

THE USAGE OF THE INTERNET IN TEACHING PHYSICS IN LITHUANIA: THE ANALYSIS OF A SITUATION AND PERSPECTIVES

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Abstract

A vision of a modern world can be hardly conveyed without Information and Communication Technology (ICT) recently having a powerful impact on all areas of life. The application of the latest ICT in the educational process raises new possibilities for both a teacher and a learner, enhances the quality of provided education and makes the educational process more adjustable.

Effective source of the information nowadays is the Internet. It has to be stated that the Internet possibilities in the teaching process are insufficiently used. On the other hand, in principal there are no reliable studies, which would reveal the actual situation in this field. Therefore, the object of our study is the usage of the Internet for teaching physics. The main aim of the study is to analyse the situation of the usage of the Internet for teaching physics and highlight the hindering/encouraging factors of its usage in the teaching process.

The study employed expert inquiry. The type of expert inquiry – “Delphi study”, containing several experts’ inquiries (stages). Research has shown, that the Internet in teaching physics is not used in due volume. The majority of problems are connected with material (including information) resources (lack of websites, computers, etc.) and the competence (methodical, information, etc.) teachers of physics.

Key words: *teaching physics, science education, modern ICT.*

Introduction

Information and Communication Technologies (ICT) are appraised as a catalyser, speeding up the development of contemporary education reforms and didactics (Monkevičius, 2002). In the developing knowledge-based society information technologies play a particularly significant role. However, even the most advanced technologies will not give a necessary effect, if their usage (application) in the educational system is not adequate to the current development of technologies and increased educational needs. It is very important that modern information technologies are abundantly, actively and *meaningfully* applied during the lessons of various subjects and that IT methods are applied to model both nature and society’s phenomena (Vingeliene, 2006). In the general education school the initial information literacy abilities are formed. In current conditions general education schools can already employ various information technologies. Probably most often it is related to appropriate computer technologies and the Internet. In 2001, the teachers’ computer literacy standard was approved in Lithuania, which obligates teachers to improve their abilities in this field. According to I. Mažulienė (2002), IT usage forces teachers to change the settled work style, raise qualification, improve abilities and otherwise plan one’s own and pupils’ activities. On the other hand, the aims of creating knowledge-based society change the external and the internal environment of schools; therefore, information processes and technologies acquire increasingly greater significance at modern educational organisations (Virbickienė, Šaparnis, Šaparnienė, 2005).

In recent years more and more studies are aimed at the analysis of ICT problems. Both,

general (Jonassen, 1996; Crook, 1996; Markauskaitė, 2000; Zylbergold, 2003; Ross, 2004; Woessmann, 2005), and concrete didactic issues are being analysed, e.g. how to use ICT for teaching separate subjects (Slabin, 2002; Augustonytė, 2005; Pečiuliauskienė, Rimeika, 2005; Praulite, Trokša, Gedrovics, 2005). U.Slabin's studies (2002), creating websites for natural sciences profile university students, are of interest. In the author's opinion, our epoch is marked with global environmental crisis and the advent of information age. Extensive implementation of a range of information technologies into high and higher school curricula and the emphasis on environmental issues in education are two leading trends in contemporary education. On the other hand, interesting studies have been conducted by the specialists of German Institute of Computer Science (München University) (Woessmann, 2005). The study demonstrated that computers might harm the learning process. It is stated that the number of computers at school and time spent at the computer at home does not confirm the fact that children learn much more if they use IT. The importance of IT for the teaching (learning) process is not denied, but it is stated that these pupils who use IT at school and at home moderately and the frequency of the usage is limited, attain better results than the ones, who spend a particularly considerable time at the computer. Our expert study in principal confirms such statements. We maintain that it would be optimal if the computer (especially using the Internet) is a natural teaching / learning aids like books and other sources of information. On the other hand, it is necessary to create conditions for teachers to raise qualification. This is emphasized by numerous researchers.

