

ICTE Journal

Volume 4

2015/1

International Journal of Information and
Communication Technologies in Education

editorial

ICTE JOURNAL HAS BEEN INCLUDED IN THE LIST OF REVIEWED NON-IMPACTED PERIODICALS

Pavel Kapoun 3

articles

THE USE OF INQUIRY BASED EDUCATION IN A SIMULATION SOFTWARE ENVIRONMENT IN PRE-SERVICE ICT TEACHER TRAINING

Václav Šimandl, Jiří Vaníček 5

E-LEARNING IN HIGHER EDUCATION: REFLECTION OF THE TERM IN MIND MAPS

Ivana Šimonová 16

EDUCATIONAL SUPPORT OF THE COURSE NURSING PROCEDURES AND INTERVENTIONS

Markéta Babičová, Ingrid Nagyová 28

DATA FROM CATALOGUES OF SOLAR SYSTEM OBJECTS IN EDUCATION

Ota Kéhar 40

appendix

WHAT DO THE PARTICIPANTS OF THE ICTE CONFERENCE IN ROŽNOV WISH FOR?

Pavel Kapoun 54

ICTE Journal

International Journal of Information and Communication Technologies in Education

ISSN 1805-3726

Volume 4, 2015/1 (issued on March 16, 2015)

Editorial Board

Jana Kapounová (Chairperson), University of Ostrava, Czech Republic

Matilda Drozdová, University of Žilina, Slovakia

Theodora Issa, Curtin University, Perth, Australia

Tomayess Issa, Curtin University, Perth, Australia

P. A. M. Kommers, University of Twente, Netherlands

David Leat, Newcastle University, United Kingdom

Mária Lucká, Slovak University of Technology in Bratislava, Slovakia

Jiří Mareš, Charles University, Faculty of Medicine in Hradec Králové, Czech Republic

Eva Milková, University of Hradec Králové, Czech Republic

Tomáš Pitner, Masaryk University in Brno, Czech Republic

Maciej M. Sysło, Institute of Computer Science, University of Wrocław, Poland

Jana Šarmanová, University of Ostrava, Czech Republic

Milan Turčáni, Constantine the Philosopher University in Nitra, Slovakia

Editorial Office

Kateřina Kostolányová (Editor-in Chief)

Pavel Kapoun (Executive Editor)

email: ictejournal@osu.cz

© 2015

University of Ostrava, Pedagogical Faculty

Department of Information and Communication Technologies

Fráni Šrámka 3, Ostrava-Mariánské Hory, Czech Republic

<http://periodika.osu.cz/ictejournal/>

ICTE Journal has been included in the list of reviewed non-impacted periodicals

Dear readers,

We are pleased to inform you that on November 28, 2014, at its 299th meeting, the Research, Development and Innovation Council approved the inclusion of International Journal of Information and Communication Technologies in Education in the list of reviewed non-impacted periodicals published in the Czech Republic. We believe that this fact will encourage you and your colleagues to not only read and quote from our Journal, but also to publish further papers in it.

The first paper of this issue of the ICTE Journal entitled “The Use of Inquiry Based Education in a Simulation Software Environment in Pre-Service ICT Teacher Training” deals with the following question: to what extent can be inquiry based learning an appropriate method for understanding the principles of computer networks? Using selected software that simulates computer networks, students of teaching discovered how computer networks and their components work. On the basis of their own discovering, the students were supposed to come to their own conclusions. The secondary aim of the project was to prepare students of teaching so that they would be able to use inquiry based learning when working with their future students.

The second paper entitled “E-learning in Higher Education: Reflection of the Term in Mind Maps” presents the results of the research on individual approaches to eLearning led by students of the Faculty of Informatics and Management of the University of Hradec Králové, Czech Republic. Students used Khan’s eLearning framework, which contains 17 conditions in 8 dimensions. Students also proposed their own mind maps. The research results showed that the approach to eLearning is not exclusively linked with the “Informatics” study program, but is closely related to modern technologies in general (including the area of education).

The third paper deals with the educational support of the course Nursing Procedures and Interventions which is being taught at the Faculty of Medicine of the University of Ostrava within the scope of the study programs Nursing and Midwifery.

The fourth and the last paper entitled “Data from Catalogues of Solar System Objects in Education” contains interesting examples of the use of catalogues of astronomical objects in education, which can be found at the Astronomia website <<http://astronomia.zcu.cz/>>. These are mainly the Solar System objects. Students can find out the current position of such objects or can interactively verify Kepler’s laws. Since the main goal of the paper is students’ involvement in practical activities, the project contains a number of workbooks. The research pointed out task-solving problems of students and difficulty they had when working with the Microsoft Excel spreadsheet application.

Dear readers,

We sincerely believe that we will meet you not only on the pages of the ICTE Journal, but also at the 16th annual conference “Information and Communication Technologies in Education”, which will be held in Rožnov pod Radhoštěm from September 15 to September 17, 2015. Further information about the conference can be found at <https://konference.osu.cz/icte/>.

Pavel Kapoun,
Executive Editor



THE USE OF INQUIRY BASED EDUCATION IN A SIMULATION SOFTWARE ENVIRONMENT IN PRE-SERVICE ICT TEACHER TRAINING

Václav Šimandl, Jiří Vaníček

Department of Informatics, Faculty of Education,
University of South Bohemia, Jeronýmova 10, České Budějovice, Czech Republic
{simandl; vanicek}@pf.jcu.cz

Abstract

The article deals with the possibilities of using inquiry based education methods as part of pre-service ICT teacher education. The question is how this teaching method can be used within a specialised subject focused on teaching technical principles, in this case concerning the functionality of various computer networks and their components. The first task was to find appropriate software for such a method of teaching. Software simulating a computer network was chosen and modified curricula was used so that students could obtain crucial competencies for understanding networks by independently exploring them for themselves: how a prepared network operates, finding connections and formulating a written conclusion. The goal was to direct students to actively experiment with the assigned networks and research answers to the assigned questions. However, instead of simply being given outright answers, students were advised how to proceed in order to find solutions for themselves. Another aim was to familiarize future teachers with this method in the role of pupil. The data for the research was acquired from participant observation and the evaluation of the lessons via questionnaires and a group discussion on the benefits and drawbacks of this approach in the lessons in comparison with similar subjects taught traditionally. It was found that successful students started to ask questions which they were interested in and to go on inquiring to answer them. Although the students realized the benefits of the teaching approach, many of them were not prepared enough to work with this method (particularly due to the lack of knowledge of basic theoretical concepts).

Keywords

inquiry based education (IBE), ICT teachers' education, computer networks, simulation software.

Inquiry based education in information technology teacher training

Inquiry based education (IBE) is an activating teaching method where students' knowledge is developed by a system of asking questions and solving problems (Papáček, 2010). As stated by Edelson et al. (1999), this method is based on authentic activities that motivate students, providing a perspective for associating new and current knowledge and the chance to make use of newly-acquired knowledge. The student studies the real world, makes his own observations and proposes possible explanations for the investigated problem (Bell et al., 2010). The role of the teacher also differs as he becomes an informed guide for problem solving and leads the student in a similar way to during research itself (Papáček, 2010).

In inquiry-based education, students should proceed as they would so in real research (Papáček, 2010). According to Bell et al. (2010), the basic phases of inquiry include determining the problem and posing questions, generating hypotheses, planning experiment design and implementation, analysing and interpreting acquired data, creating resulting models, drawing conclusions and evaluating research. If trainee teachers are to learn how to use the IBE method in practice, it is essential for them to experience it as an undergraduate student.

In compliance with constructivist teaching theories, the authors prefer an approach where the student is active, solves problems, gains experience and is led to creating cognitive models of the observed events. As presented by Hajduković Jandrić et al. (2011), the creatively active approach of a student in lessons is a prerequisite for success. Apart from this, there is a need for simulation tools, which enable a method of observation where hypotheses are verified by setting limit and untypical situations. These are capable of generating in-depth problems and if students are able to solve them, they will have reached the higher levels of Bloom's taxonomy - being able to analyse a situation, create and independently argue in favour or against a hypothesis.

Approaches included in inquiry based education can be categorised according to what part of the inquiry process the teacher takes over for the pupils or students. Eastwell (2009) differentiates four types of inquiry: confirmation, structured, directed and open.

According to Stuchlíková (2010), confirmation inquiry is where pupils or students are provided with questions and procedure and results are known. The pupil's task is to confirm these results. Structured inquiry is where the teacher gives questions and possible procedure and students are to formulate an explanation based on their implementation of the procedure (Stuchlíková, 2010). Directed inquiry is where the teacher provides a research question and students create a methodological procedure and carry it out (Stuchlíková, 2010). Open inquiry is where students pose themselves a research question, think up a procedure for it, carry it out and formulate an explanation (Stuchlíková, 2010).

The application of IBE in the teaching of practical informatics

As one of the natural and technical sciences, informatics provides possibilities to use this method to teach new concepts, understand the principles of the field and to create outlines and relationships between key concepts. Computer Networks is one of the subjects taught in practical informatics lessons. It involves students acquiring a broad theoretical knowledge whilst putting an emphasis on practical skills. However, students often rate this subject as dull

and lacking educational effect (Sun et al., 2013). Yet the study of network protocols is fundamental to the understanding of network behaviour and characteristics (Breslau et al., 2000). For those reasons, it is suitable for lessons to include activities where appropriate simulation tools enable the study of the behaviour of individual network protocols in various conditions as defined by the user (Bote-Lorenzo et al., 2012). Discovering how hubs and switches work or how a broadcast packet behaves in various network devices are examples of such activities.

The environment for implementation of IBE in Computer Networks

The requirement for practical experience of this issue leads to the creation of an educational environment which can be divided according to its authenticity.

A hardware laboratory containing real hardware devices meets the requirement of offering students a highly realistic experience (Marsa-Maestre et al., 2013). There are, however, drawbacks to this approach - limited possibilities for experimenting (the laboratory does not allow absurd settings that would prove the unattainable), the need for the physical presence of students (Momeni, Kharrazi, 2012) and the high cost of equipping such a laboratory (Marsa-Maestre et al., 2013).

Virtualized networks are made up of a number of virtual computers, running on one physical computer, which are connected to a computer network with the required configuration (Marsa-Maestre et al., 2013). Thanks to virtualization, there is no need to worry about the mother computer being damaged by an unsuitable setting (Sun et al., 2013). Yet again, the teaching of networking concepts does not seem to be ideal here, as the solution requires no inquiry into the principles of how the network works.

Simulation software is a special application which allows students to create and configure a network without the need of physical network devices (Makasiranondh et al., 2010). This is less costly and cuts out the need for a laboratory technician (Makasiranondh et al., 2010; Sun et al., 2013), but it does not enable students to gain manual skills such as cabling and physical connectivity (Makasiranondh et al., 2010). However, Al-Holou et al. (2000) claim that this software could be used to improve a student's understanding as it enables the simulation of limit situations which impose risks in real-life situations but lead to an improved understanding of concepts.

The simulation environment for the implementation of IBE in Computer Networks

There is a wide range of simulation software on offer but a lot of it is designed for research purposes, being unsuitable for teaching due to its extensiveness and difficulty to control. Students require user-friendly tools which help them create appropriate cognitive models (Makasiranondh et al., 2010).

For the needs of the innovation in education project, it was necessary to find educational simulation software allowing various topologies of computer networks to be created, configured and to have their functionality tested. Cisco Packet Tracer met those requirements, offering significant priorities for experimental teaching within a subject. It actually allows the

created network to be tested by sending messages from one device to another whilst offering the possibility of real time testing or step-by-step testing. Step-by-step testing allows messages to be passed through the network to be atomized and information about operations with the message to be displayed in detail. These can be used to verify hypotheses concerning the running of a network and the causes of non-function and hence to learn the principles of how network elements and protocols work.

For the teaching of Computer Networks in the Cisco Packet Tracer environment, official educational activities accessible as part of the CCNA Discovery Home Small Business Networking (Cisco, 2013) were analysed. These activities have been drafted in the form of training sessions. Students are gradually assigned step-by-step tasks leading to the creation and running of a simulated network and conclude with the application being verified to check whether they have proceeded correctly. An example of one of the activities is illustrated in Fig. 1.

Step 1: Set up the network topology

- a. Add two PCs and a Cisco 2950T switch.
- b. Using straight-through cables, connect PC0 to Fa0/1 on Switch0 and PC1 to Fa0/2.
- c. Configure PC0 using the config tab in the PC0 configuration window:
 1. IP address: 192.168.10.10
 2. Subnet Mask 255.255.255.0
- d. Configure PC1 using the config tab in the PC1 configuration window:
 1. IP address: 192.168.10.11
 2. Subnet Mask 255.255.255.0

Step 2: Test connectivity from PC0 to PC1.

- a. Use the ping command to test connectivity
 1. Click on PC0.
 2. Choose the Desktop Tab.
 3. Choose Command Prompt.
 4. Type: ping 192.168.10.11 and hit enter.

Fig. 1: Activity in Packet Tracer from the CCNA course (Cisco, 2006)

These activities are unsuitable for use with the IBE method, as they do not give students the chance to independently discover the functionality of a network and actively build on their knowledge. At the same time, the Packet Tracer environment allows activities like searching for the cause of an existing simulation network system error, searching for limits of functional reliability of a given network configuration or the mental transition from one class of elements to another, and so on.

Project to teach the principles of computer networks with inclusion of IBE

One of the questions that arose whilst educating pre-service ICT teachers in the principles of computer networks was how to actively involve students in the study of this abstract issue. The project went ahead as part of the pre-service preparation of ICT teachers and pedagogical ICT professionals studying first degree courses at the Faculty of Education of the University of South Bohemia in autumn 2013. The project was attended by 10 trainee teachers and another 4 students of the non-teacher information technology field. Eight two-hour lessons were taught. Most activities were based on IBE in the Cisco Packet Tracer environment. Apart from that, students could attend lectures where simulation software was not used.

Teaching approach

During lessons, the teacher made particular efforts to avoid tasks requiring students to set up and configure a new network by following certain directions. As a rule, the simulation environment was used to prepare a network with a given configuration and students were first required to explore the activity of such a network. While working through the tasks, students were to create hypotheses which they could test in the simulation environment. As stated by Wong et al. (2007), students require very brief knowledge to commence such experiments and all required knowledge can be acquired gradually.

The following types of inquiry activities were implemented during the project:

- discovering the functionality of network elements
- discovering the functionality of a network protocol
- revealing network errors

Discovering the functionality of a network

In a prepared functional network, students were required to discover the functionality of a particular element and answer the question “How does it work?” One example is a local network of star topology with a central hub as the active network element. Students were to define the functionality of this hub after having observed packet movement within the network. After adding more devices to the network, students could be challenged with further questions, for example “What are the risks posed by the creation of a local network using hubs as active devices?” Students sought the answer by experimenting with a simulated network (an example of the problem of frame collision is illustrated in Fig. 2).

In the second part of the task, hubs were replaced by switches and after having virtually manipulated the network, students were to answer questions set by the teacher, such as “How does the switch differ from the hub?” or “What other features must a switch have as opposed to a hub in order for it to meet these requirements?”

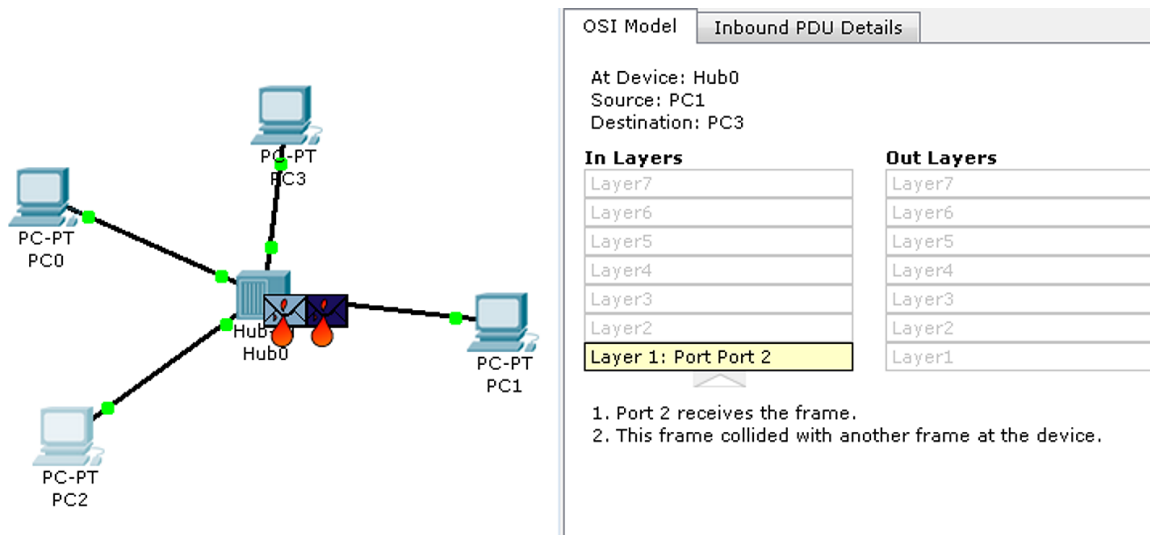


Fig. 2: Collision of frames when using a hub

Discovering the functionality of a network protocol

Students tackled the question: “What is the principle of the activity?”, e.g. discovering the principle of assigning IP addresses from a DHCP server. By experimenting in the prepared network, students were to find out what kind of communication was going on between a client requesting an IP address to be assigned and a DHCP server and write a description of the model of communication. After having suitably adapted the network, the original task can be enhanced by explaining how DHCP addresses are assigned in an environment with two equivalent DHCP servers.

Revealing network errors

Another task was to reveal errors that had been deliberately included in an otherwise functional network and seek the answer to the question: “Why does it not work?” Students tested a partly functional network in order to reveal the network error. Where possible, they were to fix it. These tasks were especially used for encouragement at the start of a new topic.

One example could be an activity where a network is made up of two subnets separated by a router. Communication in each subnet runs smoothly. However, by experimenting, students find out that packets do not “pass through the router”. Students were to find the answer via controlled manipulation with the particular network. In Fig. 3, there is a window explaining the reason for the error. However, students can only progress to this window by experimenting.

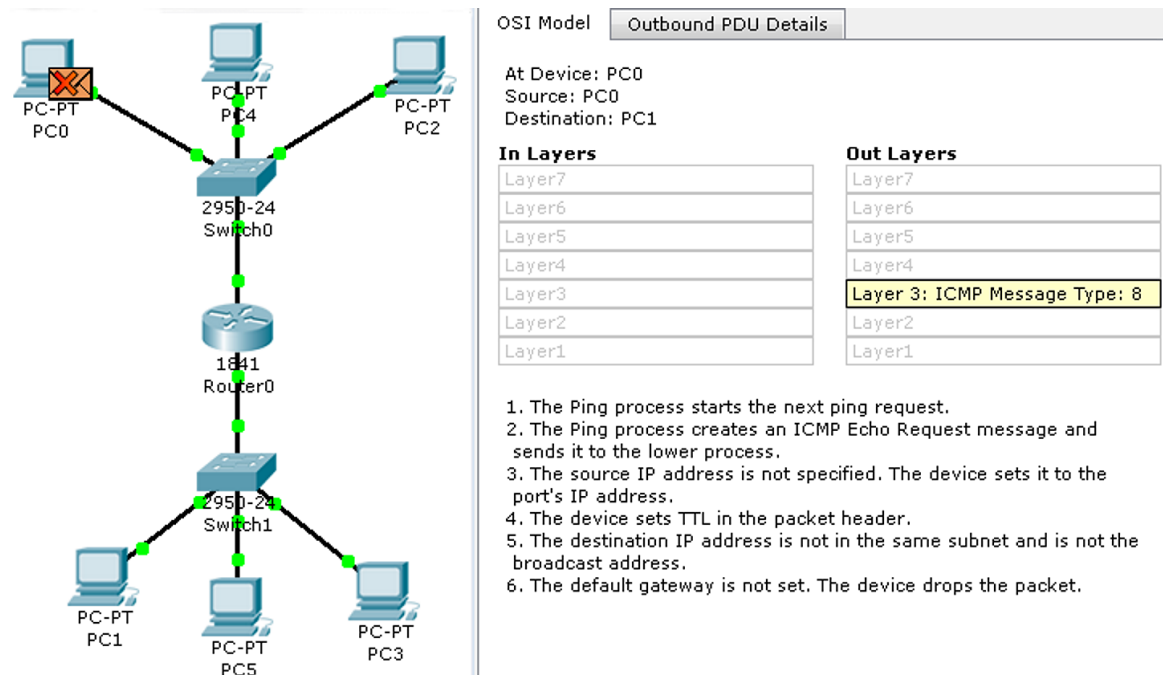


Fig. 3: Dropping of a packet due to the default gateway not being set

The role of the teacher and student

As opposed to chalk and board lessons, the roles of students and the teacher changed in IBE lessons. Here, the teacher did not impart wisdom but simply managed the course of the lesson and, where necessary, provided individual support regarding the procedure students had chosen to solve a problem. Students became active problem-solvers despite not being guided by an exact set of instructions.

Before commencing each task, the teacher set questions which students were to answer and, where necessary, suggested the procedure needed to solve the task. According to whether he revealed the possible procedure needed to solve the task or not, the teacher used either structured or directed inquiry based education. He gave advice on how to proceed or partial results to students who showed an interest or who were not able to proceed further on their own. In such situations, the teacher used leading questions to try to help students overcome any complicated passages they might have run into while problem-solving.

In compliance with the assigned task, the student himself determined the way he would work with the simulated network unless the procedure for a given task had been proposed by the teacher. According to this procedure, he manipulated the network, generated hypotheses and searched for answers to the set questions on his own. To do that, he first needed to get a good impression of how the scrutinized parts of the network work and consequently formulate written conclusions in a clearly understandable way. Students could continuously consult classmates or the teacher throughout the task.

Students who had completed the set task usually discussed their findings and conclusions with the teacher. The teacher played the role of presenter and, where necessary, summarised and generalized conclusions if students hadn't come to them on their own. The teacher expanded

by asking questions which students reacted to from their experience gained during previous manipulation.

Findings from lesson observation

On the basis of participant observation (Kawulich, 2005) it can be said that students actively experimented with the network, completed set tasks and searched for answers to the posed questions. However, it became apparent that they were not entirely prepared for such a teaching method. Unexpectedly, they often did not consider how to proceed in their work but rather found answers by trial and error. If their efforts were slow to bring results, they sought help from their neighbours in the classroom. The presence of several students with previous experience of an issue from their past studies, e.g. from high school lessons, turned out to be useful as they helped classmates who could not manage.

It was observed that the new method of work encouraged successful students to go on inquiring. Those usually added other elements to the network and investigated their functionality in the new configuration. Other students continued to investigate the given issue outside the scope of the assignment, for example by adapting the network to include one switch and one hub and observe how the two devices interact with each other. These observation results were confirmed in the following year 2014, when the project was repeated with 16 students.

Students' evaluation of the lessons

These lessons contributed to students' understanding of the principles of computer networks. Observations found that students had been actively involved and had not tried to avoid problems. They had been independent and their understanding of the issue had improved. In order to verify this information against students' opinions, all participating students were asked to fill in a questionnaire and selected students were invited to a group discussion at the end of the course. The questionnaire consisted of open questions focusing on the benefits and drawbacks of the lessons. Students could also submit ideas and opinions on how to improve lessons. The questionnaire was voluntary and anonymous.

The majority of students found lessons beneficial and attractive. Some remarked: "The lessons themselves were interesting. There wasn't much time to be bored". They appreciated the possibility to learn from one's own experience and without the need to physically assemble a network. One of the students stated: "For me, the highlight of PT lessons was the possibility to experiment with networks with almost no risk of irretrievably ruining something if it were for real". Students commenting on the employed teaching method said that it encourages a more independent manner of work and thinking, quoting "Lessons encourage independent thinking, which is good".

There were also requests for more complicated problems (for example advanced routing) or to make the whole course more practical, not only working in the simulation environment. Another remark expressed displeasure over the teacher's scholarly discussions with more advanced students who had been experimenting, which the other students did not understand.

Four weaker students were later invited to a group discussion aimed at analysing the drawbacks of lessons. What emerged from the discussion was that the students had been prevented from working effectively in the simulation environment by their lack of knowledge of theoretical concepts. Although these had been covered in lectures, the addressed students had not attended them regularly.

The addressed students also admitted that they had often lacked sufficient knowledge of technical English to work adequately in the simulation environment. Their efforts to solve this problem by using an Internet translator were not particularly successful either. They denied feeling that they had learnt to work as technicians searching for a network error. In their opinion, more time would have been needed for that and they also felt they lacked the required theoretical knowledge.

The discussion corresponded to the questionnaire. Students considered lessons to have been more useful than chalk and board teaching on the whole. Those who took part in the discussion stated that, thanks to the style of teaching used, they could remember the mediated information better than when facts are simply presented. Students themselves had not observed that this teaching method trains metacognitive competences and the ability to work by way of inquiry. In their evaluation, they focused on the fact that they had gained knowledge of an issue in a particular subject.

The use of a simulation environment for computer networks lessons (regardless of the teaching method used) was found suitable. There was a clear environment and information was provided to explain why a sent message had not been delivered. As teachers, they projected the possible use of this solution into their future lessons, bearing in mind its low cost.

Conclusions

The effect of using IBE as a teaching innovation to achieve goals in a standard practical informatics topic was verified. The aim of innovated computer networks lessons using IBE in a group of pre-service ICT teachers was achieved. Their understanding of the principles of computer networks had improved through active “research” activity. The students themselves evaluated lessons as useful and attractive, despite not achieving the required competence of professional computer network administrator. There needs to be an analysis of whether the absence of previous experience of IBE learning and hence lack of knowledge of the inquiry-based approach is not a significant factor in achieving educational aims or whether shortcomings not related to the method used are the prevalent cause, i.e. unfamiliarity with the principles of this science discipline, poor English, etc. It has become apparent that IBE methods can also be applied in informatics, a science that is not always regarded as natural.

One of the significant results of the project is that trainee teachers who had never experienced this teaching method as a pupil were able to actively try it out here. The positive feedback brings hope that trainee teachers will adopt this method as their own.

Acknowledgements

The research was supported by the project GAJU 017/2013/S.

References

- AL-HOLOU, N., K. K. BOOTH and E. YAPRAK. Using computer network simulation tools as supplements to computer network curriculum. *Frontiers in Education Conference, 2000. FIE 2000. 30th Annual* [online]. Kansas City, Missouri: IEEE, 2000, p. S2C/13–S2C/16 [cit. 20140305]. Available from <http://www.fie-conference.org/fie2000/papers/1286.pdf>
- BELL, T., D. URHAHNE, S. SCHANZE and R. PLOETZNER. Collaborative inquiry learning: Models, tools, and challenges. *International Journal of Science Education* [online], 2010, **32**(3), p. 349–377 [cit. 20140302]. Available from <http://www.tandfonline.com/doi/full/10.1080/09500690802582241#.VK-KQnvKO68>
- BOTE-LORENZO, M. L., J. I. ASENSIO-PÉREZ, E GÓMEZ-SANCHEZ, G. VEGA-GORGOJO and C. ALARIO-HOYOS. A grid service-based Distributed Network Simulation Environment for computer networks education. *Computer Applications in Engineering Education* [online], 2012, **20**(4), p. 654–665 [cit. 20140310]. Available from <http://onlinelibrary.wiley.com/doi/10.1002/cae.20435/pdf>
- BRESLAU, L., D. ESTRIN, K.FALL, S. FLOYD, J. HEIDEMANN, A. HELMY, P. HUANG, S. McCANNE, K. VARADHAN, Y. XU and H. YU. Advances in network simulation. *Computer* [online], 2000, **33**(5), p. 59–67 [cit. 20140311]. Available from <http://www.isi.edu/~johnh/PAPERS/Breslau00a.pdf>
- Cisco. Prototyping a Network. *CCNA Discovery: Networking for Home and Small Businesses* [online], 2006 [cit. 20140315]. Available from <http://goo.gl/OOJP0K>
- Cisco. CCNA Discovery. *Cisco Networking Academy* [online], 2013 [cit. 20130313]. Available from <https://www.netacad.com/cs/web/about-us/ccna-discovery>
- P. EASTWELL. Letters: Inquiry Learning: Elements of Confusion and Frustration. *The American biology teacher*, 2009, **71**(5), p. 263–264 [cit. 20140302]. Available from <http://connection.ebscohost.com/c/letters/39755452/inquiry-learning-elements-confusion-frustration>
- D. C. EDELSON, D. N. GORDIN and R. D. PEA. Addressing the challenges of inquiry-based learning through technology and curriculum design. *Journal of the Learning Sciences* [online], 1999, **8**(3–4), p. 391–450 [cit. 20140302]. Available from <http://www.worldwatcher.northwestern.edu/userdownloads/pdf/JLSEdelsonetal.pdf>
- G. HAJDUKOVIĆ JANDRIĆ, D. Ž. OBADOVIĆ, M. STOJANOVIĆ and I. RANČIĆ. Impacts of the Implementation of the Problem-based Learning in Teaching Physics in Primary Schools. *The New Educational Review* [online], 2011, **25**(3), p. 194–204 [cit. 20140303]. Available from http://www.educationalrev.us.edu.pl/vol/tner_3_2011.pdf

- B. B. KAWULICH. Participant Observation as a Data Collection Method. *Forum Qualitative Sozialforschung / Forum: Qualitative Social Research* [online], 2005, 6(2), Art. 43 [cit. 20140311]. Available from <http://nbn-resolving.de/urn:nbn:de:0114-fqs0502430>
- W. MAKASIRANONDH, S. P. MAJ and D. VEAL. Pedagogical evaluation of simulation tools usage in Network Technology Education. *Engineering and Technology* [online], 2010, 8(3), p. 321–326 [cit. 20140311]. Available from <http://www.wiete.com.au/journals/WTE&TE/Pages/Vol.8,%20No.3%20%282010%29/13-12-Makasiranondh.pdf>
- I. MARSA-MAESTRE, E. DE LA HOZ, J. M. GIMENEZ-GUZMAN and M. A. LOPEZ-CARMONA. Design and evaluation of a learning environment to effectively provide network security skills. *Computers & Education* [online], 2013, 69, p. 225–236 [20140308]. Available from <http://www.sciencedirect.com/science/article/pii/S0360131513001899>
- B. MOMENI and M. KHARRAZI. Improving a Computer Networks Course Using the Partow Simulation Engine. *Education, IEEE Transactions on* [online], 2012, 55(3), p. 436–443 [cit. 20140311]. Available from <http://sharif.edu/~kharrazi/pubs/te12.pdf>
- M. PAPÁČEK. Limity a šance zavádění badatelsky orientovaného vyučování přírodopisu a biologie v České republice. Papáček, M. (ed.) *Didaktika biologie v České republice a badatelsky orientované vyučování (DiBi 2010)* [online]. České Budějovice, Czech Republic: University of South Bohemia, 2010, p. 129–135 [cit. 20140130]. Available from <https://www.pf.jcu.cz/stru/katedry/bi/DiBi2010.pdf>
- I. STUHLÍKOVÁ. O badatelsky orientovaném vyučování. Papáček, M. (ed.) *Didaktika biologie v České republice a badatelsky orientované vyučování (DiBi 2010)* [online]. České Budějovice, Czech Republic: University of South Bohemia, 2010, p. 129–135 [cit. 20140130]. Available from <https://www.pf.jcu.cz/stru/katedry/bi/DiBi2010.pdf>
- Z. SUN, L. XU and W. CHEN. Software Construction of Experimental Environment for Computer Network Course. *2013 International Conference on Educational Research and Sports Education (ERSE 2013)* [online]. Paris, France: Atlantis Press, 2013, p. 83–85 [cit. 20140310]. Available from http://www.atlantis-press.com/php/download_paper.php?id=7421
- K. WONG, T. WOLF, S. GORINSKY and J. TURNER. Teaching experiences with a virtual network laboratory. *ACM SIGCSE Bulletin* [online], 2007, 39(1), p. 481–485 [cit. 20140311]. Available from <http://www.arl.wustl.edu/~kenw/pubs/sigcse07-teaching.pdf>



E-LEARNING IN HIGHER EDUCATION: REFLECTION OF THE TERM IN MIND MAPS

Ivana Šimonová

Applied Languages Department, Faculty of Informatics and Management,
University of Hradec Králové, Rokitanského 62, Hradec Králové, Czech Republic
ivana.simonova@uhk.cz

Abstract

The paper presents results of the survey monitoring individual concepts of e-learning of university students. The survey ran at the Faculty of Informatics and Management, University of Hradec Kralove, Czech Republic. The research sample consisted of 104 respondents who enrolled in the first year of bachelor study programme of Applied Informatics and master study programme of Information Management. In the first phase, students did not design their mind maps by themselves but the Khan's model of e-learning was used. This model includes 17 terms which are structured in eight dimensions. In the first phase students worked with these terms and structured them into their own concept; adding other terms or omitting any of them was encouraged. In case of completely different concept, students might have designed their own mind maps. The results showed students' concept of e-learning had not been completely built despite their field of study is Informatics, i.e. they are expected to have close relation to modern technologies in general, including the field of education.

Keywords

higher education, university, tertiary education, mind map, e-learning, information and communication technologies, ICT, concept, model

Introduction

As generally accepted, the main objective of the ICT (information and communication technologies) implementation into the instruction is to optimize the educational process. But this new approach does not only mean adding new teaching aids, methods, forms to the existing ones. It requires revision of the whole system and active ICT implementation in the process. The 1990's events in the Czech Republic evoked changes in all spheres of the society, including education. General development towards democracy and information and knowledge society transformed the existing structure of the educational system and brought following consequences:

- new competences reflected in new learning content were defined;
- demands for new teaching methods, organizational forms, ways of evaluation were detected;
- new relations between elements participating in the educational process arose;
- different subjects and competences were emphasized, i.e. Humanities and foreign languages, Informatics, Environmentalistics;
- learner's responsibility for his/her own education, creativeness and motivation; economic aspects of education and competitiveness;
- and last but not least the call for lifelong education appeared.

These features have been slowly but steadily included into the new educational system, which is hardly to be imagined without implementation of modern information and communication technologies. Having undergone the starting period of material and technical problems, the time came we dealt with didactic aspects of ICT implementation into the instructional process. And what are the results? Analysing the current state, following questions appeared:

- Are teachers able to apply suitable means, create and use those which are offered by new technologies?
- Do students have higher level of knowledge if they attend lessons supported by ICT or those run traditionally by teachers?
- Are the new didactic means (methods, forms and aids supported by modern information and communication technologies) really able to optimize the process of forming knowledge (Šimonová, Poulová, 2012)?

Research activities

Research activities should deal with various aspects of the above mentioned questions and problems. In this paper, we focus on monitoring the concept of e-learning in learners' mind maps.

All these research activities relate to foreign language instruction focusing on English for Specific Purposes (ESP). They were held at the Faculty of Informatics and Management, University of Hradec Kralove, Czech Republic, and sample groups included students of Applied Informatics and Information Management study programmes.

Monitoring the concept of e-learning in learners' mind maps

Receiving realistic and objective feedback is the key problem of each educational concept. Searching for new approaches to education which would provide teachers with deeper reflection of students' knowledge is evoked by crucial efforts towards improving the process. There exist various approaches to taking it, and the mind mapping (mental mapping, semantic mapping, concept mapping) is one of them.

The term of mind mapping first appeared in 1970s in the concept introduced by psychologist Buzan (2001) who searched ways of remembering experience and concluded they were saved in individual's memory in the form of clusters showing mutual interrelations. In the field of education the mind mapping relates to developing meaningful learning, i.e. a new piece of knowledge becomes meaningful to learners if in-built in their existing knowledge structures which he understands to be are identical with mind maps.

The mind map as a research method was first applied by Novak (1998) in late 1970s. In his concept mind maps are understood as diagrams expressing significant relations between terms in the form of statements. These are represented by links between terms which describe their mutual relations. This concept was later adapted by Åhlberg (2004). Buzan (2010) says the mind maps thus can be understood as external expressions of knowledge integrated in individual's mind. He emphasizes the mind map is neither "correct", nor "incorrect", but it must be always accepted in a certain context, while it could be rejected in another one.

The mind maps can be applied in different phases of instruction, e.g. for revising, practising and fixing the knowledge, and as a means of feedback. Novak (1998) distinguishes four ways how the mind maps can be used, i.e. learning strategies, teaching strategies, means to forming concept and content of single subjects and the instruction as the whole, and a means of collecting information about learner's understanding of the learning content. He also mentions other ways, e.g. strategies towards acquiring new learning content, evaluation etc. The information and communication technologies can be used for the same purpose, e.g. electronic applications for creating and analysing the mind maps, which are available on web pages of iMind-Map (2011), brainstorm and mind map online (2011), Edraw Mindmap (2011) etc.

Research design and methodology

The main research objective was to monitor how students understand the term of e-learning. Despite the term has been generally and widely used within the field of education for more than two decades, there still does not exist a generally accepted, common definition of e-learning. Until this is provided, two approaches can be applied. First, the definition presented in main European administration documents, e.g. (EC, European Commission growth, competitiveness and employment, 1993), (EC, 1995) saying that e-learning means using modern multimedia technologies and the Internet towards improving the quality of education thanks to easy approach to sources and services (EC, 2001). Second, e-learning can be considered from two different points of view (Zlamalova, 2001):

- the educational process supported by information and communication technologies;
- a set of technological tools supporting education.

Above all, Zlamalova (2001) emphasizes that under no circumstances eLearning means the technical "e-" only, but the traditional didactic "-learning" must not be omitted.

Or, as Khan says (2006), "e-learning may be considered a new approach to providing a quality, interactive learning environment, easy available to everybody, anytime, anywhere, using

features and sources of various digital technologies, and also other learning materials which suit to open, flexible and distributed learning environment“.

And, last but not least, a completely different approach is introduced by Logan (2010) who defines that “The *e* doesn't stand for electronic. Better to think of the *e* as *e*volving, or *e*verywhere, or *e*nhanced or *e*xtended ... and don't forget *e*ffective”.

Czech university research activities also focus on e-learning from the point of individual learning styles (e.g. Kostolányová, 2012; Šimonová, Poullová, 2012) and this research may contribute substantially to this process.

The research sample included 104 respondents, the 1st-year students (aged 19 - 20 years) of the Faculty of Informatics and Management who in 2011/12 enrolled in the Applied Informatics and Information Management study programmes.

Respondents had not had any experience in being tested in this way, so the method of mind mapping was not used in the traditional form, i.e. the respondents did not create the mind map themselves, but they were provided the eight-dimensional schema of e-learning designed by Khan (2006).

His eight-dimension schema replies to the question what is required for the open, flexible and distributed learning. It is presented in two versions which differ in graphic presentation. In the middle of the first schema the figure of a human being is presented. Khan does not explain how this symbol should be understood, so two basic approaches can be applied: either e-learning as a learner-oriented process; or e-learning as a way of learning which enables/provides highly individualized approach to learning which is defined by each learner and is reflecting individual learning style preferences and other didactic-psychological characteristics (i.e. requirements-oriented learning). In the second schema the word e-learning is placed in the centre instead of the human figure, which might evoke the entire ICT-supported process of learning.

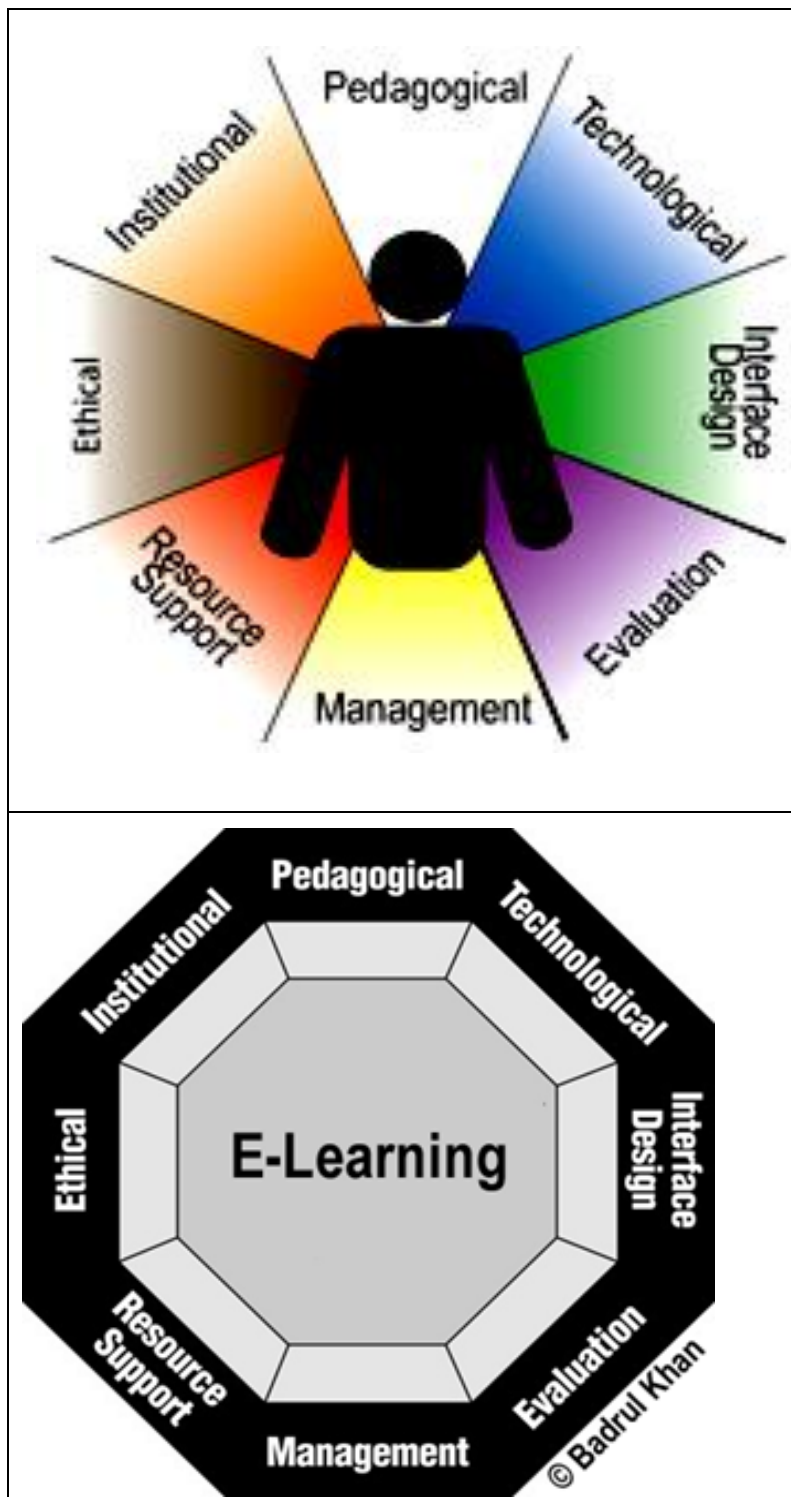


Fig. 1: Concept of e-learning: two versions of schema (Khan, 2006)

Before the research started, the principle of mind mapping and Khan's schema were explained to the respondents. Then, students modified the Khan's schema and adjusted it to their individual mind concepts by matching 17 terms defining e-learning by Khan to the eight dimensions and describing each match by an appropriate verb. In case of disagreement respondents removed the term or dimension. Additionally, they were provided several other terms by the researcher which were not mentioned by Khan (learning, tutor, communication)

and which focused on concrete subjects and foreign language learning (a subject, foreign language/s, English (ESP)). In case of total disagreement with the concept provided, respondents were encouraged to draw their own schema.

The Khan's structure of e-learning includes eight dimensions as follows: Pedagogical (P); Technological (T); Interface Design (D); Evaluation (in this research marked as feedback, F); Management (M); Resource Support (R); Ethical (E); Institutional (I). The 17 terms defined by Khan are listed below: analysis of objects, content and media used, analysis of participants (dimension P); organization, methods, strategies used in the environment (T); infrastructure design (hardware, software) (D); design of e-learning programme (design of pages, content, navigation, tools for testing) (F); management (evaluation of learner's work during the instruction using the assignments, evaluation of the learning environment (M); resource support (learning management, ways of providing and spreading information, online support, maintenance (R); social influence, cultural and geographical differences, differences in level of entrance knowledge, differences in accessibility to information, ethical and legal rules (E); institutional support in the field of e-learning services for students (I).

Research results

In this paper selected results are presented focusing on:

- Dimensions and levels used in the respondent's concept of e-learning.
- Dimensions not included in the respondent's concept of e-learning
- Additional terms included in individual concepts.
- Defining a new model of the mind map.

The collected data were processed by the method of frequency analysis.

Dimensions and levels used in the respondent's concept of e-learning

First, respondents matched 17 terms to the eight dimensions of the Khan's concept of e-learning. Results are displayed in figure 1 showing that one third of respondents (33.6 %) did not make any changes in the concept, they used all eight dimensions and matched one term to each dimension at least; 16.3 % respondents worked with seven dimensions; 15.3 % used six dimensions; 14.4 % of respondents matched terms to five dimensions and 17.3 % to four ones; 3 % of respondents used only three out of eight dimensions. Results are displayed in figure 2.

If the presented Khan's schema is considered to be the first level of the mind map, then 92.3 % of respondents added the second level and 6.7 % of respondents designed the three-level model.

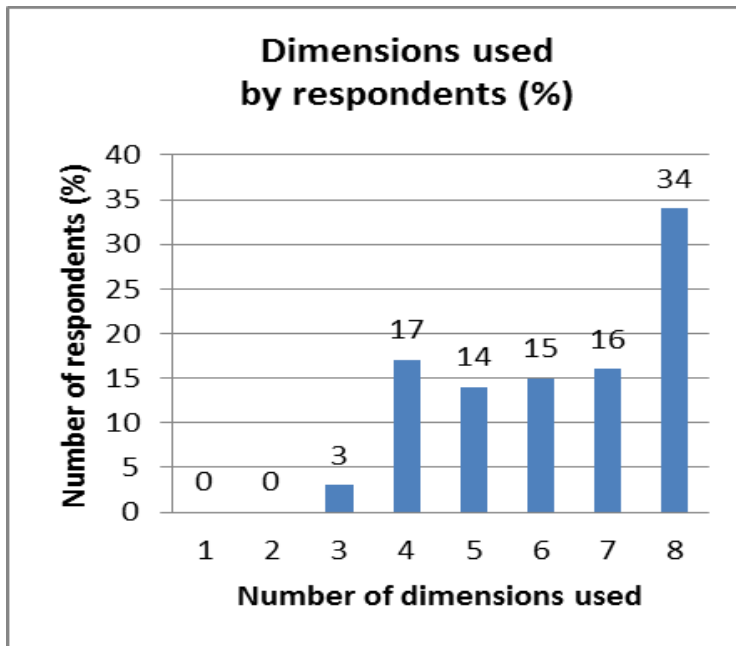


Fig. 2: Dimensions used in the respondent's concept of e-learning

Dimensions not included in the respondent's concept of e-learning

As mentioned above, respondents can match terms to eight dimensions. Results are displayed in figure 3 and showed that nearly 34 % of them had done it while 66 % of respondents used from three to seven dimensions. Not a student worked with one or two dimensions only. If respondents did not accept any dimension for the concept, they deleted it from the schema; if no term was matched to the dimension, it was accepted as it is. Reasons of such decisions were not analysed at this phase of research. Results are displayed in figure 2. The figure shows that the least frequently used dimension, i.e. the one which respondents did not match any term, is the institutional dimension (I) - this result appeared with 39.4 % of respondents. Further on, other rarely used dimensions were the ethical one (E, 30.8 %), resource support (R, 28.8 %), management (M, 22.1 %) and the technological dimension (T, 19.2 %). Remaining three dimensions were the most frequently used ones, i.e. the interface design (D, 2.9 %), pedagogical dimension (P, 6.7 %) and evaluation (F, 16.3 %). Thus the results show that nearly all respondents (97 %) understand e-learning from the point of interface design (D), which relates to the respondents' study programme, i.e. Applied Informatics and Information Management. Respondents also consider the pedagogical dimension of e-learning (P, 93.3 %) and its evaluation role (F, 83.7 %), followed by the technological dimension (T, 80.8 %), the dimension of management (M, 77.9 %) and resource support (R, 71.2 %). One term at least was matched to the ethical dimension (E) by 69.22 % of respondents and the institutional dimension (I) which was used by 60.6 % of respondents. This result reflects the research sample structure (students of IT study programmes) and confirms the above stated conclusions.

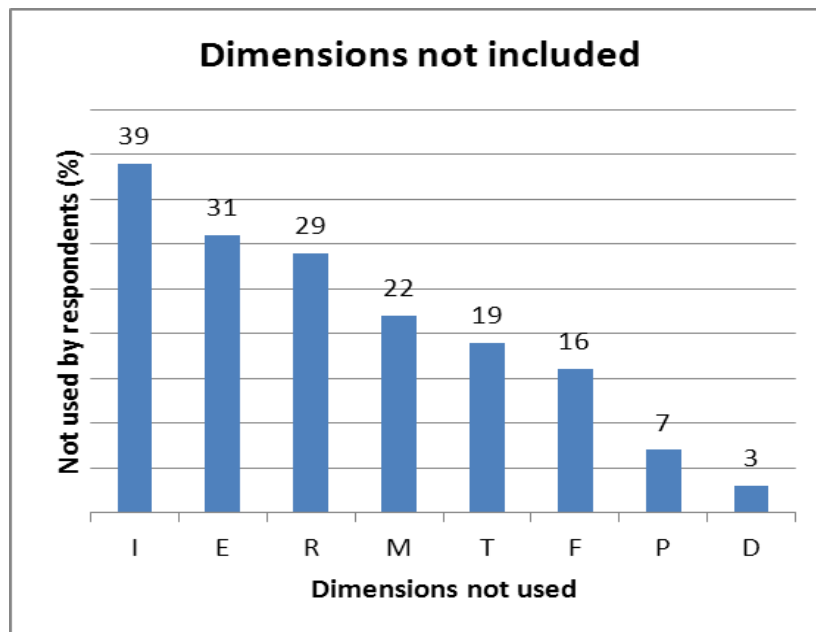


Fig. 3: Dimensions not included in the respondent's concept of e-learning

The detailed analyses discovered that 17.3 % of respondents did not match terms to the couple of dimensions, i.e. the institutional and ethical one. This couple (I, E) also appeared in combination with other slightly used dimensions, i.e. resource support (R, 6.7 %) and management (M, 3.8 %), evaluation (F, 3.8 %) and technological dimension (T, 2.9 %). Other rarely used dimension was the ethical one (E) in combination with resource support (R, 15.4 %), evaluation (F, 10.6 %), management and evaluation (M, F, 3.8 % each). Apart from the above mentioned, the institutional dimension (I) was detected in the 26 combinations of 2 - 4 dimensions.

Additional terms included in individual concepts

Except of the above mentioned terms, there exist other ones which were not mentioned by Khan but in our opinion strongly relate to the topic: *learning, tutor, communication*. The results show that only few students included any of them in their individual concepts: learning 7.7 %; tutor 3.9 %; communication 1.9 %. Totally 3.2 % of respondents used one of the terms in their mind maps, no respondent implemented two or three terms.

The reflection of a particular subject, foreign language/s and/or English (ESP) was also monitored. The results showed no respondent had included any of these terms in the individual mind map; English was mentioned by one respondent as the language of professional communication in the LMS Blackboard which was used for the ICT-supported instruction at FIM and language of IT professionals, not the subject taught/learned with the ICT-support. Our expectations were different in this field – we expected at least EPS and/or a foreign language and an IT subject would be mentioned in mind maps, even under the circumstances, when the ESP teacher and Database Systems teacher were the main organisers and present within this

research activity. In the given academic year the ESP teacher taught approximately 20 % of respondents and all of them attended lectures of Database Systems.

Defining a new concept of the mind map

Nine respondents (8.6 %) drew their own, totally different concept (model) of the mind map. Eight of them first started with re-organizing the Khan's concept but finally they designed their own schema; one respondent rejected the Khan's concept at the very beginning and designed a completely new model (Figure 2). Similarly to Khan the human body was situated in the centre but it was not defined who s/he is, because the teacher and learner were displayed separately. Several from the above provided terms were included in this schema; others were added according to the respondent's choice (friendship, stressfulness). In the text below the mind map, other two items were mentioned (motivation, responsibility) being related to all dimensions. The centre of the circle was called the system. Within the following interview the respondent explained he had considered the whole schema to be a system, not only the body in the centre which was not linked to any other dimension or described by other characteristics. Examples of individual concepts of e-learning are displayed in figure 4.

Summary and discussions of results

The results of researching the term of e-learning by the method of mind mapping showed that one third of respondents (33.6 %) had not made any changes in the provided Khan's schema; respondents had matched at least one term to each dimension; the others adjusted the schema and matched terms to 4 - 7 dimensions. The least frequently used dimension was the institutional one (more than one third respondents did not match any term to it), followed by the ethical, resource support, management and technological dimensions which were not used 20-30 % of respondents. This result proves that 97 % of respondents understand e-learning from the point of design interface, pedagogical dimension (93.3 %) and evaluation (83.7 %), followed by management, ethical and institutional dimensions and group of dimensions, e.g. IER, IEM, IEF, IET. This result reflects the structure of the sample group consisting of students of the Applied Informatics and Information Management study programmes who attend the institution where e-learning and ICT-supported instruction have a relatively long tradition and have become standard. The mind maps were structured in two levels by most respondents, 7 % of them designed three-level mind maps. Respondents matched 17 terms to eight dimensions of the Khan's concept; in general, they used 6-17 terms. One third of respondents (33.6 %) matched all 17 terms to the dimensions, using fewer dimensions step-by-step decreased from 12.5 % up to 1 %. Nine respondents designed their own mind map; eight of them worked with the provided Khan's schema first.

It is hardly possible to sum up all the collected data to a single and homogenous conclusion. Results mostly express agreement on the Khan's concept of e-learning, which can be appreciated because this concept is complex, considering e-learning from the whole width of this phenomenon. On the other side, it should be taken into account that the respondents were students of study programmes of Applied Informatics and Information Management who focus

on this field from the point of profession and interest and pay more attention to technological aspects.

Proposals for further research activities

For the future, similar research should be held so that to monitor the e-learning concept of students of teachers' training and other faculties and check whether their concepts are influenced by their future profession, i.e. whether e.g. pre-graduate teachers emphasize the pedagogical dimension of e-learning as the Informatics students do with dimensions closely relating to information technology and how the didactic approach is reflected in the e-learning concept.

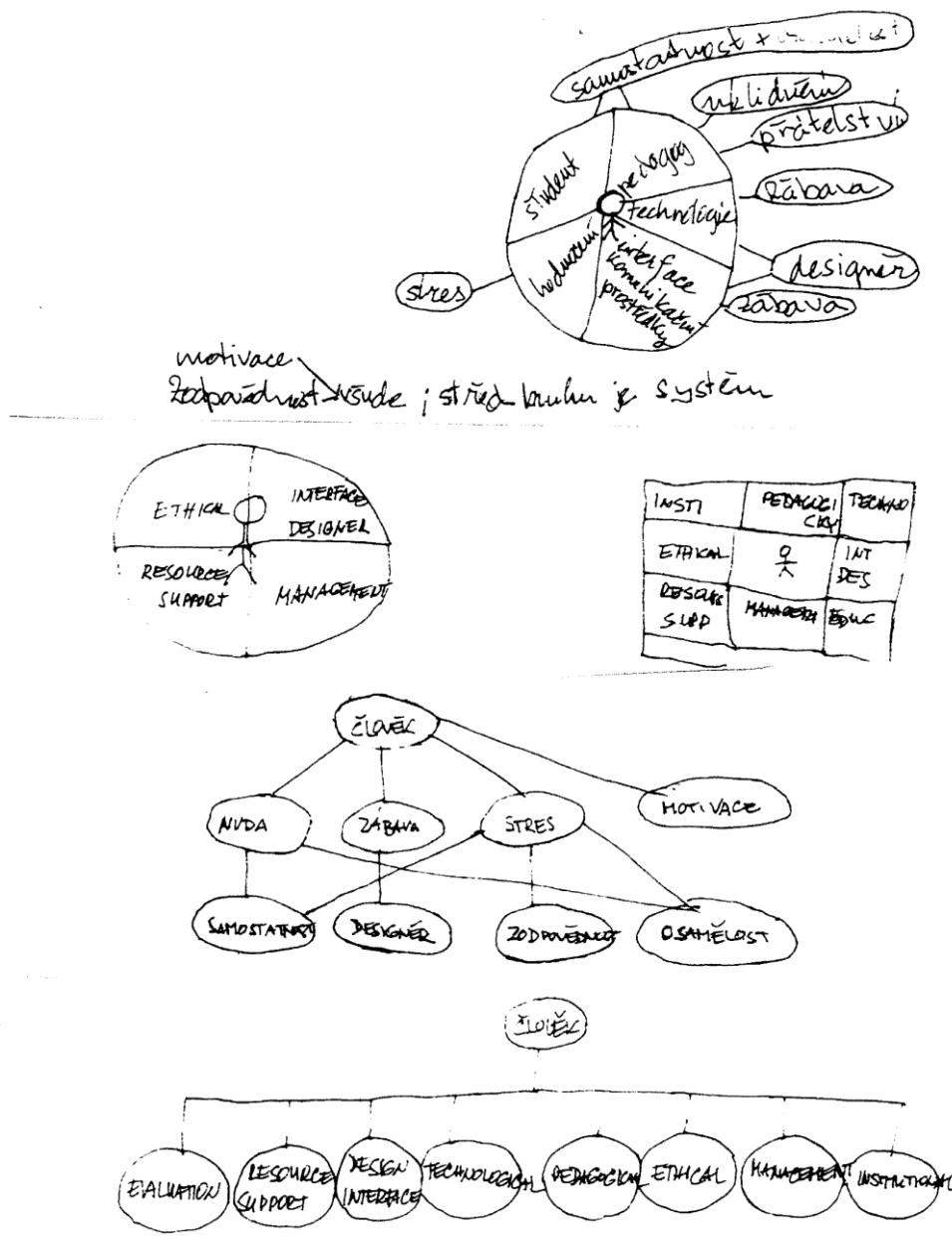


Fig. 4: Concept of e-learning: individually designed mind maps 1 – 5

English translation of Czech expressions used in mind maps:

samostatnost – self-reliance, osamělost – loneliness, uklidnění – calming, přátelství – friendly relations, zábava – entertainment, stres – stress, komunikační prostředky – communication means, hodnocení – evaluation, motivace a zodpovědnost všude – motivation and responsibility in all dimensions, střed kruhu je systém – centre of the circle is the system, člověk – man, nuda – boredom, zodpovědnost – responsibility.

References

- ŠIMONOVÁ, Ivana and Petra POULOVÁ. *Learning style reflection within tertiary e-education*. 1st issue. Hradec Králové: CZ WAMAK in Miloš Vognar M&V Publishing, 2012. ISBN 978-80-86771-51-9.
- BUZAN, Tony. *The power of creative intelligence*. London: Thorsons, 2001. ISBN 0-72-254050-7.
- NOVAK, Joseph Donald. *Learning, creating, and using knowledge. Concept maps as facilitative tools in schools and corporations*. Mahwah: Lawrence Erlbaum Associates, 1998. ISBN 0-8058-2625-4.
- ÅHLBERG, Mauri. Varieties in concept mapping [online]. [cit. 20140104]. Available from: http://academia.edu/829330/varieties_of_concept_mapping
- BUZAN, Tony. *The mind map book. Unlock your creativity, boost your memory, change your life*. New York: Pearson BBC Active, 2010. ISBN 9781406647167.
- How to make a mind map*. [online] [cit. 20131211]. Available from: <http://www.mind-mapping.co.uk/make-mind-map.htm>
- Brainstorming made simple*. [online]. [cit. 20131211]. Available from: <https://bubbl.us/>.
- Edraw mindmap*. [online] [cit. 20131211]. Available from: <http://www.edrawsoft.com/freemind.php>
- EUROPEAN COMMISSION. *Growth, competitiveness, and employment. The challenges and ways forward into the 21st century*. Brussels: European Commission, 1993.
- EUROPEAN COMMISSION. *White Paper on Education and Training - Teaching and Learning - Towards the Learning Society*. Brussel: European Commission, 1995.
- EUROPEAN COMMISSION. *The eLearning Action Plan: Designing tomorrow's education*. Brussel: European Commission, 2001.
- ZLÁMALOVÁ, Helena. *Úvod do distančního vzdělávání*. Olomouc : Univerzita Palackého, 2001. ISBN 80-244-0276-9.
- KOSTOLÁNYOVÁ, Kateřina. *Teorie adaptivního e-learningu*. Ostrava: Pedagogická fakulta, 2012. ISBN 978-80-7464-014-8.
- KHAN, Badrul. H. *E-learning : osem dimenzií otvoreného, flexibilného a distribuovaného e-learningového prostredia*. Nitra: SPU, 2006. ISBN 80-8069-677-2.
- LOGAN, Robert K. 2010. *Definition of eLearning. eLearning Concept*. [online] 2010. [cit.20120430.] Available from: <http://www.managersforum.com/eLearning/>



EDUCATIONAL SUPPORT OF THE COURSE NURSING PROCEDURES AND INTERVENTIONS

Markéta Babičová, Ingrid Nagyová

Department of Information and Communication Technologies, Pedagogical Faculty,
University of Ostrava, Fráni Šrámka 3, Ostrava-Mariánské Hory, Czech Republic
{marketa.babicova; ingrid.nagyova}@osu.cz

Abstract

The course Nursing Procedures and Interventions is being taught at the Faculty of Medicine of the University of Ostrava within the scope of the study programs Nursing and Midwifery. Despite the fact that the main part of the course is dedicated to the practical medical skills, it is suitable not only for students of full-time studies, but also for students of combined studies. The teaching of the course is organizationally demanding, because of which a Moodle e-learning course has been developed.

The article describes the aims and the education process of the course Nursing Procedures and Interventions with the support of e-learning. It deals especially with the testing of theoretical knowledge of students within the e-learning course, which has three phases – when introduced to the course for the first time, during the course, and at the end of it. The article presents the comparison of the test results of different education periods. The article also deals with the more complicated issues and parts of the course and also compares students' results with regard to their previous specialty – if they already encountered any kind of health studies or if the course is their first experience with this kind of education.

Keywords

E-learning, testing, distance learning, nursing procedures, interventions.

Introduction

The Faculty of Medicine was established in 2010 when it was transformed from the Faculty of Health Studies. This faculty offers a master's degree program in General Medicine and also bachelor's degree programs in various medical professions. Among many bachelor's degree programs taught at the Faculty of Medicine are study programs Nursing and Midwifery.

Within the scope of the study program Nursing, the course Nursing Procedures and

Interventions¹ is being taught. This course is suitable for the first year students of both full-time and combined studies, who take it during the winter semester, i.e. at the very beginning of their university studies.

The objectives of the course are determined by the annotation:

“The content of the course forms the core of professional skills of nurses and is part of the complex of basic professional subjects. The course is practical and allows students to acquire basic manual dexterity and assurance of safe and high-quality performing professional interventions and procedures in clients/patients. The high-quality procedure respects individual needs of the client/patient, especially the need for comfort, respect, confidence and safety.”

The course is aimed at practical medical skills. In the combined studies, education in these areas is impossible. Therefore, within the scope of the course, students will take part in several presence tutorials.

Each year the course Nursing Procedures and Interventions is taken by an estimated 90 students, each of which must test their individual skills under the supervision of the teacher. For practical reasons, the course has to be divided into smaller groups consisting of 10-15 students; i.e. several similar tutorials are taking place at the same time. All teachers aim for the unification of requirements for students, be it in practical education or in testing of their theoretical knowledge.

E-Learning Course

To support the teaching of the course Nursing Procedures and Interventions, an e-learning course in the LMS Moodle (system for education control) environment, which is available to all students of the study programs Nursing and Midwifery, has been developed. The main purpose of the e-learning course is to offer the students the basic information in one place. The advantages of the e-learning environment will be welcomed by teachers of the course as it enables them to unify the requirements for students set in the individual groups and available study materials.

E-learning is used in the preparation of students of medical disciplines increasingly. For example, you can remember teaching in Germany (Buch, 2014), Turkey (Lahti, 2014) or Australia (Lamont, 2014).

The fact that the course is aimed at practical skills means that the e-learning course is nothing but the support of education. It is aimed at theoretical knowledge, term definitions, process descriptions, etc. Practical training in medical institutions takes place after the education ends.

The e-learning course for the support of the teaching of the course Nursing Procedures and Interventions was created as part of the diploma thesis (Babičová, 2013). The course was elaborated according to the methodology of distance learning and was made available for

¹ The course as described in this article is an introduction to the nursing procedures and interventions studies and in the list of subjects, it is numbered as 1. For transparency reasons, this number will be omitted. The education further continues in the same named courses numbered 2 and 3.

students for the first time in the 2012/13 academic year.

Description of the E-Learning Course

At the beginning of the course, students learn basic information about its aims, themes, and teachers. The e-learning course is further divided into 6 chapters, which correspond to the topics of the course as listed in the syllabus:

- Monitoring of the physiological functions
- Extraction of the biological material
- Application of drugs
- Nutrition
- Parenteral nutrition
- Enteral nutrition

The individual chapters of the course have the same structure. Aims of the chapter, keywords and the time required for studying are set first. This is followed by study materials that come in two variants – in the form of a text with hyperlinks; and in the form of video tutorials that clearly step by step demonstrate the individual nursing procedures and interventions. A short 10-question test is included to conclude each chapter.

The course has been compiled on the basis of the methodology for creating distance learning teaching objects (Zlámalová, 2004). Study materials are compiled and structured according to the methodology for creating distance learning study texts (Bednaříková, 2004) and are inspired by the recommended literature for the course (Plevová, 2011 and Janíková, Zeleníková, 2013). For the purposes of the course, the study materials went through appropriate graphic changes. Moreover, icons for easier navigations and many examples were added. To present real activities in the real environment, instructional video tutorials were shot in the practical classrooms. Video tutorials come with a legend and students can browse through them not only at school, but they can also use them for home preparation.

The course is meant mainly for the theoretical preparation of students. Therefore, we will further examine the testing of students' theoretical knowledge within the scope of the course.

Testing Within the Scope of the Course

Every testing of knowledge in the education process has two main functions (Jeřábek, Bílek, 2010):

- Diagnostic – enables diagnosing students' knowledge in a short time. The results are accessible immediately and they are not influenced by the teacher's attitude, opinion or experience.
- Controlling – in the sense of controlling the set educational aims, which may be important for both the teacher and the student.

Depending on what education requires, there are different types of tests. The advantage of the

e-learning environment is that during the testing process the electronic tests can be created and automatically evaluated. The evaluation is at students' disposal immediately after the end of testing. This, of course, requires the closed tasks, such as multiple choice questions, matching questions, dichotomy questions, etc. Open questions with written answers are hard to process and therefore they are not usually included in electronic tests.

	Title of the chapter	Number of test questions
1	Monitoring of the physiological functions	9
2	Extraction of the biological material	10
3	Application of drugs	11
4	Nutrition	10
5	Parenteral nutrition	15
6	Enteral nutrition	11
Overall number of course questions		66

Tab. 1: Number of Test Questions in Particular Chapters

The bank consisting of 66 test tasks was created within the scope of the course Nursing Procedures and Interventions in the LMS Moodle environment. The tasks were created in accordance with the contents of the chapters and their number for particular chapters is listed in the table 1. All tasks were formulated as closed. The majority of the questions required picking one or more correct answers from the offered variants, only three of them were matching questions.

To ensure higher objectivity of testing, the parameters of questions and tests had been set so that the sequence of distractors was generated randomly as was the choice of the answers from the task bank and their sequence in the generated test. This enabled individualization of testing not only in the group of students but also within the scope of testing of each student. In an individual attempt, each student solved an original test.

Malach (2003) defines various criteria for the division of didactic tests. One of the criteria is when the test is implemented into education according to which there are three types of tests:

- Entering tests are implemented at the beginning of education and its aim is to diagnose the entering level of students' skills and knowledge and the possible chance of their mastering of the curriculum. They are not primarily used for the evaluation of students. They are the most useful when students from different schools or grades join together for studying.
- Continuous or formative tests are set during the course of education. They give the teacher feedback on how students have mastered the curriculum of the particular thematic unit. Such tests tend to deal with the short passages of the curriculum and they

are not primarily used for the evaluation of students.

- Output or summative tests measure mastering of the educational unit and are used for the final evaluation of students.

Considering when the test is implemented into education, the didactic tests have primarily diagnostic function in the first phase. Thanks to the tests, both teachers and students can obtain feedback on actual knowledge in the particular area. In this phase, the test result can even have a motivational purpose by encouraging students to further study or to complete the required knowledge. The fulfilment of these test functions is conditioned by the result not influencing the final evaluation.

On the other hand, in the final phase of the education process the tests have primarily the controlling function as they become the basis for the final evaluation of students' work.

Aims and Process of Student Testing

The division of tests according to when they are implemented into education became the basis of the experiment aimed at testing of the Nursing Procedures and Interventions course students. The experiment took place during the winter semester of the 2012/13 academic year.

The aim of the experiment was to learn students' knowledge gain during the course. The partial aim was to learn the differences in entering knowledge of the students who in their previous studies studied in both health and non-health study programs, and to observe knowledge gain of students in those groups during the course. Considering the specialization of the course and its contents, the differences in the test results between full-time studies students and combined studies students could also be expected. The number of students in individual groups can be seen in the table 2.

	Health	Non-health	Σ
Full-time studies	31	22	53
Combined studies	48	8	56
Σ	79	30	109

Tab. 2: Number of Students in Individual Groups

Testing had three phases:

- **Initial test** held before the start of the course examined students' entering knowledge. It consisted of 16 questions that were randomly generated from the bank of test tasks (66 questions). The test was held at the end of September 2012.
- **Parallel test** was held after the individual chapters, immediately after the curriculum of the particular chapter had been discussed. The total number of six tests was compiled from the questions belonging to a particular chapter. The tests results were mainly used as feedback for students and teachers. The tests were held during the winter semester in October, November, and December 2012.

- **Final test** was part of the requirements for obtaining the credits and thus was held during the credit week. Again, it consisted of 16 questions that were randomly generated from the bank of test tasks. The chosen tasks covered the entire curriculum, i.e. all the chapters.

The results of the initial test and parallel tests were not included in the final evaluation; they had only motivational and diagnostic function. The final test, which was part of the course and was held at the department in January 2013, was the only one that influenced the final evaluation of students.

Testing Results

The testing results were exported from the LMS Moodle without students' personal data and further anonymously processed in the spreadsheet processor. Each test contained the following data:

- Grading all the answers of individual students 1 or 2.
- The list of specific answers of individual students to generated questions, the list was not connected to the numbers of the questions.
- Students' average success rate in individual questions of the test.

In the list the results of the full-time studies students and combined studies students as well as their previous specialty (health vs. non-health study programs), were visibly marked. The data were used for further comparison of the achieved results for the individual groups of students.

To ensure higher objectivity of the processing, the exact formulation of the questions remained anonymous (questions had only numbers). Therefore, we list only domains within the scope of which the questions were defined.

For easy processing and comparison of the testing results we introduced a term student's success rate in the test, which is expressed as the ratio of their correct answers in the test. For the group of students the success rate is expressed as the percentage of the individual group members' success rate.

Students' Average Success Rate in Tests

The bank of test tasks was used three times during the course – in the initial, parallel and final tests. The results of the students' average success rate in the individual phases of testing are listed in the table 3. The success rate in the first test was 58%. It increased once the students had gone through the curriculum within the scope of parallel tests. In the final part of testing the students' success rate increased insignificantly. Even if the students' success rate in individual test evolved as expected, the end result of the success rate – 75% – did not match the expectations.

Regarding the overall evaluation of the course, the total number of students who participated in individual phases of testing is interesting. 100 students started the initial test, 4 of which did not finish it. Participation in parallel tests during the course of the semester gradually decreased from 88 students who took part in the first test (Monitoring of the physiological functions) to

60 students in the last test (Enteral nutrition). The most probable reason for this would be that as the semester went on, they were forgetting to fill in the tests. 93 students took the final test, i.e. compared with the students' participation in parallel tests, their number slightly increased.

It is positive that even if there were fewer students in the course than what the number of initially signed up students was (12 of the initially signed up students did not take part in the course), students worked continuously and their number decreased insignificantly (3 students).

	Number of Students	Average Success Rate
Initial test	96	58,19 %
Parallel tests	74	73,24 %
Final test	93	75,45 %

Tab. 3: Students 'Average Success Rate in Individual Tests

Success Rate in Individual Questions

Students' average success rate can also be measured for individual questions. Out of all 66 questions, the success rate in the following tests increased in only 32 (48%) questions. The growing importance of tests during the course of the semester was conditioned by the higher number of questions with the increasing success rate. The reasons for the low number of questions with the increasing success rate were clarified by the remaining questions with the decreasing success rate.

From the initial test to the parallel tests, 8 questions (12%) had the decreasing success rate. These were mainly questions for which the students guessed the correct answer in the initial test and then, as they studied the curriculum, they became confused and chose the incorrect answer. Among such questions we can place for example the question on the increased breathing frequency or the question on the presence of substances necessary for protein production. The decline in the first phases of testing is not significant, i.e. not more than 10%.

On the other hand, from the initial test to the final test, 26 questions (40%) had the decreasing success rate. Slight decline in units of a percent might have been caused by students' forgetting or their lowered attention, even if it is, considering the importance of the final test, unlikely. More significant decline (as much as 20%) was detected mainly in the matching questions where students made mistakes due to not paying attention or imprecision.

Success Rate in Individual Chapters

Students' average success rate in the individual chapters of the course can be seen in the figure 1. It can be noted that in the most cases the students' success rate in the individual chapters increased as expected. The same can be said about the success rate as for the entire course (see the comparison with the table 3).

The most successful chapter was the first one: Monitoring of the physiological functions. During the course of the semester, the students' success rate in the individual chapters was gradually decreasing. The last chapter Enteral nutrition was one of the most demanding

chapters.

In the chapters Application of drugs and Enteral nutrition the decline of success rate in the final test when compared with the parallel tests can be noted. By analysing the questions we learned that the decline in the chapter Application of drugs was caused by the higher number of questions with the lower success rate in the final test. As for the individual questions, the decline is insignificant (1-2%). Overall, it meant worse results of the chapter at the end of the course. In the chapter Enteral nutrition the problem-causing questions are those on chronological sequence of performed operations, where there is a variation in the success rate as much as $\pm 20\%$.

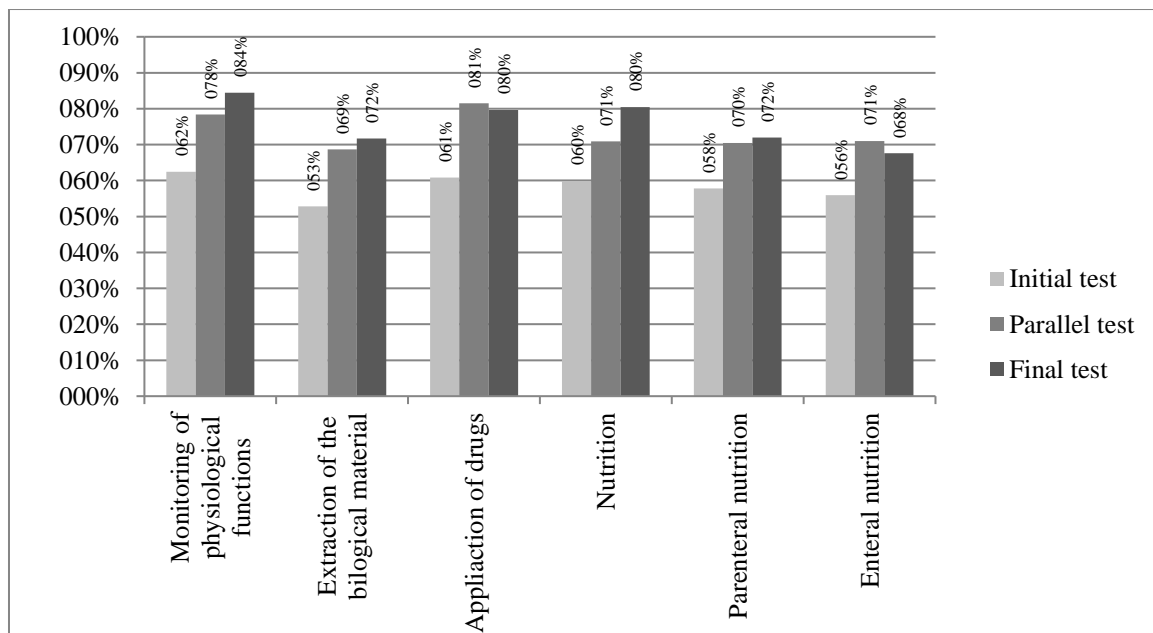


Fig. 1: Students 'Average Success Rate in Individual Chapters

Comparative Test Results According to the Division of Students into Groups

Table 2 shows the division of students into groups. Full-time studies students and combined studies students took part in the testing. The majority of students had already studied in health study programs. However, there were 30 students who had never studied in health study programs before.

We will further try to learn the differences in the results of students of individual groups.

Students' Form of Study

The course Nursing Procedures and Interventions is being taught both in the full-time studies and combined studies. Figure 2 shows the results of the students' (studying in both forms of study) success rate in parallel tests (according to individual chapters) and in the final test. The differences between both groups are not statistically significant. Nevertheless, it is surprising that almost in all tests the students studying in the combined studies had better results.

Largest differences can be found in the first two chapters Monitoring of the physiological functions and Extraction of the biological material. There the difference between the groups is more than 10%, which suggests that the students studying in combined studies have more effort and motivation. This is a general trend, which is connected to the fact that the students studying in combined studies are usually motivated by a job.

In the following phases of the testing (from the chapter 3 and on) the results between groups leveled.

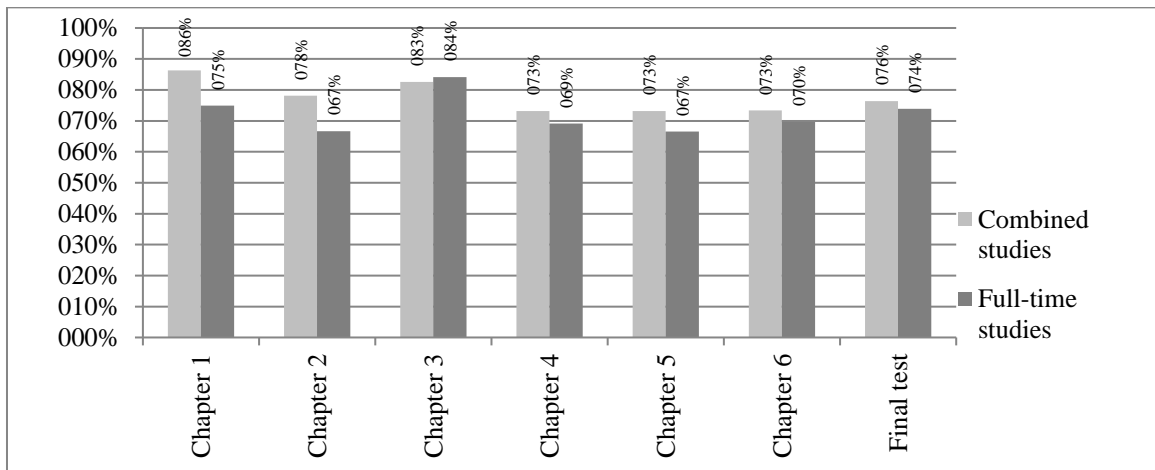


Fig. 2: Students 'Success Rate in Individual Chapters According to the Form of Study

Students' Previous Studies

In the skill-oriented studies, among which health studies can be counted, the differences in the initial knowledge of the students, who had already worked or studied in the given field, can be seen. As for the course Nursing Procedures and Interventions, we traced the group of students who had already worked or studied in the health field. The comparison of the results of both groups can be seen in the Figure 3.

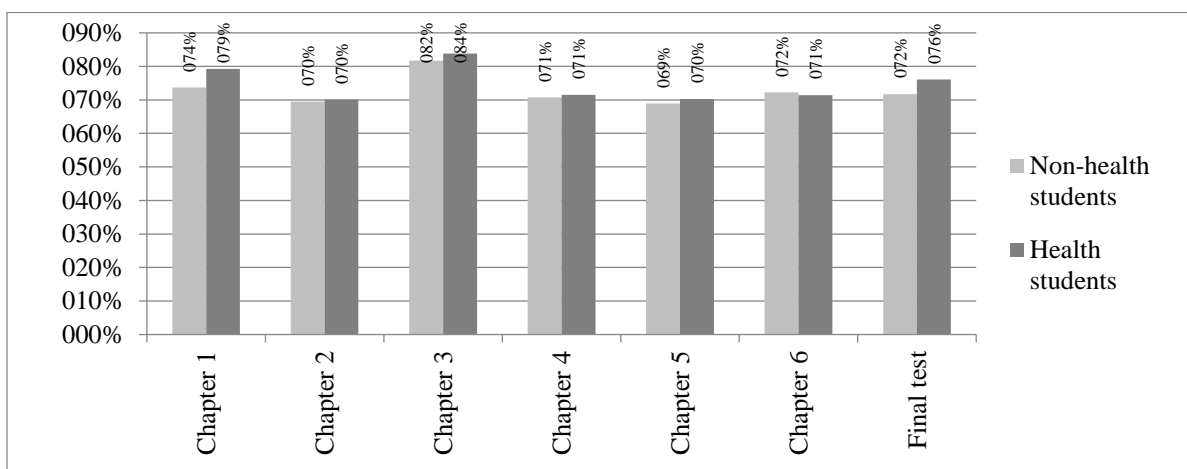


Fig. 3: Students 'Success Rate in Individual Chapters According to Previous Studies

The figure suggests that a larger (but still insignificant) difference is only in the first chapter Monitoring of the physiological functions. Subsequently, the results of both groups levelled very quickly. The results confirm a presupposition that the non-health students are aware of their handicap, try even harder and narrow the fellow students' advantage in a short time. There was no decline in the number of non-health students during the course.

Conclusion

The course Nursing Procedures and Interventions is being taught at the beginning of study programs Nursing and Midwifery, i.e. students take it during the winter semester of their first year. Due to a large amount of the practical skills the students have to master, the course is very demanding. To support the teaching of the course an e-learning course has been developed that tries to present the basic theoretical knowledge of the course, be it in the form of text study materials or in the form of video tutorials demonstrating the individual procedures and interventions. The course was implemented into education for the first time in the 2012/13 academic year.

Tests aimed at continuous diagnostics and the final control of students' theoretical knowledge, were part of the course. Testing within the scope of the course had three phases – the initial test, parallel tests and the final test which had to be passed in order to successfully complete the course.

The processing of the testing results had several phases. That enabled a deeper analysis of students' work during the course of the semester, but also a detailed analysis of the test questions and the test structure in general. On the basis of the results it can be said that the proposed process of testing students' knowledge is a suitable way of teaching that can be used throughout the entire semester. The initial test and parallel tests have the cognitive function and enable self-reflection and diagnostics of students. The final test has mainly evaluating and controlling function. All tests distinguished between students with better and worse knowledge.

The basis findings from the analysis of testing can be summed up in several points:

- Students' theoretical knowledge was gradually increasing during the course of the semester;
- More than 50% of the questions had a decreasing tendency at some point during the testing phase. Be it the questions the answers to which could be guessed in the initial test, the matching questions, or the questions that were not sufficiently remembered, i.e. the students forgot the answers;
- Students' previous studies do not influence their results in the course;
- The differences between the students studying in the full-time studies and combined studies show greater motivation and effort of the students studying in the combined studies.

The testing results did not bring any new findings; they only proved and highlighted the supposed facts. In the course Nursing Procedures and Interventions there is no need to distinguish and focus on the particular groups of students. Previous knowledge, the degree of

motivation and students' effort level during the course of the semester; and students then have similar results.

The analysis proved that in the future it is necessary to focus mainly on the creation and formulation of questions (Jeřábek, Bílek, 2010):

- For questions the answer to which can be guessed in the initial test and without prior knowledge, the distractors (offered answers) must be modified. The higher specialized level of distractors of those questions must be modified so that each of them is picked by the same share of students at the beginning.
- Ambiguously defined distractors in individual questions must be eliminated.
- The matching answers must be modified so that the matching system is clear and the number of students' incorrect answers corresponds to their knowledge.

The presented imperfections of the test tasks are common problems that occur when creating tests. Some of the slight imperfections in the formulation of the test tasks were removed immediately; the more demanding modifications will be carried out continuously according to the results of future analyses.

To sum up, it must be stated that the testing in the course Nursing Procedures and Interventions proved good and will be further continued. The results of the parallel tests were praised by all teachers as they gave them feedback and helped them in their preparation for teaching. After the initial experience, the final compulsory electronic testing of students' knowledge using the tests in the e-learning course has been implemented into the course syllabus.

References

- BABIČOVÁ, Markéta. *E-learningový kurz předmětu Ošetrovatelské výkony a intervence. Diplomová práce*. Ostrava: Ostravská univerzita, 2013.
- BEDNAŘÍKOVÁ, Iveta. *Jak psát studijní text pro distanční vzdělávání*. Vyd. 1. Ostrava: Ostravská univerzita v Ostravě, 2004, 77 s. ISBN 80-7042-981-x.
- BOND, Trevor and Christine FOX,. *Applying the Rasch model: Fundamental measurement in the human sciences*. Mahwah, N.J.: Lawrence Erlbaum, 2001.
- BUCH, Steen Vigh, Frederik Philip TRESCHOW, Jesper Brink SVENDSEN and Bjarne Skjødt WORM. Video- or text-based e-learning when teaching clinical procedures? A randomized controlled trial. *Advances in Medical Education* [online]. 2014, roč. 5, s. 257-261 [cit. 2015-03-23]. Available from: 10.2147/AMEP.S62473.
- CHRÁSKA, Miroslav. *Metody pedagogického výzkumu: základy kvantitativního výzkumu*. Vyd. 1. Praha: Grada, 2007, 265 s. ISBN 978-80-247-1369-4.
- JANÍKOVÁ, Eva and Renáta ZELNÍKOVÁ. *Ošetrovatelské výkony a intervence 2*. Ostrava: Ostravská univerzita v Ostravě, 2013. ISBN 978-80-7464-306-4.
- JEŘÁBEK, Ondřej and Martin BÍLEK. *Teorie a praxe tvorby didaktických testů*. Olomouc: Univerzita Palackého v Olomouci, 2010

LAHTI, Mari, Heli HÄTÖNEN and Maritta VÄLIMÄKI. Impact of e-learning on nurses' and student nurses knowledge, skills, and satisfaction. *International Journal of Nursing Studies* [online]. 2014, roč. 51, č. 1, s. 136-149 [cit. 2015-03-23]. Available from: 10.1016/j.ijnurstu.2012.12.017.

LAMONT, Scott and Scott BRUNERO. 'eSimulation' Part 2: Evaluation of an interactive multimedia mental health education program for generalist nurses. *Collegian* [online]. 2014, roč. 21, č. 1, s. 3-9 [cit. 2015-03-23]. Available from: 10.1016/j.colegn.2012.11.002.

MALACH, Josef. *Základy didaktiky*. Ostrava: Ostravská univerzita v Ostravě, 2003. ISBN 80-7042-266-1.

Ošetřovatelské výkony a intervence 1. Syllabus předmětu. Ostrava: Ostravská univerzita, 2012. [cit. 20131201]. Available from: <http://portal.osu.cz>

PLEVOVÁ, Ilona a kol. *Ošetřovatelství I*. 1. vyd. Praha: Grada, 2011, 285 s. ISBN 978-80-247-3557-3.

ZELÉNÍKOVÁ, Renáta and Eva JANÍKOVÁ. *Ošetřovatelské výkony a intervence 1*. Ostrava: Ostravská univerzita v Ostravě, 2013. ISBN 978-80-7464-259-3.

ZLÁMALOVÁ, Helena. *Distanční vzdělávání: studijní příručka pro pracovníky vysokých škol*. Vyd. 1. Ostrava: Ostravská univerzita v Ostravě, 2004, 71 s. ISBN 80-7042-987-9.



DATA FROM CATALOGUES OF SOLAR SYSTEM OBJECTS IN EDUCATION

Ota Kéhar

Faculty of Education, University of West Bohemia
Klatovská 51, Plzeň, Czech Republic
kehar@kmt.zcu.cz

Abstract

This contribution contains attractive examples that use catalogues of astronomical objects available at Astronomia web pages (astronomia.zcu.cz) to improve the teaching of selected astronomical topics. The main focus is to Solar system objects, list of numbered minor planets is used to demonstrate the current position of objects in the Solar system, to construct a Kirkwood gap graph or to interactively verify Kepler's laws. I put emphasis on involving students in practical activities, so the results of my research are several worksheets. All worksheets include basic procedure. Each part of worksheet is complemented by sub-questions that deepen knowledge of students and it provides welcomed feedback for teacher. All these features are available as online applications on web pages and it can be used during ICT lessons. I tried worksheets on a significant sample of secondary school pupils and university students. As a result I discovered that students usually do not have possibility to solve this kind of exercise (using data from catalog of astronomical objects) at school. Students cannot handle basic transactions in the Excel spreadsheet, especially inserting formulas into cells, data sorting or constructing a simple chart.

Keywords

Catalogues, Kepler's laws, minor planet, Kirkwood gap, interactive, application, multimedia, education

Introduction

Exercises introduced in this article are focused on improving the quality of teaching of selected astronomical topics using various catalogues of astronomical objects. These topics include Hertzsprung-Russell diagram, Kepler's laws or astronomical objects on the sky. Exercises are prepared to use them immediately during the lessons; even the Framework Educational Programme in Czech Republic contains just few specific areas of the Astronomy and the Astrophysics.

The original idea was to prepare and use raw data from catalogues only. Students can continue to work with them. I found out during my previous analysis that this direction is not suitable, Physics and Astronomy disappeared from these exercises. Unfortunately lack of fundamental knowledge of Computer Science has been a major difficulty for students to understand the basic Physics and Astronomy principles. As an improvement I considered interactive online web applications that use the data from the catalogues of astronomical objects. These applications do a lot of routine and tedious activities and thereby simplify operations of students on the computer so they can again begin to focus on Physics and Astronomy.

Finally I realized a graphical output (as online web applications) from several catalogues. Using these applications I prepared practical exercises in the form of worksheets for students and methodology sheets for teachers. Main goal were practical activities for students representing an important task for them. Exercises should be used during the Physics, Geography, Science, and ICT or other lessons. They lead students to use computers by unusual way. The key requirements for preparation of these exercises were to use data from the catalogues of astronomical objects and multimedia (like computer, internet, etc.) Another issue was to improve key competencies. I created worksheets containing the general procedure for solving each task. There are several sub-questions that deepen the knowledge of students and provide an important feedback for the teacher. I am aware that these exercises are time-consuming. It may involve using them within the special seminars, hobby groups or as a concrete task during Astronomy or Physics Olympics.

Initial Research of this Topic

Information about astronomical objects is collected since ancient time in various catalogues and lists. Currently we have a huge number of catalogues. According to the Strasbourg Astronomical Data Centre there is known more than 13,000 catalogues to January 2015. There should be possible to find a lot of interesting data. Practical exercises using multimedia resources and information technology is one of the modern trends in education. It is not a difficult issue to equip schools with modern computer technology; the weak point can be to use them effectively or prepare didactically valuable education materials.

During my initial research I did not find any Czech internet pages containing summary about usage of catalogues of astronomical objects or using their so complex visualization. During the validation process I was focused on certain areas only: whether the involvement of students in solving practical problems raise students' motivation to astronomy, or key competencies will increase during solving of practical worksheets, or how students evaluate these exercises in terms of their matter of complexity and interest.

The actual use of catalogues of astronomical objects is not very common in schools. Just around 5 % of respondents said that their teachers use Astronomia pages during the lesson. There can be two causes – lack of computer technology usage in general and how amount of teachers spend teaching astronomical knowledge (as mentioned before in relation with Framework Educational Programme). It is possible that they do not have a time for this topic during Physics

lessons. On the other hand, catalogues of astronomical objects can be used in other subjects, e.g. during Computer Science.

I used data for list of minor planets from official Minor Planet Center (MPC) available at www.minorplanetcenter.net. Web pages of MPC do not have any graphical output of these data. They are available just in the text form – as a file with size of tens of MB. As mentioned before it is not suitable to use them directly in the education process. Another option is to use data directly from NASA at neo.jpl.nasa.gov/orbits/. There is available online application displaying the current position of the minor planet in the solar system. This page has been an inspiration for me during creating of applications on Astronomia web pages. Application from NASA is based on the Java applet; this one can cause performance problems, it should be a safety risk etc. Nevertheless the NASA application itself does not contain other additional features like verification of Kepler's laws, current position of group of objects in the Solar system, construction of Kirkwood gap graph.

A part of initial research was also to verify who deals with this topic around the world. I found out just one really relevant contribution related to this topic – article “Astronomy Teaching with Astronomical Catalogues” written by Oostra and published in *The Physics Teacher* in 2006.

Oostra's article is focused on the usage of catalogues of astronomical objects at the Andean University. His goal was to teach students during independent experiments. The author wrote many of guides how to use real observations, but he always found a number of limitations. A helpful measure was to use online catalogues of astronomical objects. It refers to the fact that online catalogues are on the internet, but most of them are intended for professional usage and they are not suitable for direct usage at school. Another issue was that there are not prepared any exercises to use these data effectively. His article mentions some topics, but without further elaboration: the list of minor planets should be used to demonstrate distribution of minor planets, Trojans or Hilda groups, Kirkwood gaps. His focus was also to a discussion with students to reflect their opinion. Otