback from students about their learning and understanding. Actually, Hattie (2009) adds that a powerful influence of formative assessment on achievement is the meaningful feedback from students as to what they know and where they make errors or have misconceptions. Therefore, it is important to turn our attention towards gaining feedback from students and only providing them feedback.

Students express positive beliefs about assessment. They recognize the contribution of assessment in detecting their good skills and enhancing the effective use of their errors and their parents' comments for increasing their learning. As a result, students set new goals and try harder for succeeding them, especially when they are aware of the criteria by which they will be assessed. This is in line with Cauley and McMillan (2010) that explain that by showing the students specific misunderstandings or errors that frequently occur in a content area or a skill set, and showing them how they can adjust their approach to the task, students can see what they need to do to maximize their performance. Furthermore, according to the students' beliefs, teachers use the results of assessment for defining the degree at which their expectations are satisfied and according to the distance between expectations and results they take decisions about ways to help students overcome their difficulties.

The students' beliefs differentiate among the different assessment techniques. Their beliefs about the less commonly used but more open types of assessment may define their beliefs about the usual ways of assessment. We shall thus focus on the use of less "traditional" assessment techniques, and try to limit the use of tests, as it is extremely difficult to gain access to the students' solving procedure and strategies through asking them just to complete a task or just to choose an answer.

Therefore, more attention must be given on assessing students through ways that allow an interaction between teachers and students and provide more chances for understanding the students' cognitive processes, their knowledge, misconceptions and strategies. Such knowledge is powerful because students have a good understanding of what they are doing and why the teacher provides them feedback and these help them understand what they are learning, to set goals, and to self-assess (Cauley & McMillan, 2010).

In summarizing our conclusions, the following table (Table 6) includes factors that appear to be important for the effective implementation of formative assessment. The table indicates the way the students and can use these factors for improving themselves as learners or how they are benefited and how their teachers should use these factors when implementing formative assessment.

Table 6

Important factors for implementing formative assessment

STUDENTS	TEACHERS
Exploitation of parents' comments	
Use as a feedback source	<ul style="list-style-type: none"> • For organizing feed-forward actions • Differentiation
Expectations / assessment criteria	
Getting aware of teachers' expectations / criteria for <ul style="list-style-type: none"> • defining their own criteria • defining better self-image 	<ul style="list-style-type: none"> • Make their expectations explicit • Discuss the assessment criteria they set with students
Self-assessment	
Self-assessment as feedback source	Develop students' self-assessment skills
Formative use of errors	
Increase understanding of mathematical concepts.	For adjusting next lessons based on students' needs
Techniques of assessment	
Focus on participation in class	Use of assessment techniques allowing active interaction with students.

These factors seem to influence the teachers' practices and the students' cognitive and affective domain. Therefore, practices appearing to influence positively the students' beliefs for formative assessment should be enhanced and will be used for designing the teachers' training model for implementing effectively formative assessment practices. Thereafter, gaining access to the students, but also the teachers' beliefs will give us the opportunity to design relevant teaching material, based on their needs, in order to have the chance to achieve a change in classroom practices towards the effective implementation of formative assessment. And this is important, as teachers have a remarkable influence on students' construction of their beliefs through the ways in which they present the subject matter, the kinds of task they set, assessment methods, procedures and criteria (Pehkonen, 1998). Thus, the development of our training model and web-repository will enhance the teachers' professional development.

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SWiSE – RESEARCH AND DEVELOPMENT IN PRACTICE

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ABSTRACT

SWiSE intends to qualitatively further develop science and technology education in 61 Swiss obligatory schools (i.e. kindergarten to 9th grade). The most basic aim is to increase students' interest and joy in science. SWiSE aims to offer children and young people an age-appropriate access to science and technology, reflect and further develop science and technology education, exchange the experience with other schools and build networks, explore and implement new paths in competency-based education and develop teaching and learning materials. SWiSE approaches this in a combination of school development and teacher professionalization in relation to improved teaching and student commitment (Maheshwari, Sharma, & Chatterjee, 2011). Usually there are two SWiSE teachers per school and one aim is to foster first between-SWiSE-teacher collaboration, then within-school co-operation and last between-school co-operation. Some SWiSE teachers receive personal coaching from experts in the field of science didactics (SWiSE coaches). The project is evaluated in a three-year quasi-experimental panel study with two control groups. Besides project-related interests, the SWiSE evaluation also allows to ask empirical educational research questions. In a broad selection of further education – e.g. learning modules, innovation days/ conferences, practice and network meetings – teachers and schools are supposed to learn from and with each other.

OVERVIEW

SWiSE - Swiss Science Education has been a joint initiative of eleven Swiss-German educational institutions since 2009: The Schools of Teacher Education PH Bern, PH FHNW, PH St. Gallen, PH Thurgau, PH Central Switzerland and PH Zurich, the Institute Unterstrass of the PH Zurich, the Swiss Science Center Technorama, and the two training bodies PZ.BS Basel-Stadt and Baselland FEBL. SWiSE aims to develop interest in science and technology of 4- to 16-year-old students. Teachers are supported to reflect on the scientific and technical education and develop a competency-based education, to exchange the experience with other schools, and to develop networks.

SWiSE represents a unique collaboration between the different regions. In Switzerland, educational policy is regulated by canton and thus, the diversity of the educational systems is tremendous and challenging. SWiSE brings together experts from different educational institutions, research centers, ministries, and school practice. They share their knowledge and expertise vice versa in order to effectively initiate innovative practice implementation.

SWiSE supports school teachers to realize their individual continuing development in focusing on science and technology. The 61 SWiSE- schools (20 kindergarten / primary, 38 secondary, and 3 comprehensive schools) are distributed over six autonomous regions. In three school years (2012 to 2015), two so-called SWiSE-teachers per school engage in science and technology education and receive a compensation, financed from cantonal funds and contributions from foundations. Initially, teachers decide about their continuing development regarding their own teaching and the school's possibilities in science and technology education. Along with their school administration, they analyze needs and define individual goals in the areas of inquiry based learning, competence orientation, and education for sustainable development. During the project, SWiSE teachers visit training modules and participate in practice meetings and other SWiSE events, as for example the annual conference.

SWiSE schools and teachers are accompanied and supported by coaches, i.e. science didactic specialists in school development and education policy, who also cooperate regionally in order to coach according to regional/ cantonal educational standards. Schools and teachers also network with training institutions, other schools, and teachers from all areas of German-speaking Switzerland. Together they face the challenges of everyday teaching and the education policy changes in the Swiss educational system (see www.edk.ch/dyn/11659.php). They start to implement the new Swiss German-speaking curriculum (Lehrplan 21) and evaluate the initial experience with competence orientated teaching and assessment.

USE-INSPIRED EMPIRICAL EDUCATIONAL RESEARCH

SWiSE was inspired by the idea of similar projects in Germany (e.g. SINUS, project to improve science and mathematics teaching) and Austria (e.g. IMST, Innovations in Mathematics and Science Education). These projects established model schools with at least two teachers per school involved in the project, regional and national continuing education offers, network meetings, and a scientific evaluation. Yet, in Switzerland interdisciplinary science education at school is far more common than in the neighboring countries Germany and Austria. Therefore SWiSE addresses the needs of interdisciplinary educated in-service science teachers. From this practical perspective SWiSE wants to initiate innovation in schools via a direct mediation of research and practice in the personification of SWiSE coaches. Coaches are former teachers now working in empirical educational research. These natural science teaching professionals ensure the link to educational trends and research. On a higher level representatives of the cantonal education departments (ministries) bring in the current educational standards and policies. These, in turn, will receive valuable insight and feedback from school practice.

From a research perspective Ostermeier, Prenzel, & Duit (2010) for example showed that SINUS teachers significantly gain professional competencies and improve their classroom instruction.

In our approach we additionally incorporate the idea that attitudes play a vital role in training evaluation and rely on Kirkpatrick & Kirkpatrick (2006) that suggest successful evaluation should include four aspects: (1) participants' satisfaction and their intention to continue in the program; (2) participants' change in attitudes, improved knowledge, and/or increased skill as a result of the program. (p.22); (3) and (4) include behavioral change and the benefit of teaching as a result of attending a program.

On student level, as teachers are supported to implement inquiry-based learning, students may profit in their interest, active knowledge construction and science competence development (e.g. Höttecke, 2010).

We will address these aspects later again in the section on the evaluation of the project.

Need-orientation in SWiSE

On the one hand one could implement standards in science education that students develop conceptual and procedural knowledge (e.g. Bybee, 1997, 2002). Critics highlight the processes of student learning and their deep understanding of science (HarmoS, 2008; Shamos, 2002). On the other hand school improvement does not necessarily mean to implement standards or to adjust outcome measures in school research. School improvement can be seen as a teacher focussed professional development investment (Katzenmeyer & Moller, 1996).

Many have done research on teacher professionalization and Smith & Sela (2005) conclude that pre-service teacher education provides the framework for in-service professional development. Yet, in Switzerland, science teachers from kindergarten to lower-secondary level receive an integrated university education. Often initial teacher education also lacks practical experience in inquiry-based teaching methodology (Krämer, Nessler, & Schlüter, 2012). But how can one achieve in-service professional development based on an integrated science teacher education - including not only novice but also experienced teachers? With reference to andragogic ideas one also has to consider adults as need-driven developers: They usually prefer continuing education that helps solve current issues in their job. In the realm of constructivist teaching and the advantages of inquiry-based learning environments, one need is the feasibility to implement these methods and develop competencies accordingly. Thus, SWiSE offers its teachers a variety of need-based opportunities and ideas to get the development going. A major focus is to spread the idea of cooperation, sharing ideas within and between schools. Thus, SWiSE implemented regional meetings where SWiSE teachers from one region, but different schools get together and the host teachers present their idea on how to deal with a particular topic in class, and all participants develop on this collaboratively. The annual SWiSE conference comprises a national event. There, teachers from all regions present successful projects or offer workshops similar to those in the regional meetings. The evaluation results suggest that teachers rate this conference very useful, but, what is more, they perceive it as part of their continuing education in their developmental process. A second opportunity for need-driven development is the coaching, where teachers may draw upon an experts view or suggestions right on demand. As coaches combine methodological and content knowledge, we believe teachers can profit the most and according to their highly individual needs. Finally, from practical experience we found teachers in former projects feeling like the lone warrior in developing their lessons. This experience, to us, indicates that some higher-order identification with the project and its participants is necessary latently. In our full three-year project we hope the label SWiSE may lead to a sustainable intention for self-regulated and cooperative development, as it has been coined by SWiSE.

The Networking Concept

In general, SWiSE itself comprises a macro-network that is supposed to foster micro-networks. As a meta-network we define the cooperation of 11 institutions; mainly universities of education, but also public institutions and the Swiss Science Center Technorama, an out-of-school hands-on learning location. Each institution sends representatives to the various SWiSE-boards which hold particular authorities. They are cascaded top-down from strategic to practical, but informed bottom-up in order to ensure the practicability of decisions. The top advisory board high rank representatives decide on strategic and pecuniary issues.

Below the advisory board one can find two major strands of committees, the conceptual strand and the school-oriented strand. The conceptual strand includes the SWiSE conference planning group and the coordination group, which is formed by academics in practical teacher education. They advise supervisors that teach continuing education seminars. The school-oriented strand includes the evaluation group that discusses and supervises the scientific evaluation of the project and the operative group that organizes and supervises regional sub-groups, e.g. in Basel, Bern or central Switzerland. Each regional group advises its SWiSE coaches which themselves are in close correspondence with SWiSE schools and teachers.

Micro-networks in our sense is the networking activity of schools and teachers. In each school SWiSE teachers are supposed to initiate collaboration and innovation. They may then share their ideas regionally in self-organized regional meetings or even nationally in presentation at the SWiSE conference. Results of the quantitative evaluation show that SWiSE teachers significantly improve in their in-school collaboration and report that this has a disburdening effect. SWiSE teachers also evaluate coaching as extraordinarily useful and they meet their coach 2 half days on average per school year. Regional meetings seem to be extremely productive as well. Supra-regional meetings are rather or absolutely useful. Visits to other SWiSE schools are evaluated as profitable as well. From this practical view one could assume that cooperation in the meta-network works well within each group or board. (Note: Details on these statements can be found in the evaluation section below.)

SYNERGIES OF RESEARCH AND PRACTICE

In advance SWiSE had been initiated in a close research-practice interaction. For example the Technorama (see *The Networking Concept*) offered free entrance to SWiSE teachers and their classes. Also cantonal education departments supported the project. Finally, pleasant news was that one school's participation has been funded by a local enterprise, because the project's financial limitations were reached. In these joint initiative forces the national, cantonal, and public relevance seem to be evident.

Upon the initiation of SWiSE we find three different types of persons that interact with each other to establish a strong link between research and school praxis. There are the researchers, people educated in educational psychology and empirical educational research. They work together with professionals in teaching (e.g. former teachers/ practitioners) at university level, more academically educated practitioners. In this collaboration the result brought about fruitful and participant-oriented discussions and decisions on a conceptual level. Additionally, they share and implement their ideas into the micro-network (see 3.), where they offer a certificate of advanced studies, anchor regional meetings or hold seminars for teachers.

As a result scientific and practical knowledge cannot be disentangled anymore and in this triangulation. SWiSE thus forms a collaborative notion of development that diffuses top down bottom up through all instances and finally reaches the third type of person, the practitioner, the teacher. This diffusion is achieved by means of SWiSE coaches who are the above mentioned professionals. In this helical cascade there is continuous mutual development at each level in the project with a very close link to actual praxis at schools and in classes.

A supplementary person and central mediator is the operative project manager, who serves as a ubiquitous contact person. She usually attends every meeting on both macro and micro level, brings in current project issues or news and gathers demands whenever some are expressed. Therefore she leverages the potential of the top down bottom up transfer processes and contributes to the shared knowledge development of research and practice.

PRODUCTS AND OUTPUTS IN SWiSE

SWiSE offers a continuous website (www.swise.ch) where anybody interested can find information about SWiSE aims as well as upcoming events and prospective further education modules. Furthermore SWiSE teachers are offered a web platform called educanet. There the teachers may share ideas and/ or documents they developed online.

By participating the project, schools include the aims of SWiSE in their school profiles and define precise development steps. Accordingly ,they reformulate the school's guiding principles and establish an appropriate school culture. During the three years of the project, they develop different teaching materials and school projects, coached by the experts of didactics. A selection of teaching materials developed during the project will be published in a book.

From a practical point of view, SWiSE teachers can initiate and invite to regional or interregional meetings where they present their own school project or idea of inquiry-oriented teaching. Participants gain insights into teaching methods, team collaboration, school organisation and infrastructure of that specific school. Additionally, they exchange experiences and teaching materials. These meetings are open for teachers and school management participating the project but also external schools.

The products of the teaching and school development achieved during the three years of the project, such as teaching materials and school projects, are presented on different public conferences, meetings, exhibitions and in further education modules. SWiSE also offers a certificate of advanced studies (CAS) and includes there the experiences of the SWiSE schools and teachers. The schools of Teacher Education, partners of SWiSE, integrate the findings of the SWiSE schools in other research and school development programmes.

Besides these teacher-centered products we also share the idea of SWiSE in a variety of publications, both practical magazines as well as scientific journals. Within four years we placed about twenty articles in regional and national school magazines, presented the project in a short video, had two peer-reviewed book chapters and held about 30 presentations in Switzerland, Germany, Latvia, Cyprus, and the USA. Two doctoral students also write their PhD theses on specific aspects in the project. As SWiSE is mainly financed by three foundations (Stiftung Mercator Schweiz, Avina Stiftung, Ernst Göhner Stiftung) another output are newsletter articles and notes in their own publications.

SUSTAINABILITY OF SWiSE

Sustainability in a narrow professional sense: SWiSE wants teachers to establish innovation and cooperation and the explicit goal is sustainability itself after the project's end. Due to the current success and financial parsimony SWiSE will be continued on a self-financing basis beyond the official end in summer 2015. Then all cooperations and networks will be continued upon teachers'/ school's interest. As we find most of our project teachers identifying with the label "SWiSE" we assume sustainable development after the end of the organised project.

Sustainability in a narrow practical sense: Every SWiSE school has initiated individual projects and still produce a variety of sustainable outcomes, e.g. teachers built up a new science classroom, elaborated on experiments for students, introduced new ways of teaching or produced a broad spectrum of new or revised teaching materials. As teachers chose their projects autonomously and they were integrated and linked with already existing structures and processes we assume that teachers and school management use their products in a more sustainable manner than in projects that predetermine the outcome.

Sustainability in an interactive sense: In the horizontal interaction between SWiSE offers for example teachers may implement knowledge from the CAS into their own school and transfer their knowledge to other MINT (mathematics, informatics, natural sciences, and technics) projects running simultaneously or in the future. In a vertical interaction between researchers or coaches respectively and teachers, personal identification may foster future collaboration in MINT projects.

Sustainability in a broader sense: SWiSE could model future school development projects in Switzerland regionally in cantonal education departments or nationally in the Swiss Conference of Cantonal Ministers of Education (EDK). These projects may want to mimic the strong praxis-research interaction in order to implement innovation in other subjects. Especially the individualized coaching could be interesting in further projects as well as the in depth scientific evaluation.

Sustainability in a visionary sense: If one sees professionalised teachers as a product of SWiSE, we reckon that they invest the professionalism in their teaching and fruitfully reach their students at their interest and motivation in science learning and exploration. Therefore we hope for a social sustainability in Switzerland as a location for knowledge and research.

EVALUATION

According to Ostermeier, Prenzel, & Duit's (2010) results in SINUS teachers can gain professional competencies and well improve their classroom instruction in developmental projects.

In SWiSE we also evaluate with reference to Kirkpatrick & Kirkpatrick (2006). They belief participants' attitudes toward the project form an incremental part of a project evaluation. Four aspects should therefore be taken into account: (1) satisfaction and intention to continue in the program; (2) change in attitudes, improved knowledge, and/or increased skill as a result of the program. (p.22); (3) and (4) address behavioral change and the benefit of teaching as a result of attending a program.

Höttecke (2010) also points out that, as a result of teacher change, students may be more interested or motivated in learning.

According to the aforementioned, in the evaluation we ask a) whether there can be a "SWiSE effect" down to students, b) how SWiSE teachers develop in comparison to their colleagues, and c) how SWiSE teachers assess the utility of the coaching.

Methods

General evaluation design, method and measurement procedure

SWiSE is evaluated in a double controlled multi-level panel design (table 1). In the experimental group, 118 teachers receive SWiSE offers as is explained below. Control group one, i.e. colleague teachers (n=24) in SWiSE schools, is used to follow indirect SWiSE effects on colleagues. Control group two (n=20), off SWiSE's reach, follow their usual practice. The evaluation started in November 2012 and will end in summer 2015. Teacher assessments follow a beginning of school year (pre) – end of school year (post1) – end of school year (post2) – end of school year (post3) rhythm (see table 1). Here we report results from the pre-post1-post2 assessment.

Table 1

SWiSE evaluation design

Level	Group	November 2012		May 2013		May 2014		May 2015		N
		Pre		Post 1		Post 2		Post 3		
School	IG + AG & CG	Δ		Δ		Δ		Δ		60 + 15
Teachers	IG	□	x	□	x	□	x	□	x	118
	AG + CG	□	η	□	η	□	η	□	η	24 + 20
Students	IG	○	d	○	d	○	d	○	d	2300
	AG + CG	○	δ	○	δ	○	δ	○	δ	480 + 360

IG: Intervention group, AG: Affected group, CG: Controlgroup
 x: SWiSE intervention on teacher level, η: indirect effect of intervention
 d: effect of teacher level on student level, δ: indirect effect of affected teacher level on student level

Teacher sample and variables

Chi-square tests do not show any significant group dependencies between SWiSE teachers and control teachers as regards their gender (Fisher’s Exact; $p=.592$), the grade they teach (kindergarten/ grammar school; primary school, lower-secondary school; $X^2(2)=.331$; $p=.848$), and the teaching experience ($X^2(35)=31.623$; $p=.632$; range=[1;39] years; AM=15.73 years; SD=10.19 years).

Attitude toward the implementation of inquiry-learning (4 items) was constructed with reference to van Hooft, Born, Taris, van der Flier, & Blonk (2005). For example: "I only have a vague idea how to do inquiry-learning in my classes. [orig.: Ich habe bisher nur eine vage Idee, wie ich forschend-entdeckendes Lernen in meinen Unterricht einbringen kann.]".

SWiSE aims (8 items) we constructed on the basis of the initial ideas of the project, for example: "Collaboration with other science teachers or external experts. [Zusammenarbeit mit anderen Fachlehrpersonen oder externen Fachleuten.]".

All items could be rated on a 4-point Likert scale (strongly disagree=1 to strongly agree=4).