It has to be stated that the Internet possibilities in the teaching process are insufficiently used. On the other hand, in principal there are no reliable studies, which would reveal the actual situation in this field. Therefore, the *object of our study* is the usage of the Internet for teaching physics. The main *aim* of the study is to analyse the situation of the usage of the Internet for teaching physics and highlight the hindering/encouraging factors of its usage in the teaching process. The most important study *tasks* have been formulated:

- To analyse the situation of the usage of the Internet for teaching physics;
- To identify the hindering/stimulating factors of Internet usage for teaching physics;
- To highlight the experts' opinion about the expected development perspectives of Internet usage for teaching physics in the nearest five years period.

Methodology of Research

The study employed expert inquiry. The type of expert inquiry – “Delphi study”, containing several experts' inquiries (stages). The data of every round are generalised and repeatedly submitted to the experts. Such procedure is repeated several times, most often 3-4 times. The study was carried out in September – December 2005. Out of the preliminary formed 35 experts' group the study was attended by 29 participants. The selected experts entirely represent the population of physics teachers. Such group corresponds to the requirements of Delphi methods. The experts were selected to the group by random – purposive way. The most important criteria were experts' competence and possessed qualification category (methodologist teacher and expert teacher). The group consisted of 13 expert teachers, 11 methodologist teachers, 5 experts with scientific degrees. The latter work in higher education institutions, closely cooperate with physics teachers, and are the authors of physics textbooks for general education schools.

In the first stage the questionnaire, consisting of 5 open questions, was prepared:

- How do you assess the current situation of the usage of the Internet for teaching physics?
- How will the usage of the Internet for teaching physics be changing during the nearest five years?
- What main factors hinder to use the Internet for teaching physics?
- What main factors encourage using the Internet for teaching physics?
- What can you propose (recommend) as to the Internet usage for teaching physics?

The first stage of the study was preceded by the following short instruction to the experts:

Seeking to reflect the assessment and the predictions of the professional group, in the first stage of the study the inquiry of the experts group based on the Delphi method is organised. The key target of this inquiry is to assess the situation of Internet usage for teaching physics and to identify possible predictions of the changes of this situation. The success of Delphi-based study is significantly determined by the independent opinion of every expert; therefore, the composition of the experts' group is not announced. The group of experts, composed for this study, represents the population of the teachers of physics and the key selection criterion is competence. It is expected that it will be enough to conduct two-three stages of the inquiry (in the second stage every expert will receive the generalised results of the first inquiry). The opinion of separate experts will not be available for public or discussed publicly. The comments or the context of your opinion are of utmost importance for the study. We believe that you will participate in all stages of the inquiry.

The comments of the answers and your comments are very important because they will assist us to describe the situation more exhaustively..

The first data analysis round was followed by the preparation of the second stage questionnaire, which consisted of closed type questions. Second stage data have been processed employing mathematical statistics. The third stage questionnaire has been prepared according to the second stage generalised results. Communication with experts has taken place through e-mail. All three stages have been attended by all 29 experts.

Results of Research

The results of the first stage of the study

In the first stage of the study the experts replied to 5 essential questions. In the opinion of the majority of experts (62%) the usage of the Internet during the nearest five years will increase only insignificantly. 31% of experts maintain that the usage of the Internet will increase significantly and 7% think that it will not change at all. Having generalised the experts' opinions, 21 statement was formulated to describe the analysis of the situation (Table 3). The spectrum of the factors, encouraging / hindering Internet usage is particularly diverse (Table 1). It may be stated that general education school teachers encounter the same most diverse difficulties when they use the Internet directly in the educational process.

Table 1. Factors, encouraging / hindering Internet usage for teaching physics.

Factors, hindering teachers to use the Internet for teaching physics	Factors, encouraging teachers to use the Internet for teaching physics
<ul style="list-style-type: none"> • Scarce technical possibilities of schools, poor school funding in general; • Insufficient competence of physics teachers, their computer literacy; • Older teachers prefer the classical way of conducting the lesson (the attitude of the old generation teachers to ICT is negative); • It is difficult to coordinate time for work in the school computer classroom; • Schools lack computers, this is particularly felt in village schools; • Poor knowledge of foreign languages; 	<ul style="list-style-type: none"> • The wish to interest pupils and look for more diverse teaching forms; • The possibility to get a large amount and diverse information; • Demonstration and laboratory teaching aids are diversified; • The possibility to work more creatively and effectively; • Picturesqueness of the lesson and the results of the virtual lesson are better; • Usage of the Internet develops pupils' creativity and activeness; • Application of the Internet in the lesson enables the

