PROGNOSIS OF VISUALIZATION USAGE IN THE SCIENCE EDUCATION PROCESS

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Abstract. *Future education depends on many external exogenous factors - society evolution, technologic progress, teachers' opinion and their ability to organize the education process. Science education is difficult for many students but the progress of the society definitely correlated with achievements of science. This highlights the importance of teaching biology, chemistry, physics, geography and mathematics at school. Visualization helps students to learn science education but at the moment teachers are not likely to use computer based visualization. It is important to find out the predictions of the future – whether pedagogues are planning to use various kinds of visualization.*
The research results show more than half of teachers believe that physical visualisation in the next five years will be used similarly to now. The same situation was identified asking teachers about paper based visualization. On the contrary, application of the computer-based visualisation in near future is foreseen as the progressive phenomenon: internet sites, interactive boards will mostly increase in the next five years; also, knowledge of students will be more often inspected by aids of computer-based tests. It is planned that 3 D visual objects, experiments, schemes and modelling will be less used.
Keywords: *visualization, science education, teachers, prognosis.*

Introduction

In the near future education should guarantee high teaching equality for all, as education is the factor forming the society (Millar, 2012); this supposes the premise that from the epistemic perspective science education in future should be accessible to every learner, and therefore the educational sphere should be developed the way to form the best conditions for students with heterogeneous needs in the constantly developing world, where the educated person is to become the creator gradually.

It is planned that ICT application for the teacher and the student in future will be an important and interesting instrument to increase educational achievements (Courville, 2011; Kennedy, 2011; Guerra et al., 2011) and therefore will be widely integrated into the process of education (Belland, 2009; Trouche, Drijvers, 2010; Selwyn, 2012; Reigeluth, Merrill, 2009; Polly, etc., 2010); classical aids will be replaced by new ones (Tugui, 2011) by encouraging teachers to give more time for analysis of aids (Hicks, 2011). Computer technologies (especially visualisation) are not treated as the only ones that can

contribute to the improvement of the educational process – from the scientific and education perspective they are treated as culturally timely and favourable (Maddux, Johnson, 2011), contributing to learning but not transforming it basically (Sheehy, Bucknall, 2008), thus giving a sense to the student oriented paradigm (Smeureanu, Isaila, 2012) in reality.

Scientists state (Pence, McIntosh, 2011; Klieger, etc., 2010) that computer-based technologies in education would contribute to the creation of new educational environments, based on the domination of multidimensional and multimodal externalised visual artefacts. Their representation by innovative aids would contribute to the fulfilment of the life-long learning request (Lee, 2010), would possibly strengthen the role of the school (Robinson, 2012), because the education system has to be transformed so that it would be oriented towards the student, would enable the assurance of not only educationally but also socially valuable mastering of technologies (Facer, 2012).

Visualization can foster cognitive processes in difficult science disciplines (Билбокайте, 2013, Bilbokaite, 2015). It is especially actualised in spheres where learning about features of micro elements, not seen for the human eye, take place, without any special equipment and aids: misunderstood chemical links (Duis, 2011; Gomez-Zwiep, 2008; DiSpezio, 2010; Herman, etc., 2011), various processes (Klassen, 2009) and features of a phenomenon. It is important to find out teachers' opinion about their vision – how do they think and predict the usage of computer based visualization in near future. The findings would enclose constructions of social reality, which could be used to organize future education and to improve its' quality.

Object of the research – prognosis of visualization usage in the science education process.

The research aim is to enclose LITHUANIAN teachers' opinion about a prognostical assumption of visualization usage in the education process for Biology, Chemistry, Physics, Geography and Mathematics.

Methodology of research

Socio-economic situation. During last decade lots of Lithuanian schools got support from EU funds and improved their material basis. Mostly all teachers have possibility to use modern technical equipment and raise their working outcomes. But the technologies do not determine the usage of it in the educational process, because it needs time to change the culture of working experience.

Methods of the survey

There were used a questionnaire as an instrument and a survey as a data collection method. An analysis of data was done using *descriptive statistics: an*

index of popularity was applied to calculate ratings of variables; *analytical statistics:* Mann'o Whitney U-test was applied for a comparison of variables from two independent samples; the test was applied to two independent samples with abnormal distributions of variables ($p < 0.05$). A hypothesis concerning the similarity of means of variables in the aspect of form and gender were verified by it (Bilbokaitė, 2015).

Research sample

The random independent sample was formed under the serial principle. The number of respondents was obtained under the formula of the sample calculation. The survey involved 1481 science teachers from Lithuania (teachers of Biology – N=300; teachers of Chemistry – N=252; teachers of Physics – N=287; teachers of Geography – N=275; teachers of Mathematics – N=366). More females than males participated in the survey – the number of teachers – males in each subject was lower by 23%. The distribution of teachers according to places of work was also non-homogenous – almost three thirds of the respondents worked in towns. As regards the working experience, the majority of the interviewed teachers had the working experience of 11-30 years; also 23% of the respondents had been working in schools for 30-40 years.

Teachers from all regions participated in the survey; the majority of them were from the biggest districts - Kaunas, Vilnius, Panevėžys and Šiauliai. Teachers of all qualification categories were questioned – over 80% of respondents had qualification of the senior teacher and methodologist. In order for the data to be more reliable, samples of the survey were joined to regions, according to districts, therefore the analysis of data was implemented under five regions.

Research instrument

There was used questionnaire as a research instrument. It had five scales and in this article only one is discussed – prognosis of visualization. Internal reliability of the instrument was high, it was appropriate to measure attitude of population of teachers towards the research object. The instrument was appropriate to reveal differences of attitudes of teachers of Biology, Chemistry, Physics, Geography and Mathematics / teachers according to generalised diagnostic blocks, their separate indicators according to categorised variables.

Results

The results are presented in figures and text below them.

More than half of the teachers believe that *physical visualisation in the next five years will be used similarly to now*, i.e. will not change. This attitude is supported by the teachers with all qualification categories. One statistically significantly difference ($p = 0.011$) was identified, indicating that the teachers

with the working experience of 21-30 years are more convinced than their colleagues with the highest working experience about wider application of physical objects – prototypes in future.
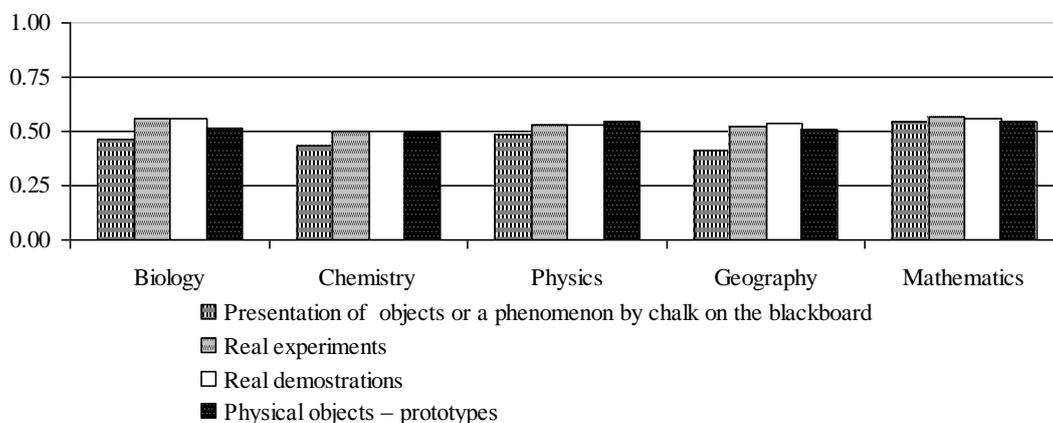

Figure 1 **Attitude of the teachers of different disciplines towards the change of application of physical visualisation after five years / IP (N = 1481)** (Author's calculations based on the data)

The teachers of Biology statistically significantly more than the teachers of Chemistry plan (Figure 1) that real experiments ($p = 0.005$) and real demonstrations ($p = 0.006$) with real materials will be wider used within the process of education. The teachers of Mathematics ($p < 0.05$) more than the teachers of other subjects support the wider presentation of objects or a phenomenon by chalk on the blackboard, more than the teachers of Chemistry ($p < 0.05$) plan the wider spread of real experiments and demonstrations as well as physical objects – prototypes. The application of the last aid in future is also supported by the teachers of Physics ($p = 0.028$) who more than the teachers of Geography expect the application of chalk upon presenting objects on the blackboard ($p = 0.007$).

The application of paper visualisation in the next five years is not likely to change (Figure 2): some aids will be used rarely; however, some of them will be applied more often. The application of paper posters in the educational process will increase the most; the second position – paper photos that will be more often used by three fourths of pedagogues. A higher educational value will be given to maps and drawings of students. The application of schemes, graphs and geometric shapes, presented on paper, will decrease.

The teachers with the working experience of 11-20 years statistically significantly more ($p < 0.05$) than pedagogues with the highest working experience believe that in the next five years the application of geometric shapes will increase. Educators with the qualification of a senior teacher more ($p < 0.05$) than methodologists think that the application of schemes, presented on paper will increase.
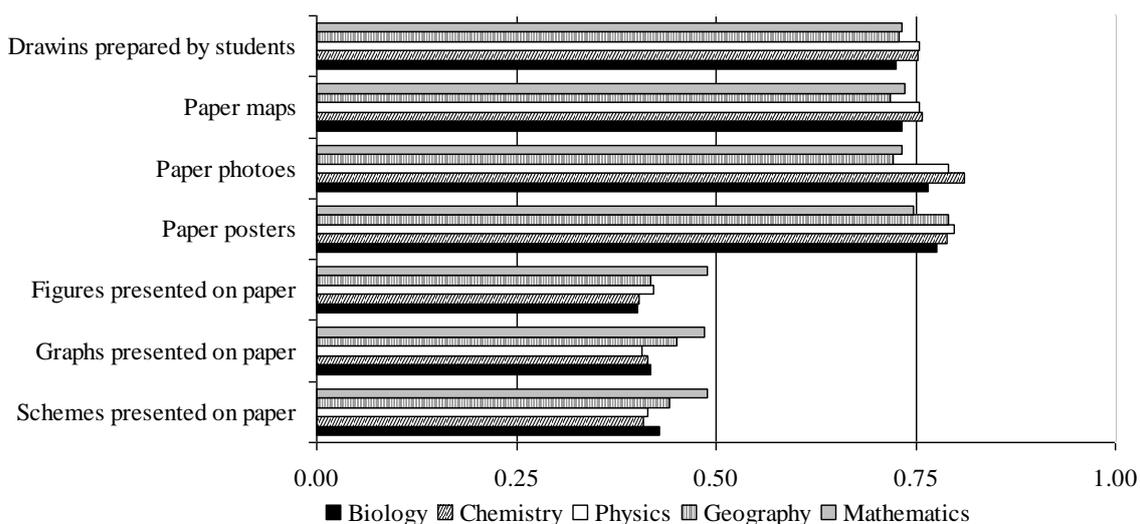
Figure 2 **Attitude of the teachers towards the change of application of paper visualisation after five years (N=1481)** (Author's calculations based on the data)

The teachers of Chemistry statistically significantly more ($p < 0.05$) than the teachers of Biology, Geography and the teachers of Biology more than the teachers of Geography and Mathematics plan that paper photos will be more widely applied in future. The teachers of Mathematics more ($p < 0.05$) than the teachers of Chemistry, Physics and Geography plan more intensive application of schemes and shapes presented on paper and more than the teachers of Biology, Chemistry and Physics – the application of graphs. The teachers of Mathematics less ($p < 0.05$) than teachers of Geography, Physics and Biology plan the application of paper posters, and less than the teachers of Biology, Chemistry and Physics – the application of photos. The teachers of Geography statistically significantly more than the teachers of Physics ($p = 0.048$) plan the application of represented graphs, while the teachers of Physics ($p = 0.000$) more than the teachers of Geography – the application of photos.

The teachers plan that the computer-based visualisation is likely to progress within the process of education (Figure 3). The majority of aids, representing this type of visualisation reach higher than an average index of popularity. According to the teachers, the application of internet sites, interactive boards will mostly increase in the next five years. Knowledge of students will be more often inspected by aids of computer-based tests. Lessons will be more often visualised by slides, educational commixes. The educational process will be diversified by visual computer games and animation. It is planned that 3 D visual objects, experiments, schemes and modelling will be less used.
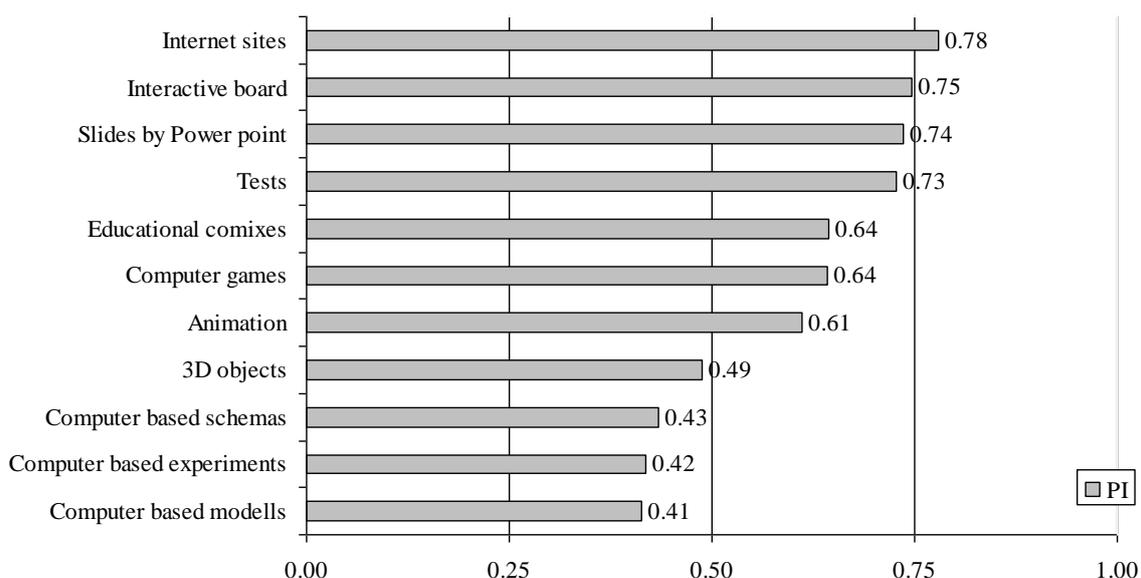
Figure 3 **Attitude of the teachers towards the change of application of computer-based visualisation after five years (N = 1481)** (Author's calculations based on the data)

The teachers with the greatest working experience statistically significantly more ($p < 0.05$) than their junior colleagues plan the higher popularity of tasks for inspection of knowledge, while the teachers with the working experience of 11-20 years more than those with the working experience of 21-30 or 31-40 years plan ($p < 0.05$) the application of the interactive board. However, the teachers with the great working experience less ($p < 0.05$) than the other groups of the respondents plan the application of computer-based schemes. The teachers with the working experience of 11-20 years statistically significantly more than the teachers with the working experience of 21-30 years believe that the application of computer games is likely to increase. The teachers with the working experience of 21-30 years more ($p < 0.05$) than their senior colleagues plan the educational benefit and popularity of educational commixes and animation among other aids of visualisation. The senior teachers statistically significantly more ($p < 0.05$) than the teachers methodologists plan the wider application of experiments, computer-based modelling, schemes and 3D objects during lessons.

It was defined that teachers of some disciplines support it more. The teachers of Geography statistically significantly more ($p < 0.05$) than the teachers of other subjects plan the application of computer-based schemes; more than the teachers of Biology, Physics and Mathematics ($p < 0.05$) – the application of computer-based schemes and tasks for the inspection of knowledge; more than the teachers of Physics ($p = 0.006$) – illustrations of experiments in the computer screen and more than the teachers of Mathematics ($p = 0.003$) – internet sites.

The teachers of Chemistry statistically significantly more ($p < 0.05$) than the teachers of Physics and Mathematics plan the popularity of videos, computer games and knowledge inspection tasks in the own subject, more than the teachers of Physics – the illustration of experiments in the computer screen ($p = 0.012$), more than the teachers of Mathematics ($p < 0.05$) – animation, the interactive board and tasks for the inspection of knowledge. The last two aids are planned the higher educational popularity by the teachers of Physics, statistically significantly more ($p < 0.05$) than by the teachers of Mathematics. The teachers of Chemistry in own disciplines expect higher ($p = 0.014$) application of tasks for knowledge inspection than the teachers of Biology. The teachers of Mathematics more ($p < 0.05$) than the teachers of Chemistry plan the wider application of 3D objects in future and more than the teachers of Physics believe that during the lessons of Mathematics illustrations of experiments, computer-based modelling and computer-based schemes will be more often ($p < 0.05$) applied in the next five years. During the lessons of Biology more than in lessons of Physics the illustration of experiments in the computer screen ($p = 0.001$) will be applied, more than during lessons of Mathematics ($p < 0.05$) – the application of the interactive board and internet sites. The teachers of Physics more ($p = 0.021$) than the teachers of Chemistry plan the higher popularity of animation during own disciplines in the next five years.

Conclusions

More than half of teachers believe that physical visualisation in the next five years will be used similarly to now. The same situation was identified asking the teachers about paper based visualization. On the contrary, application of the computer-based visualisation in near future is foreseen as a progressive phenomenon: internet sites, interactive boards will mostly increase in the next five years; also, knowledge of students will be more often inspected by aids of computer-based tests. It is planned that 3 D visual objects, experiments, schemes and modelling will be less used.

Teachers with the greatest working experience more than their junior colleagues plan the higher popularity of tasks for inspection of knowledge. Teachers with the working experience of 11-20 years are planning to use the interactive board. Teachers of Chemistry more than others plan that paper photos, videos, computer games will be more widely applied in future. Teachers of Geography more than others plan the application of computer-based schemes and tasks for the inspection of knowledge; Mathematicians more than Chemists plan the wider application of 3D objects in future.

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