Student sample and variables

Students from grade 3 to 9 (primary and lower-secondary school) was given an online link to the questionnaire from their teacher in class and did the questionnaire together with their teacher. In item generation and adaption we decided to construe content unspecific items. That means that there is noch reference to a subject like biology or physics.

The items rather ask for science subjects in general. Yet, the students were instructed to rate the items with reference to the subject they were taught by the teacher we also evaluate.

Intrinsic learning motivation was assessed with 7 adapted items suggested by Koch (in press 2015), e.g. "I am totally engaged in science lessons. [Im Naturkundeunterricht bin ich ganz bei der Sache.]".

The relevance of science learning was assessed with 4 adapted items taken and adapted from Buff, Dinkelmann, Steiner, & Reusser (2012), e.g. "Science means a lot to me. [Naturkundeunterricht bedeutet mir viel.]"

Self-regulation was assessed with 4 items, e.g. "I learn best in science lessons, when my teacher let's me do on my own. [Am besten lerne ich im Naturkundeunterricht, wenn die Lehrerin oder der Lehrer mich allein machen lässt.]" (see Rakoczy, Buff, & Lipowsky, 2005).

All items could be rated on a 4-point Likert scale (strongly disagree=1 to strongly agree=4).

51% of the students were male and the average age of the whole sample was 12.94 years ($SD=1.74$). Altogether we assessed 2959 students, 76% of them were taught by a SWiSE teacher and 79% were native speakers Standard German/ Swiss German.

Chi-square tests do not show any significant group dependencies between SWiSE students and control students as regards their gender (Fisher's Exact; $p=1.00$), the language they speak (Standard German/ Swiss German/ other language: $X^2(2)=4.755$; $p=.093$).

Results

Can there be a SWiSE effect?

In the initial evaluation before the program we wanted to know how relevant SWiSE-aims considering student motivation are. Therefore we asked teachers, both control and SWiSE teachers, on the implementation of the teaching-relevant SWiSE aims ($\alpha=.73$), and we also assessed their students' intrinsic motivation ($\alpha=.87$). Because our data have hierarchical structure, i.e. students are nested in classes, we used multilevel analysis to find out about the impact of following SWiSE aims on student motivation. On student level we also controlled for the attitude towards the relevance of science learning ($\alpha=.89$), self-regulation ($\alpha=.75$), grade (primary=reference vs. lower-secondary), and sex (girls=reference).

In sum, results show that considering SWiSE-aims in class has a significant positive impact on student motivation, independent from students' sex. Teaching more according to SWiSE aims may increase students' intrinsic motivation by .09 points.

Longitudinal analysis

After two years of SWiSE (i.e. pre-post1-post2 evaluations) we hardly had attrition, neither in the SWiSE group, nor in the two control groups. Yet, longitudinal analyses revealed, that only about 50% of the teachers' questionnaires could go into a repeated measures ANOVA (SWiSE: N=70, Control1 in SWiSE school: N=9, Control2 outside SWiSE: N=11). Therefore we use a more liberal 10%, $p < .10$, level of significance.

We found a significant time effect where the intention to do inquiry-learning in class increases from pre to post1 and from post1 to post2. There is also a significant group effect ($p = .05$) in exchange. Dunnett T3 post-hoc analyses revealed that SWiSE teachers were significantly above the level of the external control group ($p = .07$).

Utility of coaching and meetings

We evaluated the utility of the coaching process after the first (post1) and after the second year (post2) in the project. Results show that 56 SWiSE teachers were being coached for two half days in the median each year. 59% considered the coaching extraordinarily useful after the first year and 63% after the second year. Correlations show that neither satisfaction with coaching, nor the amount of coaching requested are dependent from teaching experience.

SWiSE teachers significantly improve in their in-school collaboration compared to non-SWiSE teachers. 79% report that their in-school collaboration has a disburdening effect. 59% of the SWiSE teachers that receive coaching consider this as extraordinarily useful and they meet their coach 2 half days on average per school year. 36% evaluate regional meetings as extremely productive. 10% (12 out of 114) also participated in supra-regional meetings and of these 75% think these meetings are rather or absolutely useful. Only a couple of SWiSE teachers also visit other SWiSE schools, but when they do, 9 out of 10 declare they profit from the visit.

SUMMING UP AND EXPECTATIONS

With reference to the utility and success of SWiSE and its scientific evaluation we believe that the project can be seen as a model for prospective developmental projects in Switzerland. SWiSE aims at lifelong learning combined with in-service teacher professional development with a special focus on networking and collaboration within and between schools. By reference to just some examples the idea of SWiSE makes practical and scientific sense (Alfieri, Brooks, Aldrich, & Tenenbaum, 2011; Berkemeyer, Manitus, Müthing, & Bos, 2009; Dean & Kuhn, 2007; Hofman & Dijkstra, 2010; Meirink, Meijer, Verloop, & Bergen, 2009; Samarapungavan, Mantzicopoulos, & Patrick, 2008). SWiSE tries to bring "together practitioners, researchers and policy makers in order to support Practice-

Based research and its contribution to practice and theory." (www.eapril.org/about_eapril/What_is_EAPRIL). This is achieved as the project leaders established general aims on six levels in education: Children, teachers, schools, universities, educational system, and research which to a large degree correspond to the levels of research and development suggested by Burkhardt & Schoenfeld (2003): Learning, individual teacher, representative teacher, and system change (p. 11).

First, children and young adolescents should get the chance to develop and keep their interest in scientific phenomena and questions and also increase their disciplinary and meta-disciplinary competences. All this is also seen in the context of personality development and preparation for career choice.

Second, teachers develop, test and reflect on innovative lesson planning and teaching material. They exchange and cooperate among each other at school and establish regional networks. Teachers may also profit from job enrichment as they themselves initiate and participate in developmental processes at their school. Furthermore, working with a professional coach seems to be a good opportunity for teachers for specialist counseling on the individual level. Therefore, coaching can represent a good model for permanent, successful and sustainable professional development.

Third, organizational school development focuses on school cooperation as well as regional partnerships with enterprises and institutions. Schools may also link current development programs to SWiSE.

Fourth, universities, the Swiss Conference of Cantonal Ministers of Education (EDK), other institutions for school development etc. collaborate with each other and gain/ share their experience in this large-scale developmental project.

Fifth, on the level of the educational system, SWiSE, as mentioned above, may function as a role model for future projects, because it is the first of this kind in Switzerland. SWiSE wants to build a basis for future Swiss teaching. Within the next years there will be national curricular as well as structural changes in the school system (HarmoS and Lehrplan 21) which all highlight competence-oriented learning and teaching. Additionally, SWiSE wants to enhance the status of a scientific and technological education that is highly relevant for the future research position of Switzerland itself.

Public conferences/ innovation days and educational seminars, initiated by SWiSE, are meanwhile well established and appear to be important platforms for discussions about science education and inquiry-based learning.

Sixth, the project is evaluated continuously and systematically based on established ideas of school and teacher prerequisites (e.g. Shulman, 1987), well grounded theories of program evaluation (e.g. Huber, 2011; Kirkpatrick & Kirkpatrick, 2006), profound knowledge in educational and andragogical psychology (e.g. Baumert & Kunter, 2006; Knowles, 1979), and recent developments in competence assessment (e.g. Brovelli, Bölsterli, Rehm, & Wilhelm, 2013).

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THE CONTRIBUTION OF GESTURES IN THE ACQUISITION OF GEOMETRIC CONCEPTS IN EARLY CHILDHOOD¹

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ABSTRACT

The present paper explores the role of gestures in teaching and learning of geometry at a kindergarten level. Specifically we carried out observations in a kindergarten class with a focus on four children about the gestures they use in geometrical activities during mathematics instruction in two distinct periods. The synchronic and diachronic analysis of the data showed that a child of the research used to produce a gesture with a blended iconic and metaphoric character in order to explain the construction of a line. Also, the same child tended to produce deictic gestures in order to provide the place of a line. Furthermore, while at the first episode a child use to produce gestures related to the contextual character of the activity in order to give explanation about the construction of the lines, at the last episode her gestures appeared to be detached by the materiality in which the inscriptions are embedded in order to give an answer about the same question. This finding stress up the importance of the gestures' contribution in geometric learning process at preschool age.

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INTRODUCTION

Researchers of mathematical education have currently turned their attention to the development of mathematical thinking in early childhood. This tendency is induced by the findings of recent studies indicating that the mathematical knowledge young children bring to school is related to their mathematical learning for years thereafter (Sarama & Clements, 2009). An integral component of mathematical understanding is the use of multiple semiotic representations (Duval, 2006). Representations include not only written symbols, language or graphs, but also body movements, gestures and other types of signs (Radford, 2009). Gesture has privileged access to information that children know but do not articulate. As such, it can serve as an additional window to the mind of the developing child.

This study aims to gain insight into the nature and role of gestures, and the variation that gestures, speech and other semiotic resources undergo in communicating of geometrical concepts at a kindergarten level.

LITERATURE REVIEW

Gestures

By gestures we mean the movements of the arms and hands that are produced in effortful cognitive activity, such as reasoning or problem solving (McNeill, 1992). Parrill and Sweetser (2004) define the meaning of a gesture as “the relationship between how the hands move in producing a gesture, and whatever mental representation underlies it, as inferred both from the gesture and the accompanying speech” (p. 197). McNeill (2005) proposes a dimensional framework for gestures, in which every gesture has a specific loading across the following dimensions: 1) deixis, which refers to pointing movements to existing or virtual objects and actions in space, 2) iconicity, which is related to the semantic content of speech, that is, gesture visually represents the content of concrete entities and actions, 3) metaphoricity, which refers to the representation of an image of an abstract object or idea and 4) temporal highlighting, which is found in simple repeated gestures used for emphasis. In the present project, although we intend to identify the various dimensions of gestural production in geometry kindergarten classrooms, our main focus with respect to the phenomenon of gesture is on the gesture meaning and function in geometry learning. For the interpretation of gestures, McNeill (2005) considers the dimensions of gestures not as important as the form of gestures, their evolution in space and over time and the context of talking when they are produced.

Semiotic Approach

To analyze the role of gestures as semiotic resources in the classroom, they have to be inserted into a semiotic approach allowing a very general definition of “signs”. A sign, or representamen, *is something which stands to somebody for something in some respect or capacity* (Pierce, 1931/1958).

Gestures, glances, drawings, and extra-linguistic modes of expression do not satisfy all the properties of such definitions, but they seem to be as integral aspect of the semiotic activities that could be observed in the classroom. To take into account all these phenomena within a semiotic perspective, it must be used an enlarged notion of semiotic system, the semiotic bundle (Arzarello 2006). The semiotic bundle includes all the signs that are produce simultaneously, by a student or a group of students who interact in order to solve a problem and/or discuss a mathematical question. This mechanism that teachers use in relative with the development of knowledge using the semiotic resources is called semiotic game. Specifically, semiotic game takes place when teacher harmonize with the semiotic resources produced by the students and then guides the development of knowledge according these resources (Arzarello,2006).

Geometric Apprehension

Geometry lies at the heart not only of mathematics, but also of other subject-matter domains, such as physics, biology, chemistry, geography, art, architecture, etc (Sarama & Clements, 2009). Geometric thinking is closely associated with mathematical reasoning and its growth has been found to contribute to the development of mathematical competences and other cognitive abilities, such as intelligence (Clements & Battista, 1992). A basic geometric domain is the understanding of geometrical figures which is a fundamental construct in cognitive development (Sarama & Clements, 2009). Duval (1999) distinguishes four types of apprehension of a “geometrical figure”: perceptual, sequential, discursive and operative. To function as a geometrical figure, a drawing must evoke perceptual apprehension and at least one of the other three types of apprehension. Each has its specific laws of organization and processing of the visual stimulus array. Particularly, perceptual apprehension refers to the recognition of a shape in a plane or in depth. In fact, one’s perception about what the figure shows is determined by figural organization laws and pictorial cues. Perceptual apprehension indicates the ability to name figures and the ability to recognize in the perceived composite figure several sub-figures. Sequential apprehension is required whenever one must construct a figure or describe its construction. The organization of the elementary figural units does not depend on perceptual laws and cues, but on technical constraints and on mathematical properties. Discursive apprehension is related to the fact that mathematical properties represented in a drawing cannot be determined through perceptual apprehension. In any geometrical representation the perceptual recognition of geometrical properties must remain under the control of statements (e.g., denomination, definition, primitive commands in a menu). However, it is through operative apprehension that we can get an insight to a problem solution when looking at a figure. Operative apprehension depends on the various ways of modifying a given figure: the mereologic, the optic and the place way.

The mereologic way refers to the division of the whole given figure into parts of various shapes and the combination of them in another figure or sub-figures (reconfiguration), the optic way is when one makes the figure larger or narrower, or slant, while the place way refers to its position or orientation variation. Each of these different modifications can be performed mentally or physically, through various operations. These operations constitute a specific figural processing which provides figures with a heuristic function. In a problem of geometry, one or more of these operations can highlight a figural modification that gives an insight to the solution of a problem.

In early childhood it is more feasible to teach mainly two basic types of geometrical figure apprehension: the perceptual and the operative apprehension.

Gestures and and geometrical thinking and learning

Only a small body of research examined the role of gestures in the development of geometrical concepts in young children. Specifically, regarding spatial understanding and gesture production, within the age range from three to five, we found only one study, which explored the strategies 5-year-old children used to solve tasks on spatial transformation (Ehrlich, Levine, & Goldin-Meadow, 2006). The results of the study showed that children frequently produced gestures whose meaning was not necessarily identified in the accompanying speech. Children who referred to the movement of spatial transformation in their gestures but not in their speech were more likely to perform well. These findings can be regarded as an indication that gestures have the potential to improve early spatial skills related to geometrical transformations. According to the authors, since gesture can represent the movement of the transformation, e.g., translation or rotation, without involving a resulting shape, it may help focus children's attention on the transformation itself, rather than the visual form of the shapes involved, and consequently, support children to mentally simulate transformations in space. Therefore, using gesture to depict the movement involved in a spatial transformation could be an effective teaching approach.

With respect to shape understanding and gesture production, we did not find any study examining children between three and five years of age. Nevertheless, an interesting study was carried out by Kim, Roth and Thom (2010) with second-grade students which suggests, on the one hand, that gestures cannot be distinguished from the learners' own knowing and, on the other hand, that this gestural interaction between peers was an indispensable component of an inherently collective and creative communication and coordination of mathematical ideas. Roth (2001) stressed the need to specify the nature of mathematical knowledge learners express in their words, but also in their gestures, and to find out more about the associations between these two resources when students learn abstract concepts, such as mathematical concepts, at school. More recently, Kim et al (2010) noted that in mathematics education only a small number of studies closely investigated the ways in which children use gestures to express their thinking.

According to these views and to the above literature review, investigating children's gestures and their dynamics with verbalization and other semiotic resources in studying changes in early geometrical understanding has not yet received adequate attention.

METHODOLOGY

This study aims to gain insight into the nature and role of gestures, and the variation that gestures, speech and other semiotic resources undergo in communicating of geometrical concepts at a kindergarten level. More specifically the present study intends to satisfy the following research goals:

1. To specify the geometrical content of the gestures produced by the children , and the associations of this content with the various dimensions of gestures
2. To investigate the particular role of gestures in a geometric activity in relative with other semiotic systems, such as speech and the written representations.
3. To investigate the contribution of gestures in the evolution of the geometric learning process at a kindergarten level

In order to address our research question we conducted two phases of observation of four kindergarten children and their interactions with their teacher and peers during the teaching and learning process in geometry, focusing on their gestures and their connections with verbal and other representations. The group of children and the teacher have been observed within two distinct periods of time, having three months between one another.

At this paper two episodes of the second phase are presented. These episodes come from a classroom discussion concerning the kind of the lines and the relation between the lines and shapes. At these episodes two children, Lina and Helen, who identified by the "Test of Early Mathematical Abilities (TEMA)" (Ginsburg & Baroody, 2003) to have high mathematical ability, addressed the question that teacher provided.

The qualitative data of the study have been analyzed in two distinct and supplementary ways: the synchronic analysis and the diachronic analysis (Arzarello , Paola, Robutti and Sabena, 2009). Synchronic analysis will enable us to concentrate on the interrelations between different semiotic resources, including gestures and oral language, activated by the subjects (children and teacher) simultaneously at a specific moment. By implementing diachronic analysis we will be able to specify the contribution of gestures in geometric learning process.

RESULTS

Episode 1

The episode 1 is originated from the first geometry lesson at the second phase. Children had already knew the name of the geometric shapes(triangle, circle, rectangle, square) . At this lesson teacher made two points on the board and was trying to present different ways to connect these points in order to make lines. At the previous minutes she presented the straight line and children had found objects with straight lines. Concerning this episode the teacher intended to show to children that we can connect two points with curved line.

1. **Teacher:** Lina? Show me with your hands.
2. **Lina:** Like this(She brought a straight line on the air, Picture 1)
3. **Teacher:**But, this is... Look what I am going to do.(She drew a
4. curved line in horizontal direction on the board) Is it a straight line?
5. **Children:**No
6. **Teacher:** What kind of line is it?
7. **Lina:** Hm.. Skewed line
8. **Teacher:** Do you know the name of this line which is look like a
9. rainbow?Its name is curved ling. Make it with your hand.(Before teacher
10. completed her sentence, Helen made a curved line on the air in
11. horizontal direction)
12. **Lina:** Like O
13. **Teacher:** It is the half of O. Make it again to see it
14. **Teacher:** Bravo. Like a rainbow. The curve line might be inverted.
15. Make it. Like this, it goes down.(she made a curved line on the air) It
16. could be like this, like a crescent(she made a curved line on the air in
17. vertical direction)
18. **Teacher:** Make it with your hand like this (The children made curved
19. lines in vertical direction on the air)
20. **Teacher:** Bravo. These are the curved lines. And a curved line might
21. be like the O as Lina said. It could be a closed line like O. Can you find curved
22. lines in our classroom? Look at our dollhouse. I can see a
23. curved line there. .
24. **Teacher:** Tell me Line. Where can see it?
25. (Lina didn't reply)
26. **Teacher:** Tell me Nicola.
27. **Lina:** There(she show with her pointing finger the curved line on the
28. dollhouse).

While teacher ask children to refer her the way that she could join the points Lina told to the teacher like this and at the same time she brought a straight line on the air with her finger in order to specify her verbal expression(see Line 1, Picture 1). According to McNeil categorization this gesture can be considered as iconic gesture with respect to the straight line and metaphoric with reference to the connection of the points, which is an aspect of operative apprehension.

These two referents come to be blended (or condensed) in the same gesture. Here the gesture helps the children to present ideas that the girl is unable to verbally express. Furthermore Lina presented to be depended by the context while her gesture refers to the written semiotic system.

However, in this semiotic game, teacher presented not to reclaim girl's semiotic resources. Specifically she called the children to observe the line that she started to drawing on the board without give attention to child's semiotic resources. After teacher drew the line, Lina told her that the line is skewed. Possible Lina's thought induced by the fact that child made a comparison between the straight line and the curved line that teacher drew. Teacher following the semiotic game told the right name of the line and called children to represent it on the air.



Picture 1. Lina's gesture about the construction of curved lines with blended character

Before teacher presented the curved line on the air in order to children reproduced it, Helen translated the written semiotic system of the curved line of the board in an iconic gesture in horizontal direction. Specifically Helen made a curved line on the air in horizontal direction (Picture 2a). Since all the children reproduced the iconic gesture of curved line in different directions, teacher called children to find objects in the classroom with curved lines. In order to show the curved line of the dollhouse Lina used a deictic gesture to make it apparent, saying there at the same time (Picture 2b). At this time gesture was found to be useful for the girl since she had difficulties to verbalize the position of the line.

It is interesting that the curved line that child found had horizontal direction such as the direction of Helen's iconic gesture about the curved line. Although teacher called children to produce curved line in various directions, she gave greater emphasis in horizontal direction than the others.



Picture 2(a). Helen's iconic gesture about the curved line, (b) Lina's deictic gesture about the curved line of the dollhouse.

Episode 2

The second episode is originated from the last geometry lesson of the second phase. The children had already been taught the kinds of lines. The teacher narrated the story of the point, which feels loneliness and decided to be joined with other points. Thus, the lines had been created. Then the teacher called the children to tell her the way that we can make a line.

