Estonian Class Teachers' Views on Creativity and Facilitating Creativity in Technology Education

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Innovation and creativity are viewed as key issues in today's society. The surrounding world is changing rapidly, and creativity is an essential criterion for adjusting to the new circumstances and needs. At the same time, the economic value of knowledge and creativity has been acknowledged by numerous countries, enterprises and individuals and regarded as a "natural resource" that needs to be maintained and developed in order to ensure economic competitiveness. Therefore, it is necessary to provide pupils with an opportunity to participate in creative activities from the start of basic school. To find out about Estonian class teachers' views on creativity, I used a questionnaire compiled by Finnish researchers that was translated into Estonian. The total number of questions was 55. In 2018, the questionnaire was completed by 90 class teachers who were teaching forms 1 to 6, including craft and technology education. The statistical data processing program SPSS, t-test and dispersion analysis were used to process the received data. The results revealed several statistically significant differences ($p<0.05$) between three age groups of teachers based on their work experience (work experience 0 to 10 years, 11 to 20 years, and more than 20 years). The analysis of the responses demonstrated that class teachers largely support the application of creative tasks in teaching.

Keywords: technology education, creativity, elementary school, improving school

Introduction

Genius, invention, talent, creativity – these words describe the highest levels of human performance, when we are engaged in the act of being creative, we feel we are performing at the peak of our abilities, creative works give us insight and enrich our lives (Sawyer, 2012). With the quest for twenty-first century skills and the growing need for creativity in many occupations, it is more important than ever that students learn to develop original solutions in technology education (TE) (Klapwijk, 2018).

The strategic framework for European cooperation in education and training (European Commission, 2020) has four common objectives for the European Union, one of which underlines the need to increase creativity and innovation, including entrepreneurship, at all levels of education and training. According to the international curriculum analysis OECD 2030, the shaping of society and creating a future requires knowledge, skills, competences and values that could be applied to produce and manage change (cooperation, critical and creative thinking, problem solving, self-control, empathy, respect for oneself and others, persistence, trust, learning ability) (Liblik, 2018). Students need to develop skills for transforming society and forging a future in a volatile, insecure, complex and uncertain world: ability to collaborate on creating new values, willingness to take responsibility, willingness and ability to resolve conflicts, tensions and dilemmas (Liblik, 2018).

However, international comparisons have also highlighted our problem areas – lack of courage and creativity in using different skills in novel situations, fast loss of skills and low computer skills and courage in the elderly ("Ministry of Education," 2014). The changing concept of learning actively pursued in Estonia seeks to promote individual and social development of students, the development of learning skills and creativity and entrepreneurship (Vinter, 2014).

In the European ranking of the PISA 2018 survey, Estonia's 15-year-olds hold the first position in reading, mathematics and science, at the world level, our students are fifth in reading, eighth in mathematics and fourth in sciences (OECD, 2019). Estonia is one of the five countries in the world where students have been able to show improved results in two areas, given the statistical significance of the difference in results, Estonia shared 4th to 5th place in the world with Japan in sciences and ranked first among OECD countries. Estonia is also number one among European countries (Tire et al. 2019). In Estonia, 12% of students were top performers in science, meaning that they were proficient at Level 5 or 6 (OECD average: 7%). These students can creatively and autonomously apply their knowledge of and about science to a wide variety of situations, including unfamiliar ones (OECD, 2019).

The results of the PISA 2018 survey show the high level of students and the continuing professional work of teachers, but we still need to think carefully and give guidance on how we can better implement creative work in the learning process in Estonian schools. Researchers in other countries have also highlighted respective needs, pointing out that schools have shown themselves to be monotonous, using repetitive activities requiring reproduction of knowledge rather than the production of new knowledge, a widespread lack of preparation can be seen among teachers towards developing creativity at school, development of creativity is essential, especially in a globalized world in which information is available everywhere (Stoltz, Piske, de Freitas, D'Aroz, & Machado, 2015). Therefore, it is necessary to provide students with an opportunity to participate in creative activities from the start of basic school to allow them to continue to develop their creative thinking and foster the advancement of relevant educational activities.