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| <ul style="list-style-type: none"> • Psychological problems due to encountering novelties, fear to apply modern ICT; • Shortage of methodical literature on Internet usage; • Shortage of teachers' creativity; • Absence of systemised Internet references; • Too little information on Internet in the Lithuanian language; • Not all pupils have computers and the Internet at home; • Teachers are not able to use the possibilities, provided by the Internet; • Physics rooms are scarcely computerised, shortage of the Internet access; • The programmes are overloaded and teacher has little time for preparation; • Insufficient speed of the Internet (information transmitting speed); • Low salaries of the teachers, on the other hand, application of the Internet requires additional preparation, which is not paid too; • Shortage of specialised websites applied for teaching physics, Internet resources in the Lithuanian language are limited; • Complicated work conditions at school information centres; • Extensive course of physics and the teacher has insufficient time to cover it; • The programmes of physics are insufficiently applied for Internet usage; • Part of teachers resist the novelties, are inert and "tied" to traditional teaching methods; • The form of the lesson of the educational process; • High numbers of pupils in classes; • Insufficient number of physics lessons, extensive content of education; • The attitude of school administration (often perceived as a matter of fashion); • Universities continue to implement outdated methods; • Shortage of teacher's time resources; • Insufficient pupils' skills for information search, selection and handling; • Teachers' unwillingness to learn. | <ul style="list-style-type: none"> teacher to individualise and differentiate the teaching process; • The wish to improve one's own work, to go hand-in-hand with time; • Fast development and usage of information technologies; • Pupils' wish to work on computer and use the Internet; • The possibility to present the phenomena to the pupils that they find difficult to imagine; • Personal standpoint to one's own work; • Very good knowledge of the methods of teaching physics; • Developed critical thinking; • The wish and need to get what is not included in the textbook and what is not known to others; • Access to information, its content and quality; • Irreplaceable source for various project works; • Shortage of physics instruments, forcing to search for the alternative - virtual experiment; • Unlimited possibilities to familiarise with teaching methods applied by the teachers in other countries; • The opportunity to familiarise with the newest literature and subscribe it; • Teachers' technological competence; • Fast developments of the physics science (textbooks are not updated too fast); • The priorities of the improvement and modernisation of the education / self-education process at school; • Teacher may improve its image, this is particularly important for its image; • The development of independent work; • Positive managers' attitude to such work methods; • The Internet is a necessity at astronomy lessons! |
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This table demonstrates that the experts provide a particularly matter-of-fact assessment of the current situation, every expert emphasizes certain peculiarities. On the other hand, the experts' opinions in many respects coincide, are similar. This enables to make an assumption that the experts' opinions are not too scattered; hence, the received results are sufficiently valid.

We have generalised the recommendations, provided by experts, who have considered current situation and encouraging / hindering factors. The list of recommendations is given in Table 2.

Table 2. The list of recommendations.

**The recommendations seeking to improve and develop
the usage of the Internet for teaching physics**

- It is necessary to create Lithuanian Internet websites for teaching physics and provide all other necessary information: addresses, teachers' comments, discussions, etc.;
 - Physics rooms have to be equipped with Multimedia;
 - Computer usage for teaching physics should not be overestimated;
 - To create websites for teaching physics on school Intranets;
 - To establish a specialised centre, so that every teacher does not have "to invent a bicycle";
 - To study the benefit it produces;
 - To prepare the methods for Internet usage for teaching physics;
 - To change physics teaching programmes;
 - To disseminate the experience of work with information technologies more broadly;
 - To organise the physics teachers' team by means of competition and to prepare a concrete project "Physics on the Internet";
 - All physics teachers need to have free-of-charge Internet;
 - Teachers must be encouraged to create teaching programmes and make them available on the Internet;
 - It should be necessary to include mastering of certain abilities in this field into the general curricula of physics and education standards;
 - "Good practice" seminars will not change the situation, this requires a new teaching system (only the progressively thinking lecturers are able to prepare teachers with modern thinking for schools);
 - Creation of the teachers innovators' banks of methodical works;
 - It would be necessary to organise on-line physics lessons;
 - It is necessary to conduct comprehensive studies that would identify the effectiveness and other aspects of various methods, using the Internet for teaching physics;
 - To create distance learning programmes.
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The table discloses that the recommendations are quite diverse. They reflect both, positive and negative aspects. It contains doubts as to the benefit of the Internet in the educational process. In the opinion of part of the experts the thorough studies regarding the effectiveness of the Internet for teaching physics are necessary.