29. **Teacher:** I would like you to listen a short story that I have to tell you.(every
 30. time that she said something she was drawing it on the board,Picture 3a). Once
 31. upon a time it was a point. It was living alone with the other points. There
 32. wasn't anything else. Just the points. It was feeling loneliness and so it though
 33. about something. It decided to be joint with other points and with them it could
 34. be able to make the world. So the points came into together and made a
 35. straight line which was horizon and separated the sky from the earth. Then
 36. they made a curved line for the sun and using straight lines they made the
 37. sunbeams. After that, the points made a curved line about the sea and the
 38. waves. So the small point didn't feel again loneliness. It was leaving with the
 39. lines and the shapes. At first I want to tell me how we can make a line?
 40. **Lina:** You had to put a point here(she showed a point on the right) and a point
 41. there(she showed another point on the left) and bring a line(she made a
 42. straight line on the air, Picture 3b)

In order to answer the teacher's question about the construction of the line , while Lina was making a point on the left and another point on the right on the air, she told to the teacher that "you had to put a point here(deictic) and a point there(deictic) and bring a line(she made a straight line on the air)"(see lines 40-42, Picture 3b). It might be possible that Lina translated the written semiotic system of the board in gestures and verbal expressions. Similarly with previous episode Lina produce a gesture which blended aspect of iconic and metaphoric gestures.

The beginning and the end of the line (metaphoric aspect), the kind of the line (iconic aspect), the spatial positions of the line and the points and finally the construction of the line (metaphoric aspects) are blended in this gesture. In contrast with previous episode, at this episode Lina is contextually independent since she shifted from the reference on the given inscriptions and embodied the aspects of the current mathematical activity in the gesture space, producing her own points. Also, Lina appeared to produce a synchronization between her speech and her gesture, something that wasn't be observed at the previous episode.

As we can observe by teacher drawings teacher gave more emphasis in lines with horizontal direction as in previous episode. It could be supposed that for this reason Lina produced a straight line in horizontal direction and not in any other directions.



Picture 3(a). Teacher's drawing which was accompanied her story, (b) Lina's gesture about the construction of line, with blended character.

Episode 3

This episode originates from the same geometry lesson with the previous one. The episode starts one minute later than the previous one. Teacher asked Lina and Helen to participate in a game in which one of the girls had to produce a line using their hands without verbalize it in order to be realized by the other girl.

43. **Teacher:** First I want to Helen and Lina come. Stand opposite one another.
44. Helen I want to think about a line, and without tell it to someone I want to
45. make it with your hand on the air in order to Lina recognize it.
46. (Helen made a curved line in horizontal direction)
47. **Lina:** Curved line.
48. **Teacher:** Lina is your order, now. Make a line.
49. (Lina made a zig zag line in vertical direction, Picture 4a)
50. **Teacher:** Make it again. (Teacher made a zig zag line in horizontal direction,
51. Picture 4b)
52. (Lina made a zig zag line in horizontal direction, Picture 4b)
53. **Teacher:** Bravo. Which line is it?
54. **Helen:** Zig zag

Since Lina recognized the curved line that Helen produced in horizontal direction, she made a zigzag line on vertical direction (see Picture 4a). Helen was unable to recognize it as a result of line's direction.

Since that in previous episodes all the semiotic systems of the lines that they had come in touch were in horizontal direction, the vertical direction provoke difficulties to the girl. So teacher called Lina to change the direction of her line in order to help Helen. Specifically teacher told her to make it again and at the same time she made a zigzag line in horizontal direction. Lina imitated her teacher in order to help Helen(Picture 4b).

At this episode teacher chose gesture sign in order to communicate the meaning of direction, which is a difficult mathematical aspect. However , the semiotic game that she developed provided to be helpful only for Helen and not for Lina who is presented to be contextually independent at this episode. Specifically Lina extended her knowledge which was gained by the previous episodes about the line and produced a line in a different direction.



Picture 4 (a). Lina's iconic gesture about zig zag line in vertical direction, (b) Lina 's and teacher's iconic gesture about zig zag line in horizontal direction.

DISCUSSION

In these episodes of geometric lessons, gestures appear as providing specific ways of carrying out the semiotic process. The analysis has specified the geometrical content of the gestures produced by the children and the association of this content with the various dimensions of gestures.

At first, children were observed to produce three of the categories of gestures that McNeil suggests (1992). Deictic gestures were presented to convey meanings in relative with the position of the lines while iconic gestures communicated ideas with reference to the aspect of perceptual apprehension and operative apprehension such as the construction of the line. However some gestures which were observed to be iconic, they were also considered as metaphoric gestures since they blended abstract mathematics ideas. The blending different mathematic meanings in a gesture was an aspect of the particular role of gestures in a geometric activity. If we take into account semiotic bundle as an integrated system this blended character of the semiotic bundle is arising from focusing on the role of gestures. The multi-semiotic character of the semiotic bundle permit us to face with the various components of the mathematical objects taking into part in the activity in a very integrated way(Sabena,2009), such as the construction of the line, the spatial positions of the points, the beginning and the end of the line, the kind of the line.

In processes of acquiring geometric knowledge, gestures were found to play an important double role.

First, as components of the semiotic bundle, they can support thinking processes of students and promote the transition personal–institutional with suitable conversions from one sign to another.(Arzarello et al., 2009) On the one hand at the first episode Helen translated the written system of curved line in an iconic gesture. On the other hand at the second episode Lina was presented to converse the verbal and written system in a complex gesture in order to face the question of the construction of the line. Furthermore children gestures were found to be strongly influenced by the semiotic resources that teacher use to present about the lines. Specifically, in relative with lines, children gestures were found to have the same direction with all the other semiotic resources had about them, producing limits in their acquisition of geometric knowledge.

Second, gestures have also a communicative function. Both teacher and children were shown to use gesture as a communicative tool. As we can see the gestures permit to children to embody and organize ideas with alternative ways while they are unable to verbalize them. Since Helen was unable to recognize the kind of line as a result of the different direction, teacher using a gesture encouraged Lina to differentiate the direction of her line, We can suppose that the reproduction of teacher 's gesture by Lina is an indication that the child recognize the need in relative with the change of line's direction. Previous research has shown that if children grasp the meanings conveyed by the gestures they repeat, producing those gestures could support their learning (Cook and Goldin-Meadow 2006). Thus, this provides further support to the positive influence of the teacher's gestures and verbal expressions on the child's learning of spatial concepts.

Diachronic analysis gained deeper understanding of the contribution of gestures in the process of geometric learning in preschool age. In fact, gestures provide a strange way of establishment of the process of knowledge acquisition in the perceptual contextual dimension of the mathematical activity that is carrying out, but also of detaching from it to embody a specific character of generality. In this shifting, the spatial location of gestures in relative with the subjects' body and to the physical configurations of the written resources might play a particular role. Similarly, at first episode Lina produced a gesture about the construction of the line using an inadequate verbal representation. Her gesture was strongly depended by the contextual dimension. In contrast with it, at episode 2 Lina represent the construction of line using a gesture independent by the context. Also her oral representation was found to represent the construction with more details and accuracy. Consequently, we can support that this shifting between these episodes provide some elements about the child's geometrical thinking evolution.

As previous studies have shown , Arzarello, Paola, Robutti and Sabena(2009) semiotic games constitute an important strategy in the process of appropriation of the culturally shared meaning of signs. Consequently it is necessary for teacher to give attention on the role of multimodality and semiotic games play in order to these learning opportunities be identified. However, concerning the semiotic game of the third episode teacher became suitably in tune with Helen's need's and prevented Lina's geometric thinking development.

Awareness is required for teacher in order to design the conditions that encourage the meaningful learning experiences and to adjust his/her intervention strategies to the particular didactic activity (Arzarello,2006) who can support all students' learning.

Consequently the results of the study enhance previous studies(e.g. Sabena,2009) which underlied the blended character of the gestures and also the relationship between gestures and the displayed inscriptions in the semiotic bundle. Also, the differentiation between oral speech and gesture at the first and second episode provide important elements that gestures are able to contribute in the process of geometric learning. Consequently, our finding , in agreement with other studies(e.g. Elia, Gagatsis & Van Heuvel Panhuizen,2014)suggest that gestures are important source of developing abstract thinking in early childhood, which is needed to taking into account in classroom practices. However, future studies with more children, longer observations, and a variety of geometric concepts need to be conducted in order to be specified the role of gestures in geometric learning.

The findings of this study are able to answer the important question of Mathematics Education and Cognitive Psychology concerning the particular role of gestures in geometric activity in relative with other semiotic resources. Gestures were identified to intertwined with other systems of the semiotic bundle. However, in this study we have seen that children are able to provide ideas by gesturing while their verbal skills are poor. In according with other studies(e.g. Elia et Evangelou, 2014) children's gestures can provide a rich source of evidence from which to evaluate their mathematical understanding with respect to mathematic concepts in a natural classroom context. If teachers attend children's gestures as well as their words, they could have a more complete and accurate comprehension of their kindergartners' growth (Herbert and Pierce 2007). Consequently, the final conclusions and recommendations of the study concerning possible modifications in curricula and/or methodology in the teaching practices of mathematics in early childhood may be taking into account.

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PRESCHOOL GEOMETRICAL TEACHING PRACTICES AND GEOMETRICAL THINKING DEVELOPMENT: A CASE STUDY¹.

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ABSTRACT

This case study aims to analyse the geometrical discourse and geometrical products of a preschool boy, named Lam, and to examine the influence that may occur by his two teachers' geometrical instructional practices. The boy was observed, during five geometry lessons, for two separate periods of time (phase A and B), with four months distance. The results show that teachers used different teaching methods. They both approached perceptual apprehension of the geometrical figures, with the second teacher emphasizing on the operational apprehension with mereological modification (Duval, 1999). During the first phase of teaching the boys' geometrical discourse has characteristics of the lowest level Sinclair and Moss (2012) proposed. According to Clements, Swaminathan, Hannibal and Sarama (1999) the boy was performing at a syncretic level of geometrical thinking. In phase B, Lam seems to jump to a higher level of geometrical discourse (level two) as he describes shape in more complex ways based on shapes' properties. Those findings are under discussion for young children's development of geometrical figure apprehension. Implications for further research and for introducing suitable geometrical teaching practices of pre-schoolers learning are discussed.

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INTRODUCTION

Researchers' concern in preschool education of mathematics has significantly grown in the last ten years. Sarama and Clements (2009) indicate that the mathematical knowledge young children bring to school is related to their mathematical learning for years thereafter. The importance of promoting young children's geometrical understanding has been stressed by the National Association for the Education of Young Children and the NCTM (2002). Usiskin (1997) stated that geometry is the domain that links mathematics with the real world and should start in the earliest years of education. Previous theories of various researchers in geometry thinking and learning; and recent researches on the quality of mathematics instruction are used in this qualitative analysis research.

LITERATURE REVIEW

Geometrical Thinking and Learning

Numerous theories of geometrical thinking are developed and proposed by several researchers. The theories that we use in this case study are discussed below in a detail way.

Geometrical Figure Apprehension (GFA)

In a cognitive analysis of geometrical thinking, Duval (1995) distinguishes four apprehensions for a geometrical figure: perceptual, sequential, discursive and operative. To function as a geometrical figure, a drawing must evoke perceptual apprehension and at least one of the other three types of apprehension. Each has its specific laws of organization and processing of the visual stimulus array.

Specifically, the perceptual apprehension refers to the recognition and naming of geometrical figures, in different places and orientation. Sequential apprehension is required whenever one must construct a figure or describe its construction. The organization of the elementary figural units does not depend on perceptual laws and cues, but on technical constraints and on mathematical properties. Discursive apprehension is related to the fact that mathematical properties represented in a drawing cannot be determined through perceptual apprehension. In any geometrical representation the perceptual recognition of geometrical properties must remain under the control of statements (e.g., denomination, definition). Finally, the operative apprehension is the way to get an insight to a problem solution when looking at a figure. This apprehension depends on the various ways of modifying a given figure: the mereologic way, the optic way and the place way. The mereologic way refers to the division of the whole given figure into parts of various shapes and the combination of them in another figure or sub-figures (reconfiguration). The optic way is when one makes the figure larger or narrower, or slant, while the place way refers to its position or orientation variation.

In the kindergarten it is more feasible to teach mainly two basic apprehensions of figures: the perceptual apprehension (e.g. the recognition and naming of geometrical figures), and the operative apprehension with emphasis on reconfiguration (e.g. investigating and predicting the results of putting together and taking apart geometrical figures).

Geometrical Thinking

The well-known Van Hiele model (1986) suggests five levels of geometrical thinking about shapes. Those levels are Visualization, Analysis, Abstraction, Deduction and Rigor. We will emphasize only on the three first levels that a preschooler is able to reach.

The first level is called “Visualization Level” and the children here are reasoning about geometrical concepts depends on visual considerations of the concept as a whole. They can recognize and learn to name certain geometric shapes, based on their experiences. The second level is named “Analysis Level”. In this level children begins to recognize shapes by their crucial properties. It is important to mention that Hershkowitz (1989) distinguished critical and non-critical properties. Critical properties are considered to be properties of the number angles and sides of the shape. In the other hand, non-critical properties are considered to be the color of the shape, the size or the orientations of the shape. The third level is “Abstraction Level”. At this point the children begin to form definitions of shapes based on their common properties, and to understand some proofs.

Clements, Swaminathan, Hannibal and Sarama (1999) suggested a level, which they called pre-recognitive, before the visual level of Van Hiele. In this level the children may attend to only a subset of a shape's visual characteristics and are unable to identify many common shapes or distinguish among figures in the same class. The same research team proposed their own theory about shapes and geometrical thinking. They recommend two other level of geometrical thinking, the syncretic and the descriptive level. In the syncretic level a global combination of perceptions occurs without analysis. The children use phrases like “this shape looks like”. During the descriptive level, which is a more complex level than the syncretic, children can recognize, describe, and manipulate not only individual shapes, but also their components, and eventually, their properties.

Composition and Decomposition of Geometrical Shapes

Sarama and Clements (2009) form a six level theory about composition and decomposition of geometrical shapes. We will state only the four ones which pre-children can reach.

The first level is “Pre-composer”. Pre-composer children can manipulate shapes as individuals, but are unable to combine them to compose a larger shape. For instance, children might use a single shape for a tree and a separate shape for a flower. Children cannot accurately match shapes to simple frames (closed figures that can be filled with a single shape).

The second level is “Piece Assembler”. Children at this level are alike to Precomposers, but they place shapes contiguously to form pictures. In the free activity of “make a picture”, for instance, each shape used represents a unique role in the figure (e.g., one shape for one hand).

The third level is “Figure Maker”. Children can concatenate shapes contiguously to form pictures in which several shapes play a single role (e.g., a bole might be created from two contiguous squares), but use trial and error and do not anticipate creation of new geometric shapes. They can complete a frame that suggests that placement of the individual shapes but in which several shapes together may play a single semantic role in the picture.

Ending, the fourth level is “Shape Composer”. At this point the children combine shapes to make new shapes or fill puzzles, with growing intentionality and anticipation (“I know what will fit”). Eventually, the child considers several alternative shapes with angles equal to the existing arrangement. Imagery and systematicity grow within this and the following levels.

Geometric Discourse

Sinclair and Moss (2012) consider geometric thinking as a form of communication and combine this view (Sfard, 2008) with the well-known Van Hiele (1986) level of geometrical thinking to transform those levels to geometric discourse levels. They proposed only three levels, thus their focus is on the pre-school children.

The first level of geometric discourse of elementary discursive objects, corresponds to the first Van Hiele level. Shapes are related to real word and each one has only one proper name. Continuous transformation (actually or mentally) is the only way to recognize shapes. The second level of discourse of concrete discursive objects (a counterpart to van Hiele Level 2), emphasizes in shapes’ properties. Transformability is the main criterion for calling two shapes by the same name, except that due to the experience with other people’s uses of geometric vocabulary, the boundaries of permissible transformations have widened. In this discourse, an object still cannot have two different (family) names, and in particular, a square cannot be a diamond. Finally, in the third level of discourse of abstract objects (as van Hiele Level 3) two shapes can be called by the same name if the verbal descriptions of the shapes fit. One can see geometric objects as a result of reification of discursive procedures. One shape can be named by two or more shapes’ categories by its definition.

The ways pre-schoolers think and communicate in geometry are related to teachers' teaching practices, thus Klibanoff, Levine, Huttenlocher, Vasilyeva and Hedges (2006) argue the teachers' mathematical discourse is positive related to the development of pre-schoolers' mathematical knowledge. Our research main interest is to analyze how the geometrical discourse of a kindergarten boy evolves in relation to different teaching practices.

Quality of Mathematics Instruction (QMI)

Charalambous and Hill (2012) set five aspects of mathematical quality of instruction. It is important to state that only the third aspect is negative charged.

The first aspect considers the richness of the mathematics in the instruction of the teacher. This aspect captures the depth of the mathematics offered to students. Specifically, it emphasis on five elements occurs during instruction: Linking and connections (among representations, mathematical ideas, procedures), Explanations (mathematical ideas, solutions, methods), Multiple procedures or solution methods (for a single problem), Developing generalizations and Mathematical language (fluently and consistently). The second aspect is about the work with students and the mathematics. This aspect refers to whether teachers can understand and respond to students' productions (i.e. questions, explanations, solution) or mathematical errors. It states two elements: Responding to student productions and Remediating student difficulties and errors. The third aspect is emphasis on the errors and imprecision of the teacher in class. This aspect is negative charged. It consists by three elements of instruction: Major mathematical errors or serious mathematical oversights, Imprecision in language or notation and Lack of clarity in teachers' launching of tasks or presentation of the content. The forth aspect refers to the student participation in meaning-making and reasoning during instruction. This aspect captures four elements: Providing explanations, Posing mathematically motivated questions or offering mathematical claims and Engaging in reasoning and cognitively demanding activities. Finally, the fifth aspect speaks of the development of a coherent lesson trajectory. This aspect refers to the whole lesson aspects of instruction, such as teachers' selection and sequencing of tasks and examples, ability to generalize in mathematics and lesson cohesion.

METHODOLOGY

This case study is aiming to examine two teachers' geometrical instructional practices and their influences in geometrical figure apprehension of a five years old boy.

Specifically, the main research questions are:

1. What is the child's initial level of geometrical figure apprehension and geometrical discourse?
2. Which aspects of geometrical figure apprehension do the kindergarten teachers emphasize?
3. In what ways do the tasks used by the teachers during instruction affect the development of geometrical figure apprehension and geometrical discourse of the child?

Research Subject

The subjects of our research are a five years old Greek speaker, Cypriot, boy called Lam, and his two teachers (Neli and Bel). The boy's mathematical achievement score is 115 (above average 90-110) of the "Test of Early Mathematical Abilities (TEMA)" (Ginsburg & Baroody, 2003). TEMA is a USA product that is appropriate for children ages 3 to 8 years old.

Data Collection Method

The boy was observed, during five geometry lessons, for two separate periods of time (phase A and B), with four months distance, instructed by two different teachers. Due to the limitation of space, we will present, in a chronological order, only one lesson of each phase. The lesson of polygons (phase A) starts with the triangles, pass to quadrilaterals and then extended to pentagons. The second lesson (phase B) begins with revision of the types of lines and eventually pass to the recognition of shapes in various ways and places. The aims of those instructions are not the same. The first teacher emphasizes on recognition of polygons and curved shapes, while the second teacher highlights the properties of each shape but also the geometrical compositions of those shapes.

Data Analysis Method

All lessons were videotaped for a detailed analysis of the data. Geometrical discourse theory of Sinclair and Moss (2012), geometrical thinking theory of Clements et al. (1999) and cognitive analysis of geometrical figure apprehension by Duval (1999) were in used for the analysis of the boy's discourse. The qualitative method of data analysis that was used in our research is the microgenetic analysis (Lavelli, Pantoja, Hsu, Messinger & Fogel 2005).

The analysis of teachers' instructional practices was based on the instructional quality theory for mathematics teaching by Charalambous and Hill (2012) and on the geometrical figure apprehension theory by Duval (1999).

RESULTS

The results are presented as they were taken during the two phases of instruction. In each phase one lesson is presented by the teacher's instruction and the child's geometrical products and discourse are analysed.

Phase A

Neli teaching start with triangles (episode 1), then pass to quadrangles (episode 2) and ends with the pentagonal (episode 3). Specifically, in episode 1 we observe that Neli used a lot of questions in order to promoted children to explore the shape.

Episode 1: Triangle.

Teacher:	1	We will create shapes with straight lines
	2	[She puts three points on the floor].
	3	How many points did I put on the floor?
Children:	4	Three
Teacher:	5	I want as many [children] as it is the points on the floor. Come and
	6	stand on those points. One child must stand on each point. The child
	7	will become the point. [puts children on the points]
Teacher:	8	I will make lines with this woolen thread in order to unite the points
	9	and create the shape [Figure 1a]
Children:	10	Triangle
Teacher:	11	Aaa ... it looks like a triangle. Who will show me the sides?
	12	Peter?
Peter:	13	[The boy shows one angle]
Teacher:	14	This is a side. [She shows the angle]. Think about it. [she shows the
	15	shapes' side]
Peter:	16	[The boy shows the same side]
Teacher:	17	This is a side of the shape [she creates a mental line of the side] Show
	18	us the other side [she shows the other side; Figure 1b]
Peter:	19	[the boy goes and touch the other side shown by his teacher]
Teacher:	20	And the other line?
Peter:	21	[the boy shows the last side]
Teacher:	22	How many sides it has?
Peter:	23	Three
Teacher:	24	How many angles does it have?
Children:	25	Three
Teacher:	26	Three. Remember that the number of sides, a shape has, is the same
	27	with the number of its angles!