This article focuses on the analysis of the results of a creativity survey conducted among elementary school class teachers in Estonia who teach students in grades 1-6. These class teachers also teach craft and TE, which is a subject in the field of technology in the curriculum (GRE, 2010). Work on the curriculum is an ongoing process. In recent years, we have been updating the curriculum in Estonia, due to be completed by 2024. The results and recommendations of the creativity study presented in this article will hopefully contribute to the development and practical application of the new curriculum in schoolwork and could be taken into account by university teachers and researchers in student preparation and in-service training. The article poses the following general research question: What are Estonian class teachers' views on creativity and the teaching of creativity and are there differences between teachers with different teaching experience?

Creativity in Technology Education

The current iteration of the subject TE embraces learning *in* and *about* technology and developing skills in design, creativity, problem solving, systems understanding and critique, in addition to specific technical skills (Jones, Buntting, & Williams, 2015). Barlex (2006) suggests that a major educational goal of technology is to teach students the capability to operate effectively and creatively in the manmade world. It must also prepare students to participate in rapidly changing technologies and to intervene creatively to improve the quality of life (Fox-Turnbull, 2015).

Teachers are called on to be activators of meaningful learning while being creative in choosing from a wide palette of strategies to be mixed and adjusted to the context and learner (Caena & Redecker, 2019). It is, however, not easy for teachers and learners to know what creativity is and how to develop it (Klapwijk, 2018). Politicians, parents and teachers often have difficulty conceptualizing creativity in that it is inherently ill disciplined, difficult to manage, difficult to measure and difficult to understand, especially if one considers oneself as not particularly creative (Spendlove, 2015). Davies (1999) concludes that teachers may ultimately be impeding creativity in their students, particularly if they themselves lack confidence in their understanding of creativity—and are not willing to take risks due to the legislative and institutional framework in which they operate. Spendlove (2015) states that 'Creativity in Crisis' (Barlex 2003; Kimbell 2000; Spendlove 2005) exists as a prevailing theme in TE,

and the subject often fails to offer creative opportunities (Atkinson 2002; Spendlove 2005, 2007a, 2007b) and he concludes that many of the activities within TE are not conducive to creativity (Barlex 2003).

Creativity has a decisive role in problem solving in comparing, evaluating and assessing, choosing, combining and using knowledge and skills to reach a practical solution (Lindfors, 2010). Using creativity and imagination, pupils design and make products that solve real and relevant problems in a variety of contexts, while considering their own and others' needs, wants and values, TE makes an essential contribution to the creativity, culture, wealth and well-being of the nation (Banks & Barlex, 2014). Axell (2019) notes that the overarching aim of the school subject of TE is that students learn to understand and act responsibly in their technological culture and technological literacy of today implies more than the ability to create technological artefacts or to use or understand the function of certain technologies - young people also need to develop their critical thinking skills and be open to viewing the technological world from many different perspectives (e.g. Axell, 2017; Dakers, 2006; Keirl, 2006, 2011; Petrina; 2000; Williams, 2009). However, according to Spendlove (2015), creativity is an integral necessity, a component of a sustainable economy and a key determinant in the shaping of future individuals and their societies. Järvinen (2011) stresses the importance of teachers' encouraging and approving support, pupils need to have the possibility to explore the environment people have created through technology, teachers are obliged to provide pupils with the possibility of creating, developing and applying technology that is tailored to pupils.

Creativity comes out best through discussion when collaborating, where individuals around a common task or challenge get inspiration from each other (e.g., Schrage, 1995; Collin et al., 2011). It is important that knowledge that one has is applied or put into practice in an innovative, "creatively new" way. Innovation process is associated with brainstorming, problem solving, innovating, inventiveness, design, modelling, evaluation, experimental approaches and also creativity, aesthetical and ethical aspects, the aim of activity is that awareness raising, learning and design processes are integrated to enable application and create innovative solutions (Rasinen, Virtanen, Miyakawa, 2009). Thus, creativity poses special challenges to the curriculum implementation if the aim is to promote creativity: it requires more problem-based approaches to learning, more social interaction and teamwork, more tutoring than teaching, new learning environments to facilitate this (Hakala et al., 2017). When planning a new curriculum, it would be worthwhile to take these views into account and define them clearly so as to avoid any chance of misinterpretation (Järvinen & Rasinen, 2015).