The results of the second stage of the study

Having studied and generalised the first stage results, the new questionnaire for the second stage of the study was prepared. The experts assessed the current situation by a three score ordinal scale. The results are presented in Figure 1. All statements are placed on an index of the significance. The generalisation of the experts' opinions resulted in the identification of the Internet usage situation.

The majority of experts fully agree with 10 statements, partially agree with 12 statements and do not agree with one statement.

Having analysed the factors, hindering and stimulating (encouraging) Internet usage, we

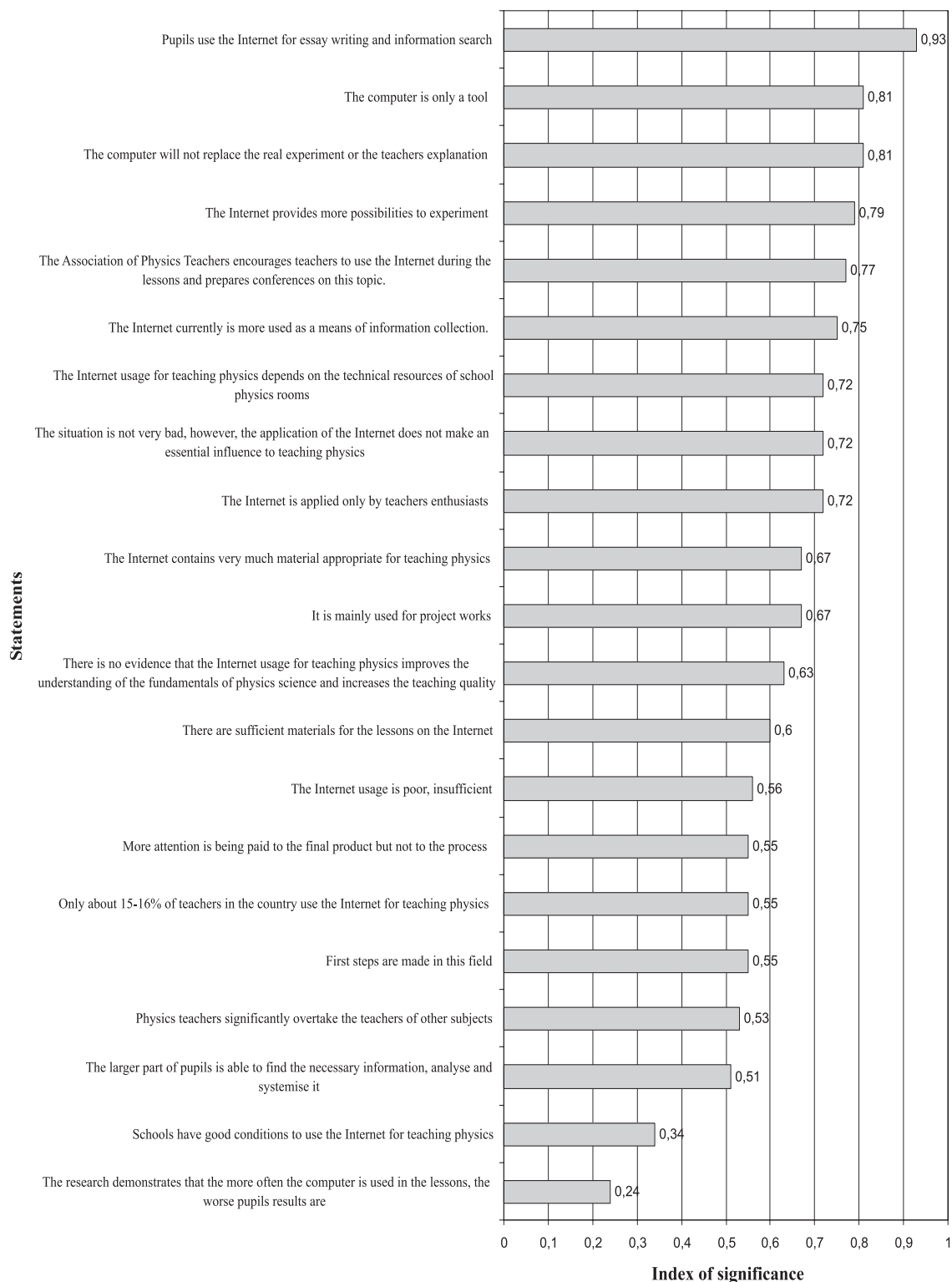


Figure 1. Current situation in the Lithuanian general education school /according to the generalised experts' assessments/.

submitted them to the experts for another assessment. From the list of given factors the experts singled out five most important mostly influencing factors. Having generalised the experts' assessments, we ranked the factors (Table 3).

Table 3. The most important mostly influencing factors (hindering and encouraging).

Hindering factors	Promoting factors
Physics rooms are poorly computerised, shortage of Internet access (1)	The wish to interest pupils, search for more diverse teaching forms (1)
Poor technical resources of schools, poor school funding in general (2)	The possibility to present the phenomena to the pupils that they find difficult to imagine (2)
It is difficult to coordinate time for work in the computer classroom at school (3)	The diversification of the demonstration and laboratory teaching aids (3)
Shortage of specialised websites applied for teaching physics, the Internet resources in the Lithuanian language are limited (4)	The Internet is a necessity during astronomy lessons (4)
Poor knowledge of foreign languages (5)	Shortage of physics instruments, forcing to search for the alternative - virtual experiment (5)

The analysis of the limiting factors discloses that essentially they pertain to the conditions and possibilities of school provision, the organisation of the teaching process and the very teacher’s competence in the field of ICT application. Having carried out the analogous ranking of the encouraging factors it can be stated that they relate to the teachers’ wish (endeavour) to interest pupils and to encourage their interest in physics. Another important point is to visualise these phenomena, which are not possible to perceive otherwise, pupils find them difficult to imagine. As it was expected the third group of factors could be related to the shortage of various instruments at schools. This forces teachers to search for more effective teaching methods.

We have analysed the experts’ recommendations and ranked them in the order of significance.

Table 4. Recommendations on Internet usage for the development of teaching physics and making it more effective.