Figure 1. (a) Neli's creation of a closed shape (b) Neli shows the side.

Neli use woollen thread for the construction of shapes with points but she did not emphasis on the manufacturing defects it may has. According to Charalambous and Hill (2012), this may be a negative element of the first aspects about lack of explanations. Negative element of the second aspect may be the way she feedbacks the boy in lines 14 to 18, thus she doesn't explain why it is not a side and it is an angle of the shape.

From the other side, children are actively members of the teaching practice (see line 5 and line 14), this is an evidence of the forth level of Charalambous and Hill (2012). Moreover, questions are used by Neli in order to promote shape' exploration of children (see line 20, 22, 24). Her responds are more integrated answers of children (see line 26 to 27) and this is a positive second aspect of Charalambous and Hill (2012).

Later on, children are introduced to quadrilaterals shapes (see episode 2).

Episode 2: Quadrilaterals

Teacher:	28	Now, I will put another point. How many children I will need?
Children:	29	Four
Teacher:	30	[she pass the thread throw the points]
Lam:	31	Now, it looks like a bigger triangle.
Teacher:	32	Lets' see.
Lam:	33	Eee square
Teacher:	34	Lam, why do you think that it is a square?
Lam:	35	Because it has four angles.
Teacher:	36	So, if a shape has four angles it is a square?
Lam:	37	And four sides
Teacher:	38	Bravo! And four sides We won't name it. It is not a triangle. But why
	39	it is not? [Made a mental straight line for the side].
Lam:	40	Because it doesn't have three sides.

Lam answer in a non-typical discourse (see line 31), and then in a more typical one (see line 33). He focuses in non-critical properties of shape as he calls a quadrilateral a bigger triangle. He is at the first level of Sinclair and Moss as he focuses on shapes' properties only when his teacher calls him to do it (see line 34 and 36). In addition, he is on syncretic level of Clements et al. (1999), because his answers are optic (see line 31), or are based on properties (see lines 35 and 37). Lam seems to recognize triangle properties and distinguishes it from squares (see line 40).

At the same time, the teacher does not explain (see line 38) the reason of not calling this shape “square” and this may cost children’ misunderstandings, so this is a negative element of the second aspect of Charalambous and Hill (2012).

Later, in episode 3, children are examining the pentagonal shape without creating one in class.

Episode 3: Pentagonal.

Teacher:	41	A moment ago, I had three points. How many sides I had?
Children:	42	Three
Teacher:	43	And how many angles?
Lam:	44	Three
Teacher:	45	When I put four point how many sides I had?
Lam:	46	Four
Teacher:	47	How many angles?
Lam:	48	Four
Teacher:	49	If I put five points how many angles will the shape have?
Lam:	50	Five
Teacher:	51	And the number of the sides?
Lam:	52	Five

As we can see from the episode 3, the teacher is using inductive thinking in order to promote generalization, as she focuses on the relation between sides and angles in a shape. This is an element of the first aspect of Charalambous and Hill (2012) about richness in mathematics.

Later on, in episode 4 children are called to group shapes together with criterions.

Episode 4: Grouping Shapes Together.

Teacher:	53	I will give you a shape.
	54	Observe the sides and the angles of your shape.
	55	Touch the sides of your shape.
Lam:	56	I have touched them.
Teacher:	57	Touch the angles of your shape; show your shape to your friend. Show
	58	him an angle of your shape.
	59	Take the shape of your friend and observe it ...
	60	Here I have three wreaths which will represent group of shapes.
	61	I want you to count your shapes’ sides.
Lam:	62	[he count the sides]
Teacher:	63	What number I have written on this wreath?
Lam:	64	Three
Teacher:	65	Which shape will we put here?
Lam:	66	Three
Teacher:	67	Three shapes. Do you think that I put the number three for this
	68	reason? Why did I put number three?
Lam:	69	For the angles and the sides of the shape.

In episode 4, teacher focuses in operational- mereological - apprehension of a shape, as she calls children to touch its sides and angles (see lines 53 to 58). She is the one who sets the criterion of grouping shapes together (see line 59 to 61), thus she does not fulfil aspect four (Charalambous and Hill, 2012) of active participation of children in teaching practice.

Table 1.
Lams' Geometrical Products and Geometrical Compositions.

Geometrical Products		Geometrical Compositions	
			

Soon after, when the child is called to make closed shapes on the computer, Lam made only prototypical shapes as isosceles triangles (see table 2, geometrical products a-b). Later, when he is called to match one of the given shapes with the ambit of his own shape with four points, he used continuous transformation, as he used not only one shape to cover his shape but five, overlapping them together (table 1, Geometrical Compositions a).

Continuous transformation is been used from Lam in order to copy shapes on his paper in order to create a geometrical composition, as we can see (table 1, Geometrical Compositions b).

Shapes are not in touch externally or internally. So we can say that because of the boy's continuous transformation and the absence of accuracy, he is on the second level of geometrical composition of Sarama and Clements (2009).

Phase B

During phase B, Bel's instruction was based to perceptual and operational (mereological) apprehension of the geometrical figure. She started by revising the types of the lines, then pass to the polygons and ends with emphasizing on triangles. In polygons she emphasized on recognition of shapes in different places and forms (as seen on the episode 5).

Episode 5: Shapes in geometrical compositions.

Teacher:	1	I enter in my spaceship and started when suddenly the rocket began
	2	to shake (figure 2a).
	3	So I realized that something was wrong and so I land my spaceship
	4	on the first planet I found in front of me. The first planet was?
	5	(figure 2b)
Children:	6	It is earth.
Teacher:	7	Why do you say that it is earth?
Tonia:	8	It is the circular planet.
Teacher:	9	That's right.
	10	He told me that in this planet called?
Children:	11	Circular
Teacher:	12	All things here are made of?
Children:	13	Circles
Teacher:	14	I went to the next planet (figure 2c)
Children:	15	The square planet
Lam:	16	Triangle, triangular planet.
Teacher:	17	My friend told me that this planet was the trrrriangular planet. All
	18	things here are made of?
Children:	19	Triangles
Teacher:	20	My friend Triangle told me to stay there, but I was scared, I told
	21	him that they have a lot of [she shows the angles of the triangle]
	22	
Children:	23	Noses
Teacher:	24	Noses, meaning?
Lam:	25	Angles
Teacher:	26	Angles which will bite me ... The next planet I landed was? (figure
	27	2d)
Children:	28	Square
Teacher:	29	Everything in this planet was made from what shape?
Children:	30	Square
Teacher:	31	He told me to stay. At the beginning I liked the idea, but later
	32	
Children:	33	It has sharp edges.
Lam:	34	And more [angles] than the triangle.
Teacher:	35	Then, I jump in my spaceship and I went to the next planet? (figure
	36	2e)
Lam:	37	Rectangular planet



Figure 2. Semiotic Representations on the interactive whiteboard.

Bel uses role play and emphasis on the perceptual apprehension of geometrical figure. Various examples of shapes are proposed by the teacher in various positions, orientations, and sizes thru geometrical compositions (see figures 2a-e). What is more, she meets the first aspect of the mathematical quality of instruction of Charalambos and Hill (2012) about richness of mathematics in lesson, as she uses multiple representations and advance technological materials as interactive blackboard. Children are part of the learning process, so she meets the forth aspect of the mathematical quality of instruction about student participation in meaning making and reasoning, too.

At the same time, Lam seems to be able to identify comfortably geometrical shapes and sub-shapes in non-prototypical geometrical forms and in geometrical compositions (e.g. see line16). Additionally, he uses terms for shapes family names and not just for only one shape. Not only is he able use the correct mathematical terminology for the angles (see line 25), but he can compare the properties of a rectangle and a triangle (see line 34). So, we could say that the child is on the second level of geometrical discourse “discourse of concrete discursive objects” (Sinclair & Moss, 2012) and on the descriptive level of Clements et al. (1999).

In the sixth episode below, children are called to group shapes together according their criterion.

Episode 6: Grouping Shapes Together.

Teacher:	38	I will pass and you will take an object from the box with the gifts from
	39	the planets. We all have a ... ?
Children:	40	Shapes
Teacher:	41	Do we all have the same shapes?
Children:	42	No
Teacher:	43	Each one has a different shape.
	44	I want you to think a way that we can put the shapes in groups. Bill?
	45	
Bill	46	The same color in one group. [...]
Children:	47	[they put their shapes in group with different colors] [...]
Teacher:	48	Is there another way that we can group the shapes?
Lam:	49	Yes, to have the same shape.
Teacher:	50	So, in one group we will put only?
Lam:	51	Circles
Teacher:	52	Nice, I want to see only circles. [...]
Children:	53	[they put their shapes in group with different kind of shapes]
Lenos:	54	We can make another grouping.
Teacher:	55	Tell us Leno, what other way can we use to group shapes?
Lenos:	56	One group for shapes with angles and one with no angles.
Teacher:	57	Super! The group with angles and the group with no angles.
Lam:	58	All shapes have angles, except circles.
Teacher:	59	Why circle does not have angles?
Lam:	60	Because it is only circular shape
Teacher:	61	Ok, so it is a circular shape? When do we have an angle?

Lam: 62 When I turn.
 Teacher: 63 So, what kind of line do I need in order to make an angle?
 Lam: 64 Two. One like this and one like this [gestures]
 Teacher: 65 How can we call them?
 Lam: 66 Straight lines
 Teacher: 67 Circle doesn't have a straight line?
 Children: 68 No
 Teacher: 69 What kind of line does it have?
 Children: 70 Curve.

In this episode, Lam is suggesting the kind of shapes as a criterion for grouping shapes together (see line 49). He focuses on critical properties of the figure. Lam recognized that circle is different from the other shapes because of his curves lines and the absence of angles (see line 58 and line 60).

Children are investigating shapes and the proposed criterion of grouping shapes together (see line 44), thus we can say that she fulfill the fourth aspect of quality in teaching mathematics of Charalambous and Hills (2012). Moreover, the teacher promotes generalization thru continuous questions (see line 61), so she fulfills the first aspect of quality of teaching mathematics. Also, she fulfills the second aspect as she responds to children with more complete answers than theirs (see line 43).

Table 2.
Lam's Semiotic Recourses and Geometrical Products

	Geometrical Decomposition	Geometrical Composition
Semiotic Resources		
Geometrical Products		

Moving on, Bel asked the children to find shapes in a geometrical composition – so they are called to do geometrical decomposition - and to create their own geometrical composition with given shapes (see table 2). She focuses on operational – mereological – apprehension of geometrical figure of Duval.

Lam products are more complex as he finds two rectangles and he creates geometrical composition with 8 shapes which are in tough without overlapping each other. So we can support that he is on the third level of geometrical compositions of Sarama and Clements (2009).

DISCUSSION

In this case study the role of instructional practises in geometrical figure apprehension and discourse of a pre-schooler is presented.

The instruction of geometry in the early years is of poor quality, as it over-emphasizes what children already know, that is, the perceptual apprehension of figures, including the recognition or naming of figures (Sarama & Clements, 2009), which Duval (2006) would have named as the botanist approach to the learning of geometrical figures. This approach was used in phase A. The boy's geometrical discourse, at this phase, seems to be at the level 1 "discourse of elementary discursive objects" (Sinclair & Moss, 2012), and his knowledge about shapes appears to be syncretic (Clements et al., 1999). He calls "square" all the quadrilaterals.

From the other hand, when instruction is based on the use of a variety of visual examples of shapes with varying relevant (e.g., number of sides) or irrelevant attributes (e.g., orientation, size), by using discussion and verbalization, describing figures or explaining why a figure is for example a triangle (Sarama & Clements, 2009) and also by operating on shapes mentally or physically (Duval, 1995), it is more possible for the child to develop a more consistence geometrical thinking and discourse. This method seems to be followed in phase B, where the instruction was based to perceptual and operational (mereological) apprehension of the geometrical figure. This instruction has higher quality, than the first one, due to the following four aspects of the instructional theory of mathematical quality: linking different representations of polygons; instruction helps children to avoid errors, as she used to promote mathematical definitions; focus on children participation in activities; links of different lesson activities and she revises previous knowledge of the types of lines. Here, the boy reaches the second level of discourse of concrete discursive objects (Sinclair and Moss, 2012), as he recognizes the family of the name "square". He reaches descriptive level of Clements et al (1999) and the third level of Composition and Decomposition of Geometrical Shapes of Sarama and Clements (2009).

Previous researches argue with this case study results that children must use multiple representations systems and real objects in order to obtain mathematical knowledge objectively (Radford, Bardini, & Sabena, 2007). Likewise, the quantity and the quality of discourse children listen in the class affects his own discourse development (Dickinson, Pierre, & Pettengill, 2004).

Further question for researches may be: What is the effect of peer's discourse and geometrical thinking/ or biological development effect? What happens with the other children of the class taught the same lessons? Did they have the same development?

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**DIFFERENTIATION OF TEACHING AND LEARNING:
THE TEACHERS' PERSPECTIVE**

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ABSTRACT

The aims of this action research are: (a) to investigate the process of differentiation of teaching and learning in mixed ability classes from the perspective of teachers', and (b) to examine the effectiveness of differentiation of teaching and learning in improving reading abilities of students from the first class of the lyceum (fifteen year olds), their self-efficacy and their attitudes towards learning. This action research uses the results of pre and post tests, students' interviews before and after the intervention, class observations and teachers' diary records. The research indicates that the main obstacles teachers have to face are: (a) to define, analyze, and hierarchize reading abilities and strategies from the simplest to the most complex (b) to clarify students' readiness (c) to design lessons to address students' readiness, interests and learning style (d) flexible class organization, and mainly (e) to get rid of misconceptions about their role in the learning procedure. In addition, the research reveals the contribution of differentiation in students' learning, self-efficacy, and beliefs about learning. The most important conclusions are that teachers' self-reflection and cooperation with other colleagues play a major role in teachers' conceptual change and in enhancing teachers' efforts to deconstruct the curriculum according to their students' needs. Finally, respecting students' individuality leads to the improvement of their knowledge and skills and motivates them to learn.

INTRODUCTION

The literacy level of societies correlates with their ability to progress in the socio-economical and political area (Unesco Institute of Statistics, 2014), and at the same time the acquisition of writing defines either the participation of a person in social and cultural aspects of life or his marginalization (Barton, 2006; Blackledge & Hunt, 2004). This raises the question as to what degree the effective development of literacy (as it is defined in each educational system) is achieved not only in the educational system of Cyprus, but in international systems as well.

Research data from Cyprus – such as the results of PIRLS-2001 for reading (Papanastasiou & Koutselini, 2008), the rates of potential illiterate students at the end of primary education (Petridou, Tsouris, Michailidou, & Kyriakides, 2009), and the poor performance of fifteen year olds in reading according to PISA results (OECD, PISA 2012) – indicate that the way students are taught to read is ineffective. The data aren't very promising not even in countries like the USA, where the performance of 25% of adolescents is lower than the average (NAEP, 2013) and almost half of secondary school students do not possess the appropriate reading skills required to study at college (ACT, 2012).

On the other hand, it is obvious that the ineffectiveness of teaching and learning the reading skills and strategies that an efficient reader ought to master is related to the inability of teachers to differentiate their instruction in mixed ability classes (Baumgartner et al., 2003; Guthrie, 2008; Harmon, Keehn, & Kenney, 2004; Irvin, Meltzer, & Dukes, 2007; Johnson, Freedman, & Thomas, 2007; Koutselini, 2006; 2008; Tomlinson, 2009), as a result of ineffective pre and in-service education (Hardre & Sullivan, 2008; Tomlinson, 2003). Well-educated teachers in differentiation of teaching and learning know what knowledge is and how it is acquired according to constructive theory (Hargreaves, 1998; Santangelo & Tomlinson, 2012), have a deep knowledge of their subject, can ascertain correctly the individual as well as the common needs of their students and adapt the curriculum, the teaching strategies, the source, the activities, the assessment and the learning environment, in such a way that they meet students' needs, their interests and learning profiles (Santangelo & Tomlinson, 2012; Subban, 2006; Tobin & McInnes, 2008). The differentiated learning procedure presupposes teachers who are capable of studying and taking their students' different biographies and biotheories into consideration (Koutselini, 2008, 2010a; Tomlinson, 2003). However the question remains: In what framework can teacher training be achieved? (May, 2007; Ruys, Defruyt, Rots, & Aelterman, 2013; Santangelo & Tomlinson, 2012);

Nevertheless, even though theoretically it is believed that the successful teaching of literacy presupposes the differentiation of the teaching process, the product and the content according to the learning aims and student needs, which need to be investigated systematically and in depth (Guthrie, 2008; Irvin, et al., 2007; Tomlinson, 2009), researchers have indicated that there is limited research data on the improvement of adolescents' literacy skills through differentiated instruction (Biancoarosa, & Snow, 2004; Cantrell & Carter, 2009; May, 2007).

The challenge of teaching students of heterogeneous classes was faced by the teachers who took part in this research too. The teachers chose action research in order to answer the questions of effective teaching of reading comprehension in mixed ability classes, because they knew that action research contributes to progressive teacher autonomy, giving him/her the ability to reconstruct the curriculum according to students' needs and to effectively solve broader educational problems (Koutselini, 2010b; McLaren, 2010). The results of current research contribute to the broader discussion about the prerequisites of successfully teaching reading comprehension in mixed ability classes, because action research contributes to the progress of educational knowledge through a bottom-up approach rather than a top-down one (Carr, & Kemmis, 1986; Koutselini, 2008).

Thus, the present research poses the following questions:

- (a) What are the problems/challenges teachers face in their effort to design and implement differentiated lessons in their class and how do they handle them in order to successfully teach in mixed ability classes;
- (b) What is the effect of teachers' active involvement in action research in their training and further professional development;
- (c) To what extent can differentiated instruction and learning contribute to the improvement of students' learning skills?

METHODOLOGY

Two Greek teachers participated in this action research. The first teacher, who had twenty-one years of teaching experience, participated in the research in the context of her doctoral studies. The other had a Master's degree in Special Education and ten years teaching experience. Students ($N = 82$) from four classes of the A' Lyceum were taught reading comprehension from October 2012 to April 2013 according to the principles of differentiation.

Quantitative and qualitative data were used to investigate the special learning conditions in classes and for a thorough analysis of the phenomena (Lazos, 1998). Pre and post tests were given to the students in each of the four classes in which the differentiated teaching and learning was implemented - the experimental group - and to the students from the four other classes in which no differentiation in teaching occurred - the control group. Qualitative data were collected via the use of teachers' journals, class observations, lesson plans and student and teacher interviews. The control group consisted of 81 students who were taught by two other teachers. The experimental and the control group were similar in the number of boys and girls, the origin and the education of parents as well as the fathers' occupation. Differences appeared in the mothers of the students of the two groups; in the control group a larger percentage (22%) of mothers had graduated from college while 14% had graduated from university. In the experimental group 13% of the mothers had graduated from college with 7% of the mothers having graduated from university. Another difference had to do with the mothers' occupations; in the control group 47% of mothers were employed in service occupations and 11% were employed in occupations which required tertiary education. In the experimental group these percentages were 32% and 6% respectively.

For the analysis of quantitative data the Rasch model (Quest Program) and Multiple Regression analysis (SPSS 19) were used. The independent variables were entered into the model step by step according to the stepwise method. Additionally, the t-test for dependent samples was implemented in order to investigate the permanence of the experimental group's reading skills according to the tests which were given in May and October 2013. For the analysis of the qualitative data content (Marshall & Rossman, 2008, 2011) and discourse analysis were used (Gee, 2011).

RESULTS

A study of the qualitative data indicated that the difficulties teachers face in the beginning of their efforts to differentiate their lessons related to:

- (a) First and foremost the lack of a structured curriculum based on prerequisites, substantive and transformational knowledge and skills which can function together in every class and from class to class.
- (b) Secondly teachers' inability to sufficiently ascertain their students' readiness even though they had studied the results of the pre-test.

A study of teachers' first lessons indicated that the difficulties also related to:

(a) Teachers' inexperience in designing appropriate activities in order to address students' readiness, interests, learning style and incentives.

(b) Inflexible class organization and weaknesses in the organization of group work which resulted in teachers not being able to manage the class and teaching time being wasted.