Method

In order to find out about the views of Estonian class teachers on creativity, I used a questionnaire compiled by Finnish researchers to obtain the results. The Finnish Government has incorporated creative strategy into its cultural policy program (2003), which also serves to highlight Finland as a member of the 'creative nations' club (Benner, 2003; Florida & Tinagli, 2004; Paija, 2001). Hakala, Uusikylä and Järvinen (2015) researched creativity in teachers, artists and engineers and their main question was, "To what extent do the expert views of creativity differ from each other?" and "What are the dimensions or aspects of creativity and creative education related to the 2010-14 curriculum renewal process, in which the views of the three expert/professional groups differ most?" (Hakala, Konst, Uusikylä & Järvinen, 2017).

The questionnaire of the Finnish researchers was translated into Estonian. Below I will discuss the research I conducted with elementary school teachers and the results of this survey.

The total number of questions in the questionnaire is 55, including the three open questions that we added. The questions can be divided into five groups. The first group "Creativity in general" includes 13 questions, the second group "Creative person and creative activity" 8 questions, the third group

"Elementary school and creativity today" 19 questions and the fourth "Creativity and the Curriculum" 14 questions. A quantitative study is descriptive in nature and entails a systematic description of the research. Due to the large number of respondents, a questionnaire was considered as most appropriate way for data gathering. Therefore, a structured questionnaire was used as the method of data collection. At the common-sense level, 'quantitative methods of social research' involve, on the one hand, counting and measuring those human behaviors that are plausibly quantifiable, and on the other hand, applying these data as evidence in the interpretation and analysis of the issues addressed by the various social sciences (Payne, 2011).

As a data collection tool, I used an online questionnaire form (Google Forms), which I sent to teachers by email. I employed a five-point Likert scale measuring attitudes and their strength (completely agree .... completely disagree) (Õunapuu, 2014).

According to the data available in 2017, there were 464 schools in Estonia which provided the first and second level of basic education. Using systematic random sampling, based on the step chosen by me as the researcher, I sent a questionnaire to every third teacher in the list of every third school (154). In 2018, 90 class teachers teaching in grades 1-6 completed the questionnaire. Quantitative results were processed using statistical data processing software SPSS, t-test and analysis of variance.

Results

The questionnaire was completed by a total of 90 class teachers, who also teach craft and TE, which belongs in the subject field of technology. Only one of the respondents was male and the rest were female. In Estonia the majority of class teachers are women, there are very few men among class teachers. The sample included teachers with different lengths of service: 14.1 % of the respondents had 0 to 10 years, 22.8 % had 11 to 20 years and 63% had more than 20 years of work experience.

The results had the highest mean values for the following statements: question number 15, *A free and open atmosphere helps to express creativity,* (M = 4.76); question number 44, *Creativity can be taught in any subject,* (M = 4.59); question number 1, *Creativity is everywhere, some people just do not notice it,* (M = 4.57). On the other hand, lower mean values were found in the following statements: question number 36, *Children are more creative when they spend more time on social media*, (M = 1.73); question number 7, *The term "creativity" is used by the elite*, (M = 1.93); question number 11, *Speed and deadlines develop creativity,* (M = 1.73).

The results revealed several statistically significant differences ($p<0.05$) between three age groups of teachers based on their work experience (0 to 10 years, 11 to 20 years, and more than 20 years). Below, I will highlight the important differences between creativity and how it is taught, based on the teachers' length of service.

Question number 8, *When talking about creativity, it is associated too much with economic growth*, was given higher rating by the teachers whose work experience exceeded 20 years (M = 2.36) than by the teachers with less than 10 years of experience (M = 1.69), p = 0.025.

Question number 19, *Creativity requires action at discomfort level*, was given higher rating by the teachers with work experience between 11 and 20 years (M = 3.33) than by the teachers with less than 10 years of experience (M = 2.46), p = 0.026.

Question number 21, *A person's life experiences can inhibit his or her creativity*, was rated higher by the teachers with work experience between 11 and 20 years (M = 3.71) than the teachers with more than 20 years of experience (M = 2.93), p = 0.003.

Question number 26, *In elementary school, too much attention is paid to creativity,* received higher ratings from the teachers whose work experience exceeded 20 years (M = 2.30) compared to the teachers with 11 to 20 years of experience (M = 1.76), p = 0.004. Another statistically significant difference was also found in the responses to this question, namely teachers with more than 20 years of experience (M = 2.30) gave higher ratings than teachers with less than 10 years of experience (M = 1.85), p = 0.043. It is quite interesting that teachers with longer period of service (more than 20 years) actually rated this question higher than teachers with 10 years and 11 to 20 years of experience.