Recommendations/proposals
It is necessary to create Lithuanian Internet websites for teaching physics and provide all other necessary information: addresses, teachers’ comments, discussions, etc.:(1)
Physics rooms must be equipped with overhead projector (-s) (2)
To establish a specialised centre, so that every teacher does not have “to invent a bicycle”; (3)
To prepare the methods for Internet usage for teaching physics;(4)
Computer usage for physics teaching should not be overestimated (5)

It was identified that the most important factors, hindering the Internet usage were as follows: poor computerisation of physics rooms and the shortage of the Internet access, poor school technical possibilities and poor funding, shortage of specialized Internet websites and of websites applied for teaching physics, poor knowledge of foreign languages, etc. The most important stimulating factors: the wish to interest pupils and search for more diverse teaching forms, the possibility to present the phenomena to the pupils that they find difficult to imagine, the diversification of the demonstration and laboratory teaching aids, etc.

In the third stage of the study the experts had to assess the generalised second stage results. In many cases the experts approved the generalised assessment of the current situation; however, they noted that the situation in town schools and village schools differed. The experts clearly expressed their concern regarding the immoderate ICT usage in the teaching process and emphasized that the computer will never replace the teacher's explanation and natural experiments with real physical bodies in the real environment. At the same time it is emphasized that in the conditions of catastrophically poor resources of the physics rooms virtual environment and virtual experiments partially solve the funding situation of teaching aids for natural sciences that is difficult to solve. The dominating opinion is that more attention should be allocated to the creation of computerized physics teaching programmes, whilst the Internet is not that convenient and is more significant for the communication between teachers and pupils, experience exchange, information, methodical material announcement, etc. The importance of Internet usage for teaching physics is understood in the broader education context too, bearing in mind not only learning physics but also the development of general abilities. It is noted that pupils are not able to search, select and systemise information on the Internet; besides, teachers find it a difficult task too. It was also noticed that teachers still focused on the result but not on the process and that the activity was organised according to the following algorithm: the teacher announces the topics, the pupils search for information and make "presentations". The analysis of such "products" and of the authors' reflection discloses the limitation of such learning.