(c) Teachers' misconceptions such as the idea that the teacher is the source of knowledge and has to transfer it to his or her students and that the teacher has to complete the syllabus even if the students have knowledge gaps.

(d) Teachers' fear and uncertainty about their ability to successfully differentiate their lessons.

The thorough study of the actions which teachers implemented to overcome the difficulties contributed to the answer in the second research question. On the one hand, the data reveals the crucial role of lesson observation, teachers' diaries, and teachers' meetings, as well as discussion about the merits and defects of their lessons, and teachers' self-reflections regarding conceptual change and in their persistence in the achievement of their aims. One of the teachers reflecting on her involvement in the action research pointed out:

“Even though the problems were complicated, I coped with them with greater courage and willingness to solve them than I did previously. My colleague and the interest of my students made me strong. I did not give up as I used to do before and I didn't adopt a traditional way of teaching. Everything was done after study and hard design. We investigated the reasons for the problems and looked for and found solutions. We did not work intuitively or incidentally as I had done in the past.”

On the other hand, the contribution of self-reflection in the reexamination of misconceptions which arose and which proved to be obstacles in differentiating teaching is obvious in the following extract from one teacher's interview:

“In the past, I strongly believed that the students learn only when I give and explain the new knowledge. I would give examples and write the most important information on the board. I was disappointed when I found out that few students had learned the new information I had taught. My participation in the research helped me realize a lot of things. I must admit that I enjoyed the fact that the lessons were not teacher-centered, that students found and discussed information through the activities. Many times, I was surprised by the maturity of their answers”.

The teachers studied the relevant literature, cooperated and found out the appropriate solutions for solving the initial problems. During the action research, they implemented the following actions to overcome the difficulties:

(a) The first thing was the development of a Program in reading and comprehension in the A' class of the Lyceum in which the knowledge and skills a literate person masters are defined and analyzed according to the relevant literature (Centre of Educational Research, 2007; Kucer & Silva, 2013; Matsaggouras, 2007; Vacca, Vacca & Gove, 1995; Vamboukas, 1992). In this Program students mastered the following reading skills and had to:

- Identify and underline information explicitly expressed in the text.
- Recall with accuracy information explicitly expressed in the text.
- Combine information from different parts of the text to complete an answer.
- Make inferences from the text by correlating information from different parts of the text and text information with their pre-existing cognitive schemata (as regards the theme or the structure of the text or the social, historical, geographical etc. context)
- Use pre-existing conceptual and cognitive schemata to interpret information, feelings and situations
- Identify and comment on the representations of reality that appear in the text, focusing on the writer's intentions and assumptions arising from the text.
- Evaluate the effectiveness of the text in relation to its target audience, by producing and utilizing criteria regarding the form and content of the text.
- Evaluate their own path to understanding the text, through monitoring, coordination and correction of all the reading strategies they use to achieve their purpose more effectively.

(b) In addition a thorough study of the results of the pre-test, as well as a clarification of which reading skills had been achieved and at which level by each student, was conducted. In such a way the starting level of each student, as well as the zone of his/her proximal development, was defined with accuracy.

(c) Moreover, an analysis and hierarchy of the teaching objectives from the simplest to the most complex was conducted and in this way a definition of prerequisites, substantive and transformational knowledge and skills was facilitated. For example, the aim of making inferences from the text, which was found to be very difficult for students, was analyzed in simple steps. Students identified and underlined information relevant to the question, correlated the latter information with pre-existing cognitive schemata, found relations (similarity, contrast, cause-effect etc.) and expressed their line of reasoning.

(d) Furthermore, teaching reading strategies and developing metacognitive skills (Erickson, 2009 ;Ness, 2008), as well as skills of student autonomy learning (Afflerbach & Meuwissen, 2005; Irvin et al., 2007), were implemented – the latter reading strategies included: a preview, strategies for understanding unknown words, posing questions, finding and underlining important information in the text, synthesis of information, creation of a concept map with the main information and the relations between it, paraphrasing the text and self regulation and redesign of the path towards understanding.

(e) Another action implemented was the selection of various texts (printed and electronic texts, comics, pictures, video clips) of graded difficulty, with the active

involvement of students, with the texts being consistent with their readiness and interests (Alvermann, 2002; Rasinski & Padak, 2004).

(f) The design of authentic activities which presupposed reading also helped teachers meet the different interests of students (Lenters, 2006; Reutzel & Clark, 2011). Such activities included writing articles in the school magazine, preparing speeches in order to take part in a debate, finding solutions to problems students have to cope with.

(g) Efforts were made to meet the different student learning profiles. This entailed:

- Using visual and auditory stimuli and various codes (language, pictures, charts, diagrams).
- Connecting new and pre-existing information and giving suggestions on how to organize the latter.
- Giving activities which allowed students to work alone (eg. text production by using information from the texts studied in class), or with the members of their group (eg. debate on a subject that arises from the texts)
- Allowing students to choose between guided activities which presupposed a series of steps (eg. collect their classmates' opinions about the use of Greeklish), and creative activities that allow students to choose how they work (eg. write a text to protest).

(h) A non-competitive class climate was achieved through motivating students to cooperate with their classmates, through emphasis on the process of accomplishment of each activity instead of the final result and through individual feedback or team feedback (Koutselini, 2008 ;Tomlinson & Imbeau, 2010).

(i) The development of cooperation skills (active listening, respect for different opinions, discussion by using arguments and cooperation in order to successfully obtain common objectives) was achieved. At the same time, a code of behavior was applied which was created with the active involvement of the students. Self-evaluation and peer evaluation were also promoted with positive behavior in group work being rewarded and roles being assigned.

The direct and active involvement of teachers in responding to students' differences contributed to the successful teaching of reading skills. The Hierarchical Regression Analysis showed that the distribution of the performance of students of the experimental and the control group was interpreted by the participation in the intervention and by the performance in the pretest only. The participation in the intervention contributed more to the interpretation of the distribution of the performance (38%) than the performance in the pretest A1 (21%) (Table 1).

Table 1.
Hierarchical Regression Analysis for variables that explain the performance in the posttest A2

Independent variables	B (SE)	B
<i>Second step</i>		
Participation in the intervention	1.66 (0.12)	0.73***
Performance in the pretest A1	0.68 (0.08)	0.47***

Notes.

R²=0.59 for the second step *p<0.05, **p<0.01, ***p<0.001

It is very important to mention that, according to the Hierarchical Regression Analysis, the variables of sex, classes of teacher b' and low education of mother (primary and or lower secondary school) interpreted - before the implementation of intervention - the 26% of the distribution of the performance in the pretest A1 (Table 2).

Table 2
Hierarchical Regression Analysis for variables that explain the performance in the posttest A1

Independent variables	B (SE)	β
Boys	- 0.76 (0.11)	- 0.46 ***
Classes of teacher b'	- 0.38 (0.13)	- 0.2 **
Mothers' education (Primary or and lower secondary school)	- 0.31 (0.14)	- 0.15 *

Notes.

R²= 0.26 *p<0.05, **p<0.01, ***p<0.001

Nevertheless, after the intervention, the variables of sex and mother's low education did not affect the interpretation of the distribution of the performance in the post-test A2. This reveals that the impact of the intervention stopped the negative role of these two variables in students' performance in pretest A1 and shows the catalytic role of the intervention in boys' performance as well as in the performance of students whose mothers have low education. At the same time, the students of teacher b' increased their performance by 1.66 points in posttest A2 as a result of their involvement in the intervention, whilst their performance in pretest A1 remained constant.

Additionally, according to the t-test in dependent samples, the performance of students of the experimental group in the comprehension of informative text remained at the same level five months after the intervention.

The relative analysis shows that they performed better in posttest A2 which was given in October 2013 ($\bar{x} = 0.75$, $SD = 0.76$) than in the posttest A2 which was given in April 2013 ($\bar{x} = 0.71$, $SD = 0.88$). This variance was not statistically significant ($t = -0.49$, $df = 77$, $p > 0.05$).

Student discourse analysis revealed a broadening of students' knowledge regarding the meaning and the dimensions of reading after the intervention. Low performance readers mentioned the cognitive dimension of reading, moderate and competent readers mentioned the critical dimension of reading and more competent readers defined the metacognitive dimension as well. Simultaneously, students used this knowledge to evaluate themselves as readers and to clarify their difficulties in reading comprehension. On the contrary, before the intervention a great number of students (56 out of 82) stated that they did not experience any problems in comprehension.

At the same time, student discourse analysis showed that the number of reading strategies students knew and used increased after the intervention (Table 3). Additionally, the majority of students declared that their reading skills had improved due to their newfound knowledge of reading strategies.

Table 3
Reading Strategies students (N = 82) know and use before and after the intervention

Reading Strategies	Before	after
Preview	55	73
Find and underline important information in the text	32	66
Write keywords or points next to each paragraph	6	24
Carefully reread a text or paragraph in order to identify keywords, correlate the words with known information and to reword what they perceive as important	45	54
Use the context for understanding unknown words	29	61
Use a dictionary	26	47
Analyze the parts of words or find the family tree to which the word belongs	6	45
Find synonyms or antonyms of words	5	44
Find the definition of a word in the text	3	22

It was also found that before the intervention students believed that knowledge was comprised of an amount of difficult and “*useless*” information which the teacher presents, explains and writes on the blackboard or in leaflets, whilst students have to listen to, read or rewrite this information in their notebooks, in order to learn it as the teacher wants. However, after the intervention the meaning of knowledge changed for the students.

They mentioned the reading skills and strategies they had learnt and the contribution of these skills and strategies in their comprehension of a difficult text. Students considered these skills and strategies useful and permanent knowledge which equipped them with the skills to find information in a text, something which they could not master previously. As a result, their feelings of “*desperation*” were eliminated.

According to students’ comments, after the intervention, the resources which were used in the lessons were interesting. The learning environment became not only creative but also one of acceptance, encouragement and the expression of personal interest. In this environment many opportunities were given to students to cooperate with their classmates, to communicate, to exchange opinions and express their disagreement. In such a way this learning environment motivated the efficient as well as the less efficient students to learn. It was obvious that this learning environment was different from the competitive and authoritarian climate which they had experienced before.

CONCLUSION

In this research the catalytic role of the direct and active involvement of the teachers in the solving of problems which arose in the class is obvious. Solutions to the challenges of teaching in mixed ability classes are not given by experts nor are they imposed by an external authority. On the contrary, teachers should investigate, find and design solutions according to a cyclic, spiral procedure from student needs assessment to definition, analysis and hierarchy of the objectives of learning and teaching, and then to the design and implementation of differentiated lessons, evaluation and redesign depending on the new needs of students. In this way teachers can become autonomous (Koutselini, 2008; Tricarico & Yendol-Hoppey, 2012). The benefits for the teachers are obvious, because by moving from theory to practice, they can acquire skills which enable them to design and apply differentiated lessons and feel self-confident and enthusiastic about their students’ success.

Teachers get rid of positivism and algorithmic procedures of curriculum development - products of modernity - which have as their aim the transmission and reproduction of the dominant culture (Giroux, 2010). On the contrary, they become involved in a cyclic, spiral and heuristic procedure, in which the needs, as well as the obstacles the social structures and people’s interaction impose are realized by the teachers. Thus, teachers assume responsibility for solving problems and in so doing achieve their emancipation (Koutselini, 2010a). In this procedure of their occupational emancipation and maturity the role of conceptual change is crucial.

Conceptual change is achieved through their active involvement in the reconstruction and adaptation of the given curriculum to the micro level of the classroom, and through reflection and cooperation between the teachers themselves. This confirms research data which indicates that in order for teachers to realize their sub-conscious perceptions and possible misconceptions about teaching and learning it is necessary for them to have the opportunity to reveal and understand their false beliefs, as well as how these affect the transformation of their theoretical knowledge into active teaching (Giroux, 2010; Hargreaves, 1998; Koutselini, 2010a).

The positive results of the intervention on students' performance and the improvement of their knowledge about the dimensions of reading and comprehension reveal how successfully the teachers taught, which is in agreement with research data which shows the contribution of differentiation of learning and teaching to students' performance (Antoniou, Kyriakides & Creemers, 2011; Farkas, 2003; Valianti, 2010). Simultaneously, the results of current research contribute to the wider discussion on the preconditions of effective teaching and learning reading skills among adolescents (Biancoarosa & Snow, 2004; Cantrell & Carter, 2009; May, 2007). The better performance of students in the posttest correlates with the development of reading strategies. This result supports research data which highlight that the effective use of reading strategies distinguishes the competent readers from the non competent ones (Afflerbach & Meuwissen, 2005; Irvin et al., 2007).

From interviews conducted the belief of the majority of students that they have improved as readers shows the enhancement of their self-efficacy. The latter correlates with actions which teachers adopted, something which pupils were aware of as their interviews indicated. The above-mentioned actions included teaching to address students' readiness (Koutselini, 2008; Tomlinson, 2005), teaching reading strategies (Afflerbach & Meuwissen, 2005), providing essential feedback in order for them to improve their reading skills (Carpenter & Pease, 2013), as well as teachers' sincere interest, acceptance and encouragement (Subban, 2006; Tomlinson, 2003). It should be mentioned that teachers listened to their students' voices in order to address their diverse particularities (Koutselini, 2008; Tomlinson, 2009).

Taking into consideration that among the aims of differentiation of teaching and learning are the active involvement of students in problem solving, the development of critical thinking (O'Brien & Guiney, 2001) and cooperation skills (Carpenter & Pease, 2013), as well as attitudes and skills of self-regulation and autonomous learning (Koutselini, 2008; Tomlinson, 2005), in a dynamic learning environment (Koutselini, 2008; Straham, Kronenberg, Burgner, Doherty & Hedt, 2012), it is worth noting that students who took part in this action research confirmed the achievement of these aims, expressing positive comments on their role in the production of knowledge as well as the conditions under which they worked. It is obvious that learning is the outcome of quality teaching which is not based on what the teachers do, but on how and on what students are working on and how they feel, a finding which is reflected in the most vivid way in the following extract from one of the students:

“The lesson was more interesting than lessons in previous years. When we studied a text, the way we saw the world changed and sometimes we managed to change the attitudes of the members of our group ... it was fun to cooperate with my classmates... We found out knowledge ... All my classmates were more active than in any other lesson ... The students, who used to remain silent in other lessons, were active in this one”.

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CHANGING THE PASS MARK FOR THE MATHEMATICS ENTRANCE TEST

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ABSTRACT

Raising the pass mark for the entrance math test for prospective primary teachers has led to several unexpected processes in a Dutch teacher education institute. These include changing ownership of the math test from the group of math educators to the whole institute's team of teacher educators, the development of practice based theories on prospective teacher math learning by teacher educators and a discourse within the institute that touched upon the tension between prospective teachers who do not pass the test having to abandon their study vs. profiling the institute as setting high standards.

Thijs and Van den Akker's (2009) curricular spider web provided an instrument for explaining data from this case study. However, it also prompted a discussion on whether the curricular spider web is a useful instrument in the context of teacher education curriculum development.

INTRODUCTION

Prospective primary school teachers need sufficient mathematical skills to enable them to successfully participate in teacher education and in their future profession. In order to secure these math skills, Dutch teacher education institutes have for a long time set requirements in the form of entrance tests (Keijzer & Van Os, 2002; Straetmans & Eggen, 2005). Since 2005 the so-called Wiscat test is used at all Dutch primary teacher education institutes as a mathematics entrance test. Nationally, institutes agreed on a pass mark for this test at the p80 level of final year primary school students. This means that prospective primary teachers who just pass the test outperform 80 percent of final year primary school students, but it also means that 20 percent of these students will outperform this prospective teacher.

In response to discussions on the quality of Dutch mathematics education, a new nationwide test for prospective teachers, the so-called mathematics knowledge base test, has been launched recently. This is a test that prospective teachers need to pass in their third year in teacher education. Prospective teachers need to pass both tests to successfully graduate.

The Wiscat test and the mathematics knowledge base test are different in a sense that these tests target different aspects of mathematical skills. The Wiscat test tests arithmetic skills, while the objective of the mathematics knowledge base test is to test the prospective teacher's mathematical knowledge for teaching. However, although these tests are different in many respects, the Wiscat test score turns out to be a good predictor of the knowledge base test score (Keijzer & Hendrikse, 2013). Research by Keijzer and Hendrikse shows that a p80 score on this test is generally insufficient to achieve the level of mathematics required by the mathematics knowledge base test within two and a half years. They showed that a pass mark corresponding to percentile 92 of the numeracy level of final year primary school students is a better match.

These research results were an argument for the teacher education institute iPabo to raise the pass mark for the entrance test from p80 to p92. Prospective teachers who do not reach this score in their first year in teacher education, will not be allowed to continue their study. This case study describes processes and developments within the institute as a consequence of raising this pass mark. In this description we first will focus on prospective teachers' mathematical knowledge for teaching. Next, we will introduce a model for curriculum development that was developed by Thijs and Van den Akker (2009). In analyzing developments in the institute we will explore the extent to which their model is useful in describing the observed developments. We will end with a tentative conclusion and a perspective.

MATHEMATICAL KNOWLEDGE FOR TEACHING

Mathematical knowledge is considered critical for primary school teachers to achieve high educational outcomes (KNAW, 2009). However, for realizing these outcomes teachers need specific mathematical knowledge, often referred to as mathematical knowledge for teaching (Ball, Thames, & Phelps, 2008) and, in the Netherlands, as professional numeracy (Oonk, Van Zanten, & Keijzer, 2007). The Dutch mathematics knowledge base for prospective primary school teachers describes knowledge and skills that prospective teachers need to acquire during their study (Van Zanten, Barth, Faarts, Van Gool, & Keijzer, 2009). This knowledge base can be seen as an elaboration of the ideas formulated by Ball et al. and by Oonk et al.

Mathematical knowledge for teaching and professional numeracy both describe mathematical knowledge that is specific for primary school teachers. Ball et al. presented this knowledge in an oval scheme (fig. 1) symbolizing subject matter knowledge and pedagogical content knowledge.

As for subject matter knowledge, placed on the left in figure 1, Ball and colleagues show that a teacher should be able to use his or her mathematical knowledge in daily life. They refer to this aspect of teacher knowledge as common content knowledge. They also indicate that teachers need knowledge of mathematics as a formal structure, which they named horizon content knowledge. Apart from this mathematical knowledge that is not specific for teachers, Ball et al. use the term specialized content knowledge as knowledge that is for teachers only. This is, for example, mathematical knowledge that teachers use in analyzing students' work (Kool, 2013).

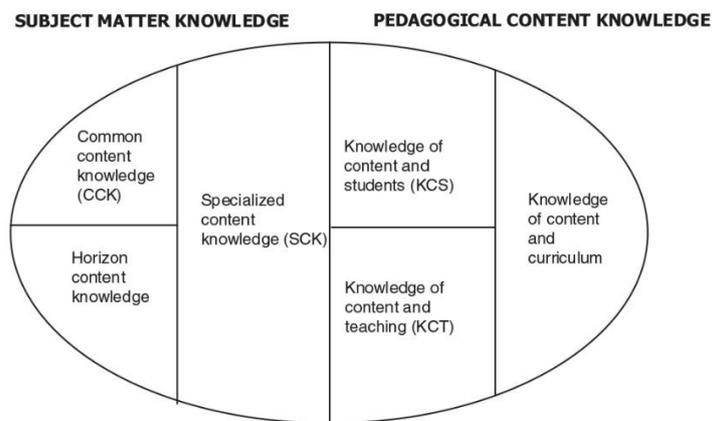


Figure 1. Mathematical knowledge for teacher (Ball, Thames and Phelps, 2008, p. 403)

Oonk, Van Zanten and Keijzer have chosen another way to describe teachers' mathematical knowledge. They extended notions such as number sense (McIntosh, Reys, & Reys, 1992) and mathematical literacy (OECD, 2003; OECD, 2004). Someone who is mathematically literate can identify and understand the role mathematics plays in the world and can make well-founded mathematical judgments in daily life situations. Number sense refers to a kind of feeling for numbers and relations between numbers and number operations. Teachers in primary education need to be mathematically literate and need to possess adequate number sense. But that is not sufficient. A teacher should also be able to utilize his or her mathematical literacy and number sense in teaching. Therefore, a teacher needs to recognize the mathematics of students' daily lives and in their surroundings, and use this knowledge of the students' learning in teaching. According to Oonk et al. mathematical literacy and number sense of teachers is of a different kind than mathematical literacy and number sense for people not teaching mathematics. They call this special kind of mathematical literacy: professional mathematical literacy. The way they define this special mathematical literacy and number sense of teachers implies that a teacher possesses mathematical knowledge for teaching as Ball and her colleagues formulated.

We discuss the ideas of Ball et al. and of Oonk et al. here, because both play a role in the mathematics knowledge base and its assessment. The knowledge base is founded on the notion of professional mathematical literacy, while nationwide assessment is aligned following the ideas of Ball et al. This is the case because Ball and her colleagues distinguish between subject matter knowledge and pedagogical content knowledge, while the teacher education institutes decided to limit the nationwide test to subject matter knowledge only (HBO-raad, 2013). Prospective teachers are tested on their knowledge and skills concerning common content knowledge, horizon content knowledge and specific content knowledge.

Both prospective teachers and their institutes want to be prepared for the nationwide knowledge base test. They therefore focus on those aspects of mathematical knowledge that are tested. Since especially horizon content knowledge is new in primary teacher education, this test raises questions about the mathematical knowledge prospective teachers need to show (Lit, 2010). From a different perspective teacher educators wonder how they can adapt their program so that on the one hand prospective teachers can pass the nationwide test, but on the other hand also develop pedagogical content knowledge that is not included in the test (Van Dam-Schuringa & Terlouw, 2012).

CURRICULUM DEVELOPMENT

Primary teacher education in the Netherlands is frequently influenced by new views on educating teachers, and therefore teacher education is developing permanently. These developments also affect the mathematics program within the curriculum. An example of this kind of development is the introduction of competence based teacher education as a means to address curriculum overload (Landelijk Overleg Lerarenopleidingen Basisonderwijs, Expertgroep Kwaliteit Lerarenopleiding Primair Onderwijs, 2004; Biemans, Nieuwenhuis, Poell, Mulder, & Wesselink, 2004; Wesselink, Biemans, Mulder, & Van den Elsen, 2007). Teacher education program renewal as a consequence of the implementation of competence based teacher education did sometimes lead to the intended results, but these results are also under discussion, for instance because they are not reflected in credits students need to complete their study (Pantić & Wubbels, 2010; Struyven & De Meyst, 2010; Kamphorst, Hofman, Jansen, & Terlouw, 2013). Another issue that is discussed extensively in relation to the shift to competence based teacher education is the role of pedagogical content knowledge and subject matter knowledge (Klep & Paus, 2006). The holistic view on professional development that underpins the idea of competence based learning marginalizes the need for teachers' domain specific notions on learning and teaching, as well as that for teachers' subject matter knowledge.

This example of a recent development in Dutch primary teacher education shows that this paradigm change touches upon more domain specific considerations in teacher education. This is especially so for mathematics education, because the mathematics curriculum in the Netherlands is also the subject of a societal and political debate (KNAW, 2009). We could say that here we see specific parts of the arena of developing the teacher education curriculum. Thijs and Van den Akker (2009, p. 11) visualized this arena for curriculum development as a spider web (fig. 2). And, although the considerations mentioned seem to be at some distance from the Thijs and Van den Akker model, we will use that model as the theoretical foundation in this case study.

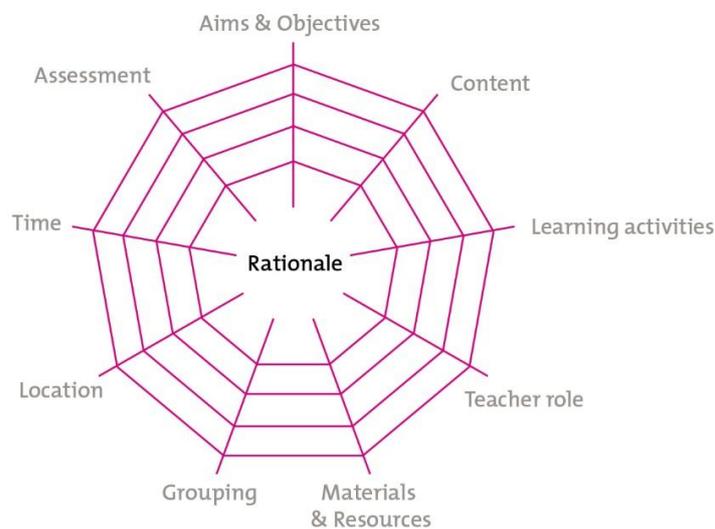


Figure 2. Thijs & Van den Akker, 2009, p. 11

RESEARCH QUESTION

This study describes the consequences of raising the pass mark of an entrance test for first year prospective primary school teachers. Indications that this higher pass mark was necessary for student teachers to pass a new nationwide test in their third year was a reason for the institute's decision to do so. Thijs and Van den Akker's model on curriculum development suggests that changing an assessment in this way could have consequences for other aspects of the curriculum. The model specifies the areas where these developments can take place. But as this model is not specifically developed with teacher education curricula in mind, changes in the curriculum may be of a different nature than the model indicates. This leads to the following research question:

What are the consequences of raising requirements for mathematics in primary teacher education?

We describe how this change in the curriculum influences learning and development of prospective teachers, teacher educators and others within the institute, such as the management, the board and the examination board.

METHOD

This study describes relations and connections within a unique and relatively new situation, which involves several, possibly unknown, variables. This situation is typical for case study research as research methodology (Yin, 2009). In this case study we use a large spectrum of sources to retrieve the data necessary to depict the situation of the study and to perform analyses needed to clarify relations and connections within the situation. Specifically we will use:

- prospective teachers' mathematics test scores,
- prospective teachers' narratives on work for mathematics in teacher education (obtained by semi-structured interviews),
- observations in mathematics lessons in teacher education,
- prospective teachers' opinions on the importance of mathematics in teacher education and demands on student teachers (obtained from a survey with a verbal explanation afterwards),
- teacher educators' opinions and ideas about demands on prospective teachers for mathematics (obtained through interviews, and discussions in formal and informal meetings for teacher educators),
- (documented) policy changes.

Interviewees were chosen so that all opinions and perceptions of the situation could be included in the research. We spoke with prospective teachers who attended most of the mathematics lessons, including the extra support. Most of these student teachers struggled with their mathematics. The teacher educators we spoke with were mathematics educators and prospective teachers' tutors. One of the mathematics educators was an experience math educator, while the other was an experienced educator, but had only recently started as mathematics educator. Both mathematics educators teach mathematics for first year student teachers. The tutors we spoke with, are tutors of first year groups of student teachers: two tutor team leaders and two tutors who spontaneously expressed their opinions on mathematics requirements for prospective teachers.

In the data that is obtained from interviews and otherwise, we next looked in different groups for ideas and notions that confirmed each other, in the sense that statements that were made in one group were tested in another. Furthermore we looked for explanations for events within the case that is subject of this research.

We elaborated these explanations in order to compose a ‘full story’, where we used theoretical notions on ‘assessment’ and ‘mathematical knowledge for teaching’. The ‘full story’ finally is validated in a member check.

The full story is in fact the case study. This study resulted in some tentative conclusions, which in a peer review were shared with mathematics educators of other, but similar, teacher education institutes.

RESULTS

Prospective teachers

Comparing prospective teachers’ test scores on the entrance test in 2013-2014 and 2012-2013 offers a first glance on the effects of the higher pass mark. In the year 2012-2013 the pass mark for the entrance test was 103 (corresponding to percentile 80 in primary education), which changed to 120 (corresponding to percentile 92 in primary education). When we compare the test scores over these two years, we see that prospective teachers who enter teacher education from general secondary education (Dutch: havo) did reach higher scores. Their average score rose from 117 (in 2012-2013) to 128 (in 2013-2014). In this group, not only did the average test score rise, the spread in scores also increased considerably, namely from 15 to 23. Since the distribution of the test scores is near normal, this means that a considerable group of prospective teachers score above 140, a score that is considered to indicate ‘strong in mathematics’. This means that raising the pass mark for the group of prospective teachers who enter teacher education from general secondary education did not only lead to a higher average score, but also to a larger group of high performers in mathematics.

This picture is dramatically different if we look at the development of prospective teachers who enter teacher education from secondary vocational education (Dutch: mbo). Over the two years mentioned, their average score increased from 103 to 105 (with sd is 21 resp. 26). This means that the average prospective teacher who entered teacher education from secondary vocational education only just reached the pass mark in 2012-2013, while in 2013-2014, with the higher pass mark, only a small portion of these student teachers could pass the test.

We thus see that the new pass mark makes it hard for many prospective teachers to pass the entrance test. That, however, does not mean that these student teachers do not agree with this pass mark. A majority of the first year prospective teachers state that primary school teachers needs to do very well in mathematics and therefore agree with the institute’s high requirements for mathematics (Duman, in preparation). However several students do criticize the test. This has to do with the adaptive nature of the entrance test, since this results in a situation where prospective teachers who take the test are always confronted with items on the edge of their knowledge and skills.

Low performers report that this leads to stress, as this confirms over and over again that mathematics is difficult and that they therefore will fail to pass the test. We however found that this is not a systematic effect. The development of prospective teachers who report stress for the test does not differ from student teachers who report no or less stress.

Prospective teachers also blame themselves for their insufficient score on the test. Several student teachers indicate that they underestimated the test. They experienced that if your skills in mathematics are not high enough, you should not study for the test a few days beforehand. An investment from the start of the study year is necessary, according to prospective teachers in interviews. Several student teachers only realise this halfway through the year and are therefore, they state, unable to realize enough progression.

The higher pass mark is a signal in two ways. On the one hand it indicates that students need to invest in their mathematical skills and knowledge. On the other hand it shows some prospective teachers that they are unable to meet the institute's requirements on mathematics. This might explain why more prospective teachers decide to prematurely stop with their study in 2013-2014, compared to 2012-2013. To put it differently, a consequence of raising the pass mark probably is that a number of prospective teachers do not take every chance to pass the test and stop early in their study, compared to when the pass mark was lower. We use the word 'probably' deliberately, because this case study did not focus explicitly on leaving student teachers' motives.

First year prospective teachers who continue their study generally choose to invest firmly in their mathematics. If the pressure of the test becomes high, they choose a reproductive learning style, where they try to memorize and automate procedures, without targeting meanings of numbers in the mathematics problems or the operations used in them (Vermunt & Verloop, 1999). Prospective teachers indicate that they appreciate explicit help offered by teacher educators, especially when help is offered in small groups and 'tailor-made'. They tell that they learn a lot from this kind of 'tailor-made' help. However, we were unable to find a systematic effect here. Prospective teachers who participated more often in extra help sessions did not show a larger increase in test scores. The variety of help that is offered to student teachers, for example from friends and family, and the variety of materials used, possibly explains why help offered by the institute does not systematically affect student teachers' growth. Where some prospective teachers participate in help offered by the institute, others benefit equally from the help of others.

Tutors

Tutors are teacher educators who form the first contact for prospective teachers when they encounter problems in their study. For a significant number of student teachers the high pass mark for the mathematics test is such a problem, therefore tutors talk about their struggle with the mathematics entrance test with prospective teachers.

One of the tutors says: “It is awful when you have to tell about a third of your group that they probably will not pass the test.” Tutors indicate that they want to be involved in this kind of policy change in the curriculum. For example they want to know what the basis is for raising the pass mark. In interviews with tutors they let us know that in their eyes there is no problem in raising standards, particularly when it is clear this contributes to the quality of primary education, the prospective teachers’ future workplace. They do, however, mention the relation between the entrance test score and the score on the third year mathematics knowledge base test. They argue:

- the higher pass mark is based on data from a time when teacher education was not yet fully focused on the third year test,
- there are many exceptions to what is found in statistical significant relations; prospective teachers with a low score on the entrance test are occasionally able to pass the third year test.

These arguments are founded on the idea that teacher education should show that it believes in people’s development. One of the tutors declared that, because of raising the pass mark, she has seen prospective teachers, whom she would have liked to keep at the institute, stop with their study. Tutors experience that the higher pass mark triggers prospective teachers. They work harder for mathematics. On the reverse some of the tutors get the idea that primary teacher education is only about mathematics. They see prospective teachers struggling in making choices. For instance, focusing only on mathematics to pass the entrance test, can lead to failure elsewhere, which in the end may also lead to a student teacher having to stop their study. The entrance test, according to tutors, results in prospective teachers’ unrest and stress. The adaptive nature of the test strengthens this effect, because prospective teachers cannot browse through the test and start with items they can do well. According to the tutors the adaptive nature of the test makes that student teachers are continuously confronted with their lack of knowledge.

Tutors are worried about prospective teachers who enter teacher education from secondary vocational education, since they are in general low achievers in mathematics. The tutors observe that these prospective teachers are often unaware of their inability. They look for blame for failing the test outside themselves, for example blaming the adaptive nature of the test or the stress experienced when working for the test, and while doing the entrance test. They think that working hard will solve these problems. On the other hand tutors notice that prospective teachers with a low performance in mathematics decide to quit their study earlier in the year 2013-2014 than their peers did in 2012-2013, when the pass mark was lower. Tutors experience that on all levels within the institute the problems prospective teachers experience are considered seriously. They welcome the mathematics section better targeting their activities at the problems student teachers face.

However, what remains is that in 2013-2014 more prospective teachers will give up their study than in previous years. In time that may be compensated by an institute that presents itself as offering high quality; for the short term the institute will lose student teachers and consequently educators' employment. Tutors mention the difference between the nationwide pass mark for the entrance test, which is lower than the institute's new pass mark. They assume that other institutes may benefit, because the iPabo invests a lot in their student teachers, which in some cases raises low performers to a level that is accepted by other institutes, though not by the iPabo. In this way some low performing prospective teachers are supported to switch from the iPabo to another institute. Therefore the tutors plead for a nationwide change of the pass mark for the entrance test, or at least one that is regionally set.

Mathematics teacher educators

At the institute, mathematics teacher educators support prospective teachers to the level of mathematical literacy as reflected in the entrance test pass mark. They observe that raising that pass mark activates prospective teacher, and that in this way the level of teacher education rises. Student teachers aim for higher requirements and in doing so reach higher than they did in recent years. Mathematics teacher educators notice that an investment from their side was needed. In cooperation with the management they realised extra time to support student teachers and started to fill in this time so that student teachers' activities met the higher norm.

One of the mathematics teacher educators says that setting higher norms is needed because of societal unrest about mathematics education. He notices that this has also changed the culture within the institute. This is related to the discussion within the institute resulting from raising the pass mark for the mathematics entrance test. Another mathematics teacher educator sees that higher requirements for mathematics skills makes that there is less attention for pedagogical content knowledge. He says: 'That is a pity, because especially pedagogical content knowledge inspires prospective teachers.' He recognizes a kind of paradox. Higher demands on student teachers' mathematical skills and knowledge were introduced to improve these prospective teachers' classroom performance in mathematics, and now this higher goal results in diminishing attention for knowledge on students, teaching and curriculum (cf. fig. 2).

Mathematics teacher educators notice that aiming for a higher pass mark makes that prospective teachers need to change from an instrumental learning style to learning directed at insight in mathematics. They see indications that prospective teachers can get a test score of 103 points (percentile 80 in primary education) when they learn for reproduction, which – in the teacher educators' opinion – is impossible when the pass mark is set at 120 (percentile 92 in primary education). Considering this, they see another problem. Many prospective teachers look outside the institute for help to improve their mathematical skills.

This help is usually aimed at reproduction and of an algorithmic nature, and generally not at acquiring insight in mathematics.

Mathematics teacher educators also see that the new pass mark provides a signal for low performing prospective teachers in mathematics, that they better leave primary teacher education. In this way the test functions effectively as a means of selecting student teachers. Furthermore, raising the pass mark shows the outside world that the iPabo aims at quality. Mathematics teacher educators expect this will soon lead to a different group of prospective teachers in the institute.

Management

The institute's management chooses to raise the entrance test pass mark, in response to research that linked the test score in the entrance test and that of a nationwide third year test (Keijzer & Hendrikse, 2013). The management, in doing so, considered that it is better to tell prospective teachers in their first year of study that they cannot continue their study, than in their third or fourth year in teacher education.

Shortly before the summer break, the research results became available, and therefore some haste was required in raising the pass mark. The mathematics section proposed changing the pass mark, after learning about the research results through their professional network. Mathematics teacher educators were very pleased with the response from the management in this matter. Supported by the management they started adapting the mathematics curriculum for the new pass mark. After the summer break the institute's management noticed that because the change was implemented fast, tutors were not or insufficiently informed. They then organized talks between mathematics teacher educators and tutors to explain what considerations played a role in this change in pass mark. Several talks between tutors and management followed, when it appeared that the higher pass mark raised many questions for the tutors in their meetings with student teachers. In these talks tutors were mostly interested in learning about the actions undertaken by mathematics educators to help the prospective teachers in getting to the requested level. They thus had information they could use when talking with student teachers, for example that participating in extra help could be necessary to reach the requirements set by the institute.

Tutors also raised questions when they saw that more student teachers decided to leave the institute than in previous years, when the pass mark was lower. This loss of prospective teachers for the institute was also a concern for the management, which by taking this measure tried to aim at a higher quality of the institute and its prospective teachers, but realised that losing student teachers was another effect of their policy. The management took research by the mathematics research group of the institute into consideration²⁰.

²⁰ This is the research in this case study and whereof the results are presented in previous paragraphs.

During the year 2013-2014 the management monitored the effects of the new pass mark and supported mathematics teacher educators in helping prospective teachers to meet the institute's requirements. They for example facilitated extra time to help student teachers and appointed third year prospective teachers to provide 'tailor-made' help for their peers who were struggling with their mathematics. Moreover, the management felt that future prospective teachers also needed to be informed about the institute's demands concerning mathematics skills and knowledge. This resulted in 2014-2015 in changing information for freshmen and a changed intake of new student teachers.

REFLECTION

We motivated this case study on changing a pass mark for the Dutch nationwide mathematics entrance test. The pass mark was raised, because this should result in only those prospective teachers continuing their study after their first year who would probably pass a second nationwide mathematics test in the third year of primary teacher education. But both tests are not goals in themselves. The actual goal is teachers with sufficient mathematical knowledge for teaching, who are adequately prepared for teaching mathematics in primary school.

Thijs and Van den Akker's (2009) model for curriculum development shows a spider web as a metaphor to show how different aspects in this development influence each other (see fig. 2). This metaphor appears to be an adequate focus in describing the consequences of changing the pass mark of the mathematics entrance test. We saw that mathematics educators and their management motivated changing the content, learning activities and teaching materials used in teacher education, based on the higher pass mark. They connected a higher pass mark to ideas on prospective teachers' mathematics learning and decided that this should be aimed at insight in mathematics instead of fluency in following mathematical procedures. This then marked the direction in which mathematics in primary teacher education in the institute developed. A result of the higher pass mark and changing teacher education was that not all prospective teachers could be supported adequately within the provided time, so for specific groups of student teachers extra help was arranged. In their turn prospective teacher attend extra meetings but also choose their own ways to meet the requirements. This means teaching is situated both within the institute (by a teacher educator or assistant) and outside the institute. Preparing for the test of course also happens when prospective teachers do so at home.

Thijs and Van den Akker in their model demonstrate that the teacher's role is one of the factors in developing the curriculum. Our analysis shows that in this situation one can speak of (at least) two teacher roles, that of the tutor and that of the mathematics educator. Mathematics teacher educators target their support at prospective teachers obtaining insight in mathematics. In their turn tutors support prospective teacher differently.

They clarify the institutes' demands and discuss what efforts are needed to meet these. They also talk about these efforts in relation with other efforts needed to continue the study after the first year.

The rationale behind demands for prospective teachers' mathematical knowledge is that their teaching in primary education depends on this mathematical knowledge for teaching and, moreover, that this mathematical knowledge is needed in obtaining pedagogical content knowledge. Demands laid down in the third year mathematics test show societal demands for teacher education. Raising the entrance test pass mark can be seen as a policy change to follow this call from society. Raising this pass mark in this way touches upon the curriculum's rationale, in the sense that a higher level of prospective teachers' mathematical proficiency is needed to show the quality the institute requires for becoming a teacher.

TENTATIVE CONCLUSION

This case study researches consequences of changing a pass mark for a mathematics entrance test at the iPabo. Analyses within the case study are meant to find out what effects may result from this curriculum change. In the case study we see that a higher pass mark results in several obvious consequences. Prospective teachers work harder to meet the institute's demands, and there are more student teachers who cannot meet the new demands. The latter, whether prospective teachers are able to meet the demands, is somewhat related to the prospective teacher's previous education. Prospective teachers who enter teacher education from general secondary education (Dutch: havo) are generally able to develop to the level required by the institute. Prospective teachers who enter teacher education from secondary vocational education (Dutch: mbo) show no or less development and student teachers from this group more often choose to leave teacher education (Meijer, Vermeulen-Kerstens, Schellings, & Van der Meijden, 2006). Mathematics teacher educators invest in adapting the mathematics curriculum and talk to tutors about their efforts and considerations, to convince them of the necessity of the higher demands and to show what they do to help the first year prospective teachers.