Question number 40, *I would like to teach creativity to my students, but I do not have relevant knowledge and skills* indicated that teachers with little work experience, less than 10 years, agreed with this statement significantly more often (M = 3.38) than teachers with longer work experience, more than 20 years (M = 2.77), p = 0.045. Answers to this question are important for finding out whether creativity teaching is pursued in schools. The responses show that teachers with less than 10 years of experience lack relevant knowledge and skills required to teach creativity in lessons compared to the teachers whose length of service is more than 20 years.

Summarizing the results, teachers outlined many positive and negative aspects related to creativity that can be taken into account in curriculum development and when training teachers at universities. In conclusion, teachers' views on creativity and its teaching in elementary school were generally similar rather than different.

Discussion

The results of the questionnaires provide a cross-section of classroom teachers' ratings and opinions on creativity and its teaching in elementary schools.

Teachers with more than 20 years of work experience pointed out, on average, that when it comes to creativity, it is too much associated with economic growth compared to teachers with 10 years of teaching experience. This may be due to the fact that the issue of economic growth is important in Estonia and there have been many and constant discussions on this topic. Less experienced teachers see creativity more broadly and in other areas as well.

It seems that teachers whose teaching experience is longer than 20 years often draw on familiar patterns based on their life experiences, whereas teachers with teaching experience of 11 - 20 years do not yet have sufficient life experience that would inhibit their creativity. Teachers whose teaching experience is less than 10 years are actively engaged in multiple tasks and it is likely that it does not make much difference whether a task is inconvenient for them or not. In contrast, teachers with 11 - 20 years of teaching experience have already established certain routines they are used to and are not especially interested in taking on new tasks that may be inconvenient for them.

Teachers with longer teaching experience pointed out that too much attention is paid to creativity in schools. These teachers are used to dealing with the development of students' creativity and carrying out related tasks and activities on daily basis. It appears that teachers with shorter teaching experience need teaching materials and instructions for conducting creative tasks in lessons more than teachers with longer experience. In-service training courses of universities could help teachers in this situation. In university studies, more emphasis should be placed on the ability of students to compose creative tasks and to implement these tasks in school lessons. The curriculum development could be accompanied by the production of appropriate teaching materials, so that teachers would not have to design and develop these by themselves. The teaching materials should be scientifically based and thoroughly tested and approved in schools as part of experimental teaching. There is certainly a need to develop materials that enhance and practice creativity in students of different ages, taking into account different degrees of difficulty.

When creativity is written about in educational documents, it is certainly necessary to point out how it can be concretely implemented in schoolwork so that the word creativity does not remain a slogan but can be applied by teachers in schools. The key factor remains the teachers' ability to engage students creatively and innovatively in lessons, which presupposes that teachers have had an opportunity in the course of their university studies and in-service training to identify what choices, methods and learning activities to apply in their lessons to promote "outside the box" thinking and acting in students and what activities would be engaging and would facilitate creativity in their students.

To ensure reliability and generalizability of the research results, I have followed the principles listed below: as a basis for the survey questionnaire of the study, I used a questionnaire developed in Finland; as a researcher, I aimed at objectivity and planned my research activities ahead as well as ensured that the measuring instruments were independent of the researcher; while conducting the study, I followed ethical principles and thoroughly described the process related to the methodology of the study; while processing the data, I used different statistical tools and characteristics.

As far as the validity of the research is concerned, I can confirm the following: the data have been collected correctly in accordance with the task of the investigation and there is sufficient data; the data collected in the process of the survey are true and the class teachers who responded to the survey are competent respondents; the sources analyzed were suitable for researching the topic; the results are based on the data of the study and the conclusions/discussion rely on the data.

Having worked at school for many years, I can assert that younger students are more likely to act creatively than older students (e.g., grade 8 students). Therefore, what to do with older students to advance their creative tasks could be the topic of the next study. One of the most difficult questions to research is how and on what basis to evaluate students' creativity, and how to guide and evaluate the process of student creativity development, so that finding creative solutions would become a habit and pleasant pursuit for students.

Only a certain proportion of the teaching staff of schools - class teachers, participated in the survey, so conclusions can be drawn from them only and no major generalizations can be made. Therefore, this topic and accompanying factors certainly require further research.

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