The third stage of the study raises the issue of the importance and the shortage of educational research in Internet usage for teaching physics: it is stated that teachers do not have research-based proofs that Internet usage for teaching physics is an efficient aid, i.e. that it improves the understanding of the foundations of physics science and increases the teaching quality; the Internet is used for teaching physics based on the belief that this is effective and useful. Another opinion related to the research proposes to repeat the inquiry after several years because the situation is permanently changing. In principal it could be possible to talk about long-term observation (monitoring).

Commenting the generalised assessments of the factors, limiting Internet usage for teaching / learning physics, the experts point out that most often computers appear in physics rooms from informatics rooms, when the latter are supplemented with new computers; that ICT usage for teaching other subjects at schools is still not an important task; that in the opinion of school administration computerisation of physics rooms is a too big luxury; that teaching should take place in the state language, whilst on Internet useful information is most often given in other languages, therefore, it is emphasized that it is necessary to create a Lithuanian data basis for teaching physics on Internet; it is emphasized that the teachers and university lecturers' methodical activities should be better coordinated.

Commenting the generalised assessments of the factors, encouraging Internet usage for teaching / learning physics, the experts point out that in recent years at schools, particularly in the basic school stage, the motivation of learning is decreasing and the teachers use the Internet mostly to interest pupils in physics, in the subject and to increase the prestige of physics science and partially one's own prestige. The experts also emphasize the possibility to find filmed material on Internet and solve the issue of poor resources of physics rooms, demonstrating various physical phenomena, particularly the ones that cannot be directly observed. The experts repeatedly emphasize the possibility to find information about the newest discoveries in physics science on Internet that is not and cannot be found in the textbooks and other printed sources. At the same time they disclose the concern that due to the shortage of teaching aids the Internet may just supplement the formation of the perverted view of reality. Besides, attention is paid to the problems of safety during experiments: on one hand virtual experiment ensures pupils' safety, on the other hand, the school must teach to behave with instruments cautiously – this is more difficult to implement in the virtual environment.

Commenting the generalised recommendations the experts point out that in addition to the Internet equally important is the encouragement to create software programmes for teaching physics. In some experts' opinion, encouraging ICT usage for teaching it would be necessary to start with software programmes and not with the Internet. Again, the function of the Internet

as a means of communication is emphasized because teachers often would like to assist each other but there are no possibilities; for this purpose the specialised Internet website, which some experts imagine as a virtual textbook, could be of help. Experts relate the creation of the specialized data basis in the Lithuanian language on the Internet to saving teacher's time, teaching, provision of the scientifically proved methods of ICT usage for teaching physics. Here the experts' opinions part: some of them do not see the point why the teachers should "invent the bicycle" individually, others would like to encourage teachers' pedagogical creativity. The first are favoured by the ones who state that is it good to use the already tested and proved out methods because quality teaching is not possible without methods, whilst the process of their creation and testing may be long but necessary; therefore, it is recommended to coordinate teachers' and university lecturers' methodical activities. It is recommended that the Internet is used in moderation because like elsewhere quantity may dwarf quality; the computer will not replace the teacher but the teacher has to be in the front; therefore, the teacher has to use modern technologies in his / her activity.

Conclusions

- The Internet possibilities for teaching physics are not being fully used both for objective and subjective reasons.
- It is expected that during the nearest five years the Internet usage will increase only insignificantly.
- Higher effectiveness of ICT application for teaching physics can be achieved in the presence of continuous monitoring (how the situation changes, what influences it, etc.), on the other hand, the physics teachers need continuous methodical assistance, independent of their formal qualification. Effective ICT application for teaching physics is one of the composite parts of the competence of physics teachers.
- Continuous studies and in-service training institutions should allocate more attention raising the qualification of physics teachers in this field.

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