The discourse within the institute in the group of tutors, in the group of mathematics teacher educators and also the discourse between these teacher educators – with and without the management present – is in fact a discourse on the tension between becoming a high quality teacher education and the care for prospective teachers who want to meet the institutes demands in their own way and in the time they need to meet these demands. It is a discourse where opinions about education and research results meet. In the institute research results on prospective teachers' academic progress and the way student teachers invest in their mathematical skills are discussed; both result from developing teacher education. This is of high quality and there is reason to presume that prospective teachers' failing development reflects their capacities.

However further optimizing teacher education may offer low performing prospective teachers the small amount of extra support they need to develop their mathematical knowledge for teaching to the level demanded by the institute. In this discourse on ways for realizing high quality teacher education, teacher educators develop into researchers of their teacher education practice. They question their practice and are supported by critical friends. They look critically at research results, knowing that these results have their limitations. They look at the results of teacher education as prospective teachers' development, and consider change aspects of the curriculum from this perspective. They thus ultimately realize thought through teacher education, aimed at current targets, knowing that teacher education will never be finished and that up-to-date will be outdated soon.

EPILOGUE

The decision to raise the pass mark for the mathematics entrance test was taken on short notice. This was necessary, because haste was needed. The examination board therefore checked at the end of the college year whether enough care had been taken in this decision. Shortly before the end of the college year the examination board declared that this was not the case. As a consequence prospective teachers who did not meet the new requirements, but did meet the old requirements, were allowed to enter their second year in primary teacher education. This does not make this case study of less interest. The institute decided to implement the new pass mark (in a somewhat adapted form) in the new season, this time doing so carefully enough. Therefore we can consider the year 2013-2014 to be a dress rehearsal for the year 2014-2015. And this is as true for adapting the curriculum as for grounding the requirements set for mathematics. The discourse on the pass mark will certainly continue in 2014-2015. In 2013-2014 this discourse proved a fertile starting point to improve teacher education as practice based research. That will be no different in 2014-2015, nor will it be limited to the iPabo. Many institutes for primary teacher education are looking for ways to effectively support prospective teachers in acquiring mathematical knowledge for teaching. Discourse between professionals is the most obvious way to arrange this. In that sense this case study provides ideas for other institutes to develop the institute's culture, while at the same time demands for prospective teachers meet what society expects from teacher education.

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NETWORK INTERVENTIONS ON THE PROCESSES OF THE E-JOURNAL OF THE FINNISH UNIVERSITIES OF APPLIED SCIENCES

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ABSTRACT

This article addresses the activities of the UAS Journal, which is published by the Rectors' Conference of Finnish Universities of Applied Sciences (ARENE). The UAS Journal focuses on education, research and development activities in the fields of practice-oriented higher education in Finland. The intent of this study is to find out if our interventions have supported the development of the journal; the distinct research method employed is action research supported by quantitative content analyses. Interventions have been carried out in the formal sector, via an editorial board, and in the informal sector, via Facebook and e-mailing.

Our paper is organized as follows: the first chapter introduces the reader to UAS Journal e-publication. The second chapter discusses the network as background to the UAS Journal based on the different network roles. The action research orientation of the study is introduced in the third chapter. In the fourth chapter, the interventions and the outcomes are presented. The results of the study are discussed and summarized in the fifth and concluding chapter.

Keywords: action research, higher education, open journal system, journalistic process, university of applied sciences, UAS Journal

INTRODUCTION

This article deals with the activities of the *UAS Journal* which is published by the Rectors' Conference of Finnish Universities of Applied Sciences (ARENE) and has been financed by the universities of applied sciences (UAS) since 2010.

The *UAS Journal* is published online (www.uasjournal.fi) and includes four issues a year. The articles of the journal are published mainly in Finnish.

The aim of the *UAS Journal*, according to ARENE, is to be a window to the Finnish UASs. Additionally, networks and their activities (such as the production of an electronic journal) are important aspects of human capital and help increase institutional support for a particular region (Coleman 1988), and higher education institutions are significant regional actors (Ministry of Education and Culture 2010). The *UAS Journal* can be seen as one of the instruments carrying out the so-called third task, or regional development activities, of the Finnish universities (ARENE 2013). The journal focuses on education and research and development activities in the Finnish UASs. One of the aims is to clarify the profiles of traditional universities and universities of applied sciences (Wolff 2002). The main target groups of the *UAS Journal* are the staff members of Finnish higher education institutions, their interest groups and actors in the related work organizations. Currently, the journal aims to attract readers from outside Finland, especially from European countries (Kantola & Friman 2012).

The *UAS Journal* is a combination of a magazine and a scientifically-oriented publication: it is possible for the authors to both write expert articles and publish peer-reviewed articles (PKP 2011) in the journal. Both the semi-closed internet publication platform and the new possibilities provided by open social media have been adopted by the journal (OJS 2011).

The goal of the journalistic process of the *UAS Journal* has been to facilitate knowledge-sharing and educational practices by building up the capacity of Finnish networks in strategic multi-field areas to collaborate in a more integrated type of partnership (Panhelainen & Suosara 2008). At the beginning of the new millennium, the e-journal network was one of the many activities engaged in by those developing Finnish UASs (Kantola et al 2007). Networks, in general, played an important role in the diffusion and adoption of different kinds of educational innovations (Rogers 1995). The developer network behind the e-journal was part of a program carried out between 2002 and 2009 to build social networks between individual experts working in UASs and traditional universities.

The *UAS Journal* has been published since 2010 as the result of a merger of *Keve* and *Osaaja* (Friman et al. 2009). The merger presented new challenges because it represented the combination of two different starting points, working methods and target groups. The four annual issues of the *UAS Journal* can each be seen as a managed mini project.

The intent of this study is to support the development activities of the *UAS Journal*. Thus, the distinct research method is action research supported by quantitative analyses (Kuula, 2001; www.scu.edu.au). The first author in this article, is the editor of the *UAS Journal*, while the second author is the journal's social media expert and the third one, is the sub editor.

The user data presented in the article has been collected using Google Analytics. Interventions have been made in the formal sector, via the editorial board, and in the informal sector, via Facebook and e-mailing.

ACTION RESEARCH

In general, action research is not a single theory but rather a framework for how to deal with situations where the researchers are part of the research process. Action research covers many forms of action-oriented research. There are two different profiles that the action researcher may have: that of the insider, as an active manipulator, or that of the outsider (Coughlan et al. 2002; Norton 2009). Of these two roles, the authors of this article have taken on the role and task of the manipulator.

The researchers of this study have intervened in three main areas: the editorial process, the marketing process and the network process. The interventions have mainly focused on these three processes, although the content of these processes does not exclude or exist entirely separately from other processes. The main objective has been simply *to increase networks in the UAS Journal both among the readers and the authors*.

According to the Lewin (1951), action research is intended to solve problems and is led by experts working with others; it involves a process of actively participating in a changing situation while conducting research. Lewin also stated that action research can be undertaken by larger entities, such as networks or institutions, and it can be assisted or guided by professional researchers with the aim of improving strategies, practices and knowledge about the environments within which the different stakeholders operate. In this sense, it seems that the method is especially suitable for the *UAS Journal* and the way in which it organizes activities across university boundaries. As designers and stakeholders, researchers work with other experts to propose a new course of action to help the *UAS Journal* network improve its work. In fact, Kurt Lewin was the first author to coin the term action research by saying that it is "a comparative research on the conditions and effects of various forms of social action and research leading to social action that uses a spiral of steps, each of which is composed of a circle of planning, action and fact-finding about the result of the action" (Lewin 1951).

Thus, action research is open ended with no fixed hypothesis. It begins with an idea that is developed and followed through with during the research process, with researchers always accounting for how it is progressing and continually checking whether it is in line with what they wish to happen. Seen in this way, action research can be viewed as a form of self-evaluation. (McNiff 2013.)

THE NETWORKS

The *UAS Journal* network consists of different sub networks. The journal itself can be seen as a project or as a development program produced and supported by the network. The Rectors' Conference of Finnish UASs has required that a related, national expert network should be supported and has assured via its recommendations that all Finnish UASs are somehow involved in the journal's processes. ARENE also stresses that higher education stakeholders should be involved, which partly explains the member composition of the board of advisors. Looking at the network more closely, it is possible to recognize several activity roles connected to the processes employed by the *UAS Journal*.

The **board of advisors** represents the interest groups and stakeholders. The role of the board of advisors is to set the general guidelines for the procedures and themes of the publication. The members of the board meet twice a year. The **board of editors** consists of the staff members of traditional universities and universities of applied sciences. The board of editors suggests themes, subjects, articles, and authors to the chief editors and bring their expertise and networks to the assistance of the *UAS Journal*. The board of editors meets three times a year.

The **chief editor** bears the juridical responsibility for the *UAS Journal* and set the publication's guidelines and policies. In practical matters he/she acts in close cooperation with the editor, visiting editors and also the writers. A **visiting editor** is an invited expert on the subject matter. His/her task is to commission interesting articles by inviting knowledgeable authors to participate. The visiting editor reviews the articles for (formal) correctness before sending them to the chief editors and to the editor. For each issue, the **sub editor** manages the table of contents and the incoming articles, acquires the permission to publish from the writers, proofreads and does the layout for the articles, submits them to the publication, prepares the issue data, publishes the issue and sends out the marketing e-mails and press releases. He/she also follows, analyses, and reports the statistics.

The network of **authors** is actively involved on the supply side, and yet the authors are also a very active group on the demand side as well (as readers and users). Lacking user surveys and identified user data, we are assuming that the regular **readers** consist of the staff of universities and UASs as well as their interest groups and those involved in related projects.

INTERVENTIONS AND OUTCOMES

In this chapter, we will introduce our interventions to the *UAS Journal* in the same order as the journalistic schedule proceeds. This can be called the design of our action research project (Coughlan et al 2002). The new technologies and information networks have widened the possibilities for flexible systems of production (Dewdney et al 2006) which can be seen also in this case.

As mentioned earlier, the aim of the *UAS Journal* is to inform and advise the staff both in UASs and working organizations about research and development in order to promote cooperation between educational institutions, business and industry, thus advancing regional vitality and prosperity (Friman & Rissanen 2011). In following, we describe each process at the same time, introducing the ideas about how to intervene in and develop the process. Each intervention may have different sub-elements or indicators, which again can be analyzed in different ways (user data, meeting memos, etc.).

Table 1 below describes the interventions, indicators and outcomes that we have focused on in our e-journal activities and the network processes that both help to produce and make use of the *UAS Journal*. The interventions' time range is four years: from the spring of 2010 to the spring of 2014.

Table 1.
The interventions, indicators and outcomes of the UAS Journal

Processes	Interventions	Indicators	Outcomes
Editing process	Merging two publications	One online publication with a mission	www.uasjournal.fi
	Forming editorial and advisory boards and building an author network	One editorial and one advisory board; number of articles, writers and participating organizations	Board members named. Number of writers has increased. Number of articles and organizations constant
	Widening the scope of topics and articles	Variety of themes	A different theme for every issue
Marketing process	Direct e-mailing	User statistics on site	Number of visits and visitors has increased, two out of three visitors new
	Press distribution	Media hits	Not followed
	Use of existing networks	UASs' intranets as traffic source, Facebook activity, network activity	UASs not a significant source of traffic, use of Facebook growing, Kever member as writers in <i>UAS Journal</i>
Networking process	Supporting co-writing	Number of co-written articles	Number of writers has increased
	Inviting peer readers	Number of peer-reviewed articles	Referee process in place, number of articles steady
	Presence in social media: Facebook profile, LinkedIn group, Twitter account.	Number and activity of friends, members or followers.	Number of participants rised. Sharing increased.
	Utilizing the editorial and advisory boards	Activity of board members	Number of meetings Number of written articles

Table 1 shows how we have classified the main network activities into the three main processes: the editorial process, the marketing process and the networking process. The activities of these three processes are overlap somewhat depending on the nature of the activity.

Editing process

The main intervention concerning the editorial process has undoubtedly been the merger of the *Osaaja* magazine and the *Keveer* journal in order to establish the new *UAS Journal*. The goal of the merger was to preserve and develop the best practices of both publications.

The *UAS Journal* started off with two chief editors from both merged publications. After approximately one year, one of them concentrated on the referee articles and the other continued as the sole chief editor. By time, other commitments made it impossible for her to continue as the chief editor so a change was made. Soon after the two publications were merged, an electronic platform was inherited from the *Osaaja* magazine. The reason that the *UAS Journal* chose to use the open journal system is practical: both preceding publications were published on the very same platform and major technical changes seemed unreasonable at the time of the merger. We have also chosen to favour the authors' possibility to submit manuscripts based on the modern practices of visuality and user-friendliness.

The primary action of building and strengthening the author network has been to gather writers from the networks of editors and board members. The articles are both independent pieces of work and co-written texts. The number of authors has doubled in two years. At the same time, the number of participating organizations has gone up from 38 in 2011 to 54 in 2013.

The new visual identity, including a new logo, was designed for the *UAS Journal*. The structure (including the use of categories, the role of the front page, the relation between text and photos, the use of video, and so on) was formed on the basis of former practices. Over time, slight changes have made to the layout of the publication (e.g. the photo on the entry page) as well as to the structure of the content (e.g. shorter articles).

At the same time, as we were making decisions about the design and appearance of the journal, the editorial process was defined. The role of the editors is to make proposals about the issue themes, to filter agendas, to acquire and choose between articles, and to evaluate and to "package" the content. For the readers, there is an endless load of data and information on the Internet, and one issue of the *UAS journal* can be seen as a selected "package" of certain themes.

The production process for the *UAS Journal* has mainly been as follows:

1. The yearly plan for the themes for each issue is discussed by the board of advisors and the board of editors during the preceding year.
2. The process for the refereed articles has a schedule of its own, depending on the submitted articles and timetable of the peer reviewers.

3. Each issue is compiled with the cooperation of the chief and visiting editor and the subeditor.
4. The exact formulation of the headlines and the choice of authors are mainly done by the visiting editor and the chief editor just before publishing.
5. The marketing of each issue is roughly planned when the themes are discussed. More detailed target groups, channels and schedules are planned when making the issue.
6. User statistics are the numeric data we use for analyzing the success of our actions.

Publishing theme issues is our way of broadening the scope of topics and articles and, at the same time, of focusing and packaging the contents. We had a different theme for every issue in since 2011. Perhaps the most visible intervention, which also affects the usability, has been the shift from the use of pdf format files to the use of an HTML format.

We evaluate and develop the publication and the activities surrounding it by discussing the process and the product in advisory and editorial board meetings and by gathering feedback from the visiting editors. We count the continuation of funding as one form of feedback and a sign of satisfaction: ARENE continued to finance the journal after the initial project phase. In addition to advisory and editorial board meetings, a special ‘development team’ of three active members plans, undertakes, analyses and reports development actions.

Marketing process

We aim to both widen and engage the reader audience. In addition to utilizing existing networks, we use focused e-mail marketing to attract new readers. We are also present in social media to both market the publication and to network with people through a common interest. The target reader group and the *UAS Journal* network are mixed so that in part the readers and authors share the same environment in which the contents are produced and used. In other word, the network itself produces themes and topics that the publication processes for the network and for other readers as well.

E-mailing was the first and the only marketing method for a long time. The main target group was the communications departments of the Finnish UASs. New groups have been included in the mailing procedure and, at present, e-mails about each issue are sent to the following groups:

- The communications departments of the UASs (20+ recipients)
- Authors (15-20 per issue) are encouraged to spread the word in their circles
- The boards of advisors and editors get an e-mail reminder about the latest issue (15 members)

- The former Kever network members (230 people) are informed (see section 4.2.5)
- A focused distribution list of 500-700 e-mail addresses have been purchased for the use of each issue.

We measure the success of the e-mail lists by following user statistics. Most of the traffic to the site is direct, such as through e-mail links. The second biggest source is organic Google. Over the years, we have widened the reader audience, but there is no strong level of engagement — this is natural, as the themes and contents vary from issue to issue: approximately 70% of visitors are new (Google Analytics). We believe personal promotion to be an important activity in the marketing process. We aim to encourage all those involved to spread information about the publication in their professional networks and as part of their work in UASs. Some UASs are keener to promote the *UAS Journal* through their intranets than others, and this is evident based on user stats: those intranets can be identified as a clear source of traffic. This is thanks to the actions of the visiting editors, authors and communications departments.

The main purpose of our presence in social media is to support sharing and discussions about the content of the *UAS Journal* items. Additionally, Facebook activities have been focused on as a way to inform others about and discuss the publication. The number of friends in the UAS profile is about 500. So far, social media mainly covers the Facebook followers, but Twitter and LinkedIn have also been used somewhat. However, the audience has only had a minor role in these media. The UAS e-journal internet link to the new issue has been posted on Facebook and Twitter for the friends of *UAS Journal*. Each article and item has an independent URL of its own, so it has been rather easy to inform the Facebook network and to raise topics for discussion. The active discussions and comments have occurred on a rather seldom basis, but the liking actions have mildly increased. User statistics for the *UAS Journal* platform show that Facebook is a clear source of direct traffic. Facebook comments about the articles have helped increase the number of visitors and readers of those articles.

We have aimed to improve the transparency of the publication by writing articles about the making of and the use of publication. Beginning with issue 4/2012, there was a brief article on a chosen aspect of the publication, such as a glimpse at stats on the authors and their background organizations. According to user data, however, these articles were not very popular, and the series was discontinued after a trial period. UASs' communication departments are among the first to know about new issues. We have also prepared ready-to-use press releases for the UASs' internal or external use.

The networking process

One aim of the *UAS Journal* networking project is to promote networking between both individuals and organizations. By analyzing the knowledge sharing and networking processes together, the efforts to get authors to write together in new kinds of combinations have been important interventions implemented by the chief editors of the *UAS Journal*. This part of the intervention process has proved to be quite challenging and positive results have not materialized to the extent and at the speed we had hoped for. Likewise, some new collaborations and co-authoring can be seen but not to the extent that we had anticipated.

Invitations and choice of the referee readers is an important element in the networking process. The writing in the refereed articles is more important from a content point of view, but there is no defined mechanism for inviting evaluators, and in many cases the peer selection depends on the editor's own network. In some cases, a proper strategy for inviting referee readers could be more fruitful. In this case, the practice was adopted for the *UAS Journal* from the former *Kever* journal, where the board carefully discussed the focused invitations sent to readers. The main goal for the invitations has been to broaden academic awareness of the research being done as well as the R&D activities of the various UASs. The second goal has been to seek out international readers because about every second refereed article is written in English. The group of referees consists of about 20 experts, but it is increasing all the time.

The intervention of boosting the use of social media have been mainly connected to the goals of networking, sharing and learning from each other across different organizational and other boundaries. The place of social media in the *UAS Journal's* activities can be described by using the following figure (Figure 1), which can be referred to as open learning architecture, to underline the importance of the collective learning process; at the same time, the figure represents an attempt to sketch out a big picture of the different channels used by the network.

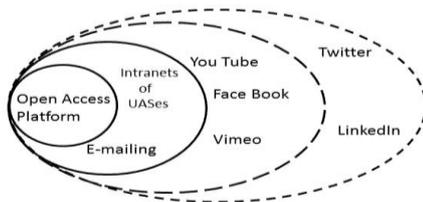


Figure 1. Information environment of the e-journal

It is extremely difficult to analyze whether or not these interventions have produced clear additional value. The *UAS Journal* has lot of friends on Facebook, but the amount of active communication is not high.

On the other hand, the knowledge (and experiences) about how to get attention for the higher education journal in social media is not yet very deep. What we know is that every time we provide brief information about items and issues in the social media, some people indicate that they like the idea and there are more visits to the journal site itself. Links on the web are a concrete form of networking. In 2014, we started to collect a list of peer journals which will appear on the www.uasjournal.fi website. We aim at outbound and inbound linking which will aid readers in finding other interesting resources and have a positive effect on the search engine optimization, as well.

CONCLUSIONS

We have found that action research is a relevant method for this kind of study. However, when action researchers are at the same time actors involved in the process or a part of the subject and active manipulators of it, then carrying out the study becomes quite demanding and time-consuming. It is also an important ethical demand to keep in mind that we may not to make the interventions because of our study but because of the principles of the journal. The roles of both advisory and editorial board are very remarkable as reflection partners and critics. (Zeni 2006.)

It is possible to study the processes of the e-journal in a network-related context by using action research. The action research approach helps developers focus on development interventions in otherwise chaotic environments. Action research strips the processes bare, forces us to make conscious interventions and enables us to study them in the light of measurable results.

The network-oriented approach described in this article has affected the activities of the e-journal. The editors, authors and readers are an active and important part of the network, not just passive observers. The network steers the journal and its contents. The number of authors contributing to the journal has increased. When the journal has more writers, then it can present more viewpoints and have richer and more interesting content.

The actions and activities of the *UAS Journal* and the networks behind it have developed and are developing over time. It will be interesting to see in the future where the saturation point for growth will be. It is difficult to predict the impact of technological or other changes on the production and consumption modes of e-publications such as the *UAS Journal*. We may well witness the extinction of such publications — or we may witness a thriving, cooperative development to the benefit of the *prosumers*, the consumers becoming the producers.

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**THE TODDLER PROJECT WORK AND OUTCOMES
(TOWARDS OPPORTUNITIES FOR DISADVANTAGED
AND DIVERSE LEARNERS ON THE EARLY-
CHILDHOOD ROAD)**

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ABSTRACT

The TODDLER Project (Towards Opportunities for Disadvantaged and Diverse Learners on the Early-childhood Road) involved 9 Universities across Europe. The project focused on the development of reflective teaching and course materials to support the provision for toddlers (18 – 36 months) from disadvantaged and diverse background and investigated different approaches to promote learning in a child centred way.

“High quality education and care from a very early age creates a good foundation for lifelong learning, especially for children from disadvantaged backgrounds. Equity in education is not yet realized for children from poor backgrounds, migrant families or parents with low education. The aim of this project was to strengthen the education of reflective practitioners to give toddlers a fair chance for lifelong learning.” (TODDLER, 2013)

Teaching and course materials were developed and produced around the areas of Toddlers within the European Context, Language Support in Multi-cultural Settings, Supporting Wellbeing, Enhancing Parental Involvement and the EYP as a Reflective Practitioner which underpins the other teaching and course materials.

A range of strategies were used to support the development of the teaching materials which were designed to be used in a flexible way around each of the areas. The final materials consist of Reports, Case Studies, an Observational Tool, DVD, an article and guidelines for reflective sessions to promote reflective practice in each of the areas. All the materials were designed to support early years' practitioners in making links between their knowledge and practice together with relevant theory and legislation supported by course guidelines.

INTRODUCTION

This paper consists of an overview and addresses the aims of the work of the TODDLER project, the theoretical framework underpinning the projects teaching materials and ethical considerations as well as information regarding the final teaching material outcomes.

The TODDLER Project was developed as a European Union, Lifelong Learning Comenius Programme, in partnership with 8 other European universities over three years and was completed in October 2013 in the culmination of the Toddler Conference, held in Ghent, Belgium on the 7th and 8th of October 2013.

The university partner countries consist of:

1. University of Stavanger, Norway, Lead Partner;
2. University College South Denmark, Denmark;
3. West University of Timisoara, Romania;
4. University College Arteveldehogeschool, Belgium;
5. Kingston University, England;
6. University of Education Schwäbisch Gmünd, Germany;
7. Instituto Politécnico de Santarém, Portugal;
8. Universitat Ramon Lull, Spain;
9. Haute Ecole Libre Mosane, Belgium.

The aim of the project was to develop the awareness of practitioners, within the early years' field, through the use of reflective practice and good examples of practice to increase awareness of the importance of educating toddlers from disadvantaged and diverse backgrounds.

The goals and objectives of the TODDLER Project were:

1. "to show the educational potential of high quality education & care in center-based settings for toddlers, in particular for those from low education/low income/migrant families.

2. to raise awareness towards the educational benefits of high quality ECEC for toddlers at risk and improve curriculum and teaching strategies of teacher education/in-service training
3. [to] contribute to a shift in the way provision for children under 3 is perceived.”

(TODDLER, 2013)

This was done through the development of flexible course and teaching materials which in their entirety are worth 5 ECTS (European Credit Transfer System).

OVERVIEW AND AIMS OF THE PROJECT

The project focused on one of the EU Commission’s priority themes for 2009-2010 identified in EURYDICE (2009), tackling social and cultural inequality for disadvantaged children. The aims of the project were to support early years’ practitioners, teachers and students in their understanding of how to promote development of toddlers (aged 18 to 36 months) from diverse and disadvantaged backgrounds.

The EURYDICE document (2009) identified how effective preschool education can promote life-long learning and provide opportunities to increase equality by supporting children in reaching their full potential. This research, with particular focus on diverse and disadvantaged children and their families, has highlighted that “what seems essential for all approaches is a positive socio-emotional climate, with emotionally safe and stable relationships, with sensitive-responsive, non-intrusive teachers” (2009:32). The EURYDICE document acknowledges that:

“The policy challenge, therefore, is to (re)build (current) systems of early childhood care and education that meet crucial design features as outlined above, that provide high quality care and education for all children, that are integrated, attractive and affordable to all families regardless social class or minority status, yet that is sensitive to differing educational needs and to compensate early educational disadvantages” (EURYDICE, 2009:39) and this therefore provided useful underpinning knowledge that has informed the development of the teaching and course materials produced by the project.

Also reinforcing this is the Effective Provision of Pre-school Education (EPPE) Project which highlighted the importance of high quality education and care from an early age to create a good foundation for lifelong learning, particularly for children from diverse and disadvantaged backgrounds within the pre-school and primary age group (Sylva et al, 2004).

These documents informed the aims of the project which were to strengthen the education of reflective early years’ practitioners to give toddlers a fair chance for lifelong learning through a range of teaching materials and resources demonstrating good/best practice.

This involved the bringing together of 9 experienced early years teacher training universities from different European countries to share, examine and develop different approaches, resources and materials to support toddlers and early years’ practitioners learning through the reflective process.

Figure 1, shows the contents and different teaching materials that were developed to support disadvantaged and diverse toddlers with the TODDLER website titles also included. The titles on the website contain the different teaching materials with the course guidance produced by the partners around five subject areas.

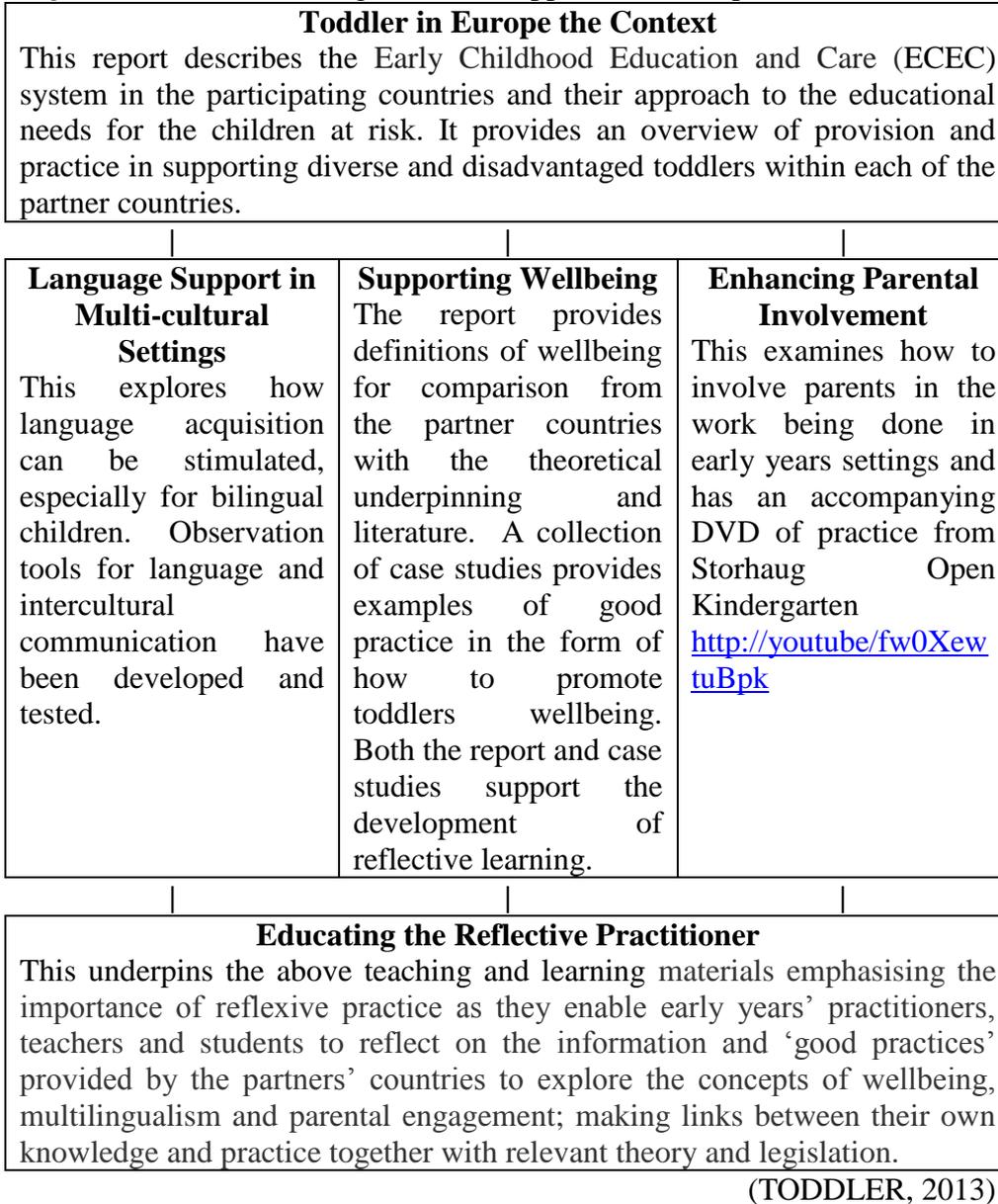
Figure 1. Programme of Work

No.	Project Organisation and Work	Titles for the Project Contents on the website www.toddlerineurope.eu
1	Project Management and Organisation	
2	State of the art	Toddlers within the European Context
3	Early Language	Language Support in Multi-cultural Settings
4	Promoting the Wellbeing of Toddlers within Europe	Supporting Wellbeing
5	Parental engagement/ involvement	Enhancing Parental Involvement
6	Educating the Reflective Practitioner	EYP as a Reflective Practitioner
7	Dissemination plan	
8	Quality Assurance	
9	Exploitation of results	

The subject areas for the teaching materials were developed so that the ‘Educating the Reflective Practitioner’/‘EYP as a Reflective Practitioner’ would support practitioners’ reflection and underpin the teaching and learning of: ‘Language Support in Multi-cultural Settings’, ‘Supporting Wellbeing’ and ‘Enhancing Parental Involvement’, see figure 2.

The teaching and course material for the ‘Toddler in Europe the Context’/‘Toddlers within the European Context’, sets the scene for all the teaching and course materials, see figure 2, providing the different realities and contexts for each country from which the materials were produced.

Figure 2. How the teaching materials support and underpin each other.



The main goal of the teaching and course materials for the subject area of the 'Toddler in Europe the Context' was to provide an overview and analysis of the context and situation of the provision for disadvantaged and diverse toddlers within each partner country.

‘Language Support in Multi-cultural Settings’ main goal was to identify the characteristics that are important when working with toddlers from multilingual and multicultural backgrounds. The main goal for ‘Supporting Wellbeing’ was the identification of good/best practices and strategies for supporting the wellbeing of toddlers through the use of reflection and comparison. The main goal of ‘Enhancing Parental Involvement’ was to support practitioners in fostering parental engagement and involvement through reflective practice to develop a better understanding of working in partnership with parents. The main goal of ‘Early Years Practitioner (EYP) as a Reflective Practitioner’ was to “establish a learning environment for systematic reflections on practice in the fields of ECEC for toddlers” (TODDLER, 2013).

All partners had input and contributed to these materials with different approaches being developed to promote opportunities for toddlers with each partner university contributing to all areas of the project. Haute Ecole Libre Mosane, Belgium took the lead and responsibility for the design and compilation of the ‘Toddler in Europe the Context’, the University of Education Schwäbisch Gmünd, Germany for ‘Language Support in Multi-cultural Settings’, Kingston University, England for ‘Supporting Wellbeing’, Instituto Politécnico de Santarém, Portugal for ‘Enhancing Parental Involvement’ and University College South Denmark, Denmark for ‘Educating the Reflective Practitioner’.

THE THEORETICAL FRAMEWORK AND ETHICAL CONSIDERATIONS

The ‘Starting Strong’ document (OECD, 2001) emphasised the significance of high quality care in early years as “the first step in lifelong learning and a key component of a successful educational, social and family policy agenda” (OECD, 2001). Further research, such as, the EPPE project (Sylva, 2004) has stressed the impact of highly qualified reflective practitioners in improving the outcomes for young children. This corroborated the EURYDICE document (2009) and provided the basis of the TODDLER Project as it identified and highlighted the needs of diverse and disadvantaged children. The European Commission identified the need for high quality provision for young children as a priority theme which informed the TODDLER project’s aims, goals and objectives. These documents provided the framework and theoretical underpinning for the TODDLER project. An important aspect underpinning this project is reflective practice as it enables early years’ practitioners, teachers and students to reflect on the information provided, explore how each partner country works with and supports early language development, wellbeing and parental involvement.

A range of strategies were used to gather the data and information for each of the subject areas, for example, semi-structured interviews were carried out for the 'Toddler in Europe the Context' which provided a basis for the creation of a SWOT analysis. Both quantitative and qualitative questionnaires were used with early years' practitioners and parents for 'Enhancing Parental Involvement'. An observational tool was developed and used in early years settings for 'Language Support in Multi-cultural Settings', representational case studies and reflective storyboards were created for 'Supporting Wellbeing' and reflective sessions developed and carried out with students for the 'EYP as a Reflective Practitioner'.

This project involved the use of vulnerable subjects 'toddlers' and their parents/guardians, early years' settings, practitioners and students. Data was gathered through observations, photographs, case studies, questionnaires, interviews, video recording and reflective sessions with students. Informed consent was therefore obtained from parents/guardians, early years setting managers and practitioners, and early years students. All participants were informed of how the data was collected, collated and used and the toddler's names were changed to maintain their anonymity. These were approved by the EU Lifelong Learning Programme and respective university ethics boards.

OUTCOMES AND OUTPUTS OF THE PROJECT

The project was completed in October 2013 and culminated with a final conference held in Ghent, Belgium where the findings and outcomes from the TODDLER project were presented and disseminated to 280 delegates from 12 different countries. The delegates consisted of Early Years Practitioners, policy makers and ECE providers.

The teaching and course materials produced for the whole project are housed and available at: <http://www.toddlerineurope.eu>. A European in-service course for early years' practitioners will be launched in the Comenius catalogue for 2014.

Toddlers within the European Context

It was important that each partner country situated and positioned the context of their provision for disadvantaged and diverse toddlers, as each country would have different policies, procedures, training and practices for this. The data and materials gathered were used to produce a report, guidance for instructors, posters and photographs of a range of provision from each partner. The guidance informs instructors to lead "a reflexive session... with students about the educational practices likely to reduce social and pedagogical inequalities in childcare organizations for toddlers" found within the report (TODDLER, 2013).

The early years' practitioners are asked to collect photographs illustrating their experiences of good practice. The report presents different provision, a comparative board, synthesis of the comparative board and a SWOT analysis for students and practitioners to compare each partner country with their own country.

Language Support in Multi-cultural Settings

“Over the past years pre-schools have become increasingly multilingual and multicultural in many parts of the world, including Europe. Early Years Practitioners (EYPs) are aware of this fact and deal with different nationalities during their everyday work” (TODDLER, 2013). It is then important that early years' practitioners develop good strategies and practices to support toddlers' learning and development of L1 and additional language learning.

The teaching and course materials “focused on language learning and the development of multilingualism and multiculturalism among children under three years of age.” With the materials produced providing “findings of second and third language acquisition research on language use in early childhood settings, case studies developed in eight European countries featuring examples of “best practice”, tools for examining the amount and quality of language support in pre-school settings as well as references and links to web-resources for further information” (TODDLER, 2013).

Supporting Wellbeing

The teaching and course materials for ‘Supporting Wellbeing’ comprise of guidelines and a PowerPoint Presentation for supporting the wellbeing of toddlers from disadvantaged and diverse backgrounds. This provides guidance and direction for the user as to how the materials could be used with links to the EURYDICE document (2009), for example, asking early years practitioners to identify the risk factors identified within the EURYDICE document that contribute to a child being referred to as diverse and disadvantaged and then exploring their own country's definition and the implications that this has for toddlers' wellbeing. The materials have been designed to be used flexibly to support the development of practitioner's knowledge and understanding through reflection, comparison and analysing the following materials:

- A Report
- Case Studies

The Report enables the practitioner to explore and reflect upon the concept of wellbeing making links between the each partner country's definition, theoretical underpinning, literature and relevant legislation that supports toddlers wellbeing from disadvantaged and diverse backgrounds was compiled. This is to be used in conjunction with the ‘Toddlers within the European Context’.

The Case Studies were designed to develop the reflective practice of early years' practitioners by consolidating their knowledge and understanding of different strategies of wellbeing of diverse and disadvantaged toddlers as they compared, contrasted and investigated the different examples of good/best practices demonstrated through the reflective storyboards provided within the case studies. "The case studies provide a useful method for the early years' practitioner, teachers and students to employ as it will enable them to explore, compare and contrast the various interactions, processes and practices that the different partner countries use to support diverse and disadvantaged toddlers wellbeing. The case studies comprise of photographs, narrative and statistical data on the setting chosen by 8 European countries providing evidence of effective practice with narratives which have been compiled into story boards" (TODDLER, 2013).

The reflective storyboards within the case studies focused on different aspects of wellbeing used within different early years' settings:

1. "Transitions and Settling-in of children into the setting.
2. Programme with or for Parents that helps them to support their child's wellbeing.
3. Activity or exploration that encourages children's wellbeing.
4. Enabling environment, such as, daily routine, resources or organisation of the environment.
5. Social Activity, such as, singing, Circle time or Meal time."

(TODDLER, 2013)

The materials developed for this subject area were trialled with students from Foundation Degree to Masters Level in five of the partner countries. The students provided evaluative feedback of their views and experiences of the materials in the form of qualitative and quantitative questionnaires and the partner countries who trialled the materials provided a report on the evaluative feedback. This was analysed using construct categories for coding (Robson, 2002) with the categories of goals, values, methods, traits/characteristics and conflict/issues being used to analyse the data. The results were that the students identified that the materials:

- promoted critical thinking, comparison, a constructive dialogue, reflection and consideration of different perspectives and practices;
- deeper understanding of the concept of wellbeing through shared knowledge, creating a constructive dialogue and appreciation of other countries' perspectives;
- reflective storyboards enabled engagement opportunities to reflect on practice, develop knowledge and understanding in an interesting and active way of learning with real images and real examples of practice to reflect upon. Students developed a deeper insight into how other countries work and facilitated reflection and development of ideas for practice.

Instructors of the materials can select to explore all or one or two of the partner countries' contribution, for example, exploring just the definitions of wellbeing or comparing and contrasting between two partner countries' case study reflective storyboards on Transitions and Settling-in of children into the setting.

Enhancing Parental Involvement

The teaching and course materials for this subject area examine best practice for working with and involving parents. The EURYDICE (2009) document review of the literature states that “the most effective intervention programmes ‘involve intensive, early starting, child-focused, centre-based education together with strong parent involvement, parent education, programmed educational home activities and measures of family support’” (EURYDICE, 2009:140) The ‘Enhancing Parental Involvement’ consists of two components, a reader and DVD. The reader builds on the use of reflective practice sessions to encourage early years’ practitioners to analyse the situations and research materials, gathered from questionnaires, as presented within the reader and guidelines for instructors. The DVD film was made in Storhaug Open Kindergarten, Stavanger, Norway, and demonstrates good practice in the concepts and importance of parental involvement. This can be viewed on the TODDLER website or via YouTube at: <http://youtube/fw0XewtuBpk>

EYP as a Reflective Practitioner

The teaching and course materials for this subject area underpin all of the other subject areas and emphasises the importance of early years’ practitioners being reflective practitioners through reflective practice. However these by no means should be restricted to these subject areas. It is important that early years’ practitioners develop their knowledge and understanding of reflective practice in relation to its practice, behaviour and culture.

An article was published by Vintilă (2013) on ‘Using reflective seminar as a learning method’ analysing the method used and the experiences and perspectives of the student experience of the reflective session carried out at the West University of Timisoara, Romania. A report was also written on the reflective sessions carried out by the partner countries in the development of reflective practice with their students. The perspectives gained from these sessions has established a basis for the development of a reflective practice model with the use of different praxis situations and this is supported by a Reflective Sessions – Guidebook: Content and Process; with “the underlying message of this guideline for the performance of reflections is the need to train agents in building a culture based on a perception of reflection processes as belonging to the professional life and not as an exception” (TODDLER, 2013).

In conclusion the whole of the TODDLER project links together as early years' practitioners are able to develop and build upon their skills as reflective practitioners. The use of the teaching materials, for this and the other subject areas, supports early years practitioners in relating their practical experience of working with toddlers from disadvantaged and diverse background by comparing and contrasting the range of different materials and example of good/best practice produced by the project to enhance their everyday practice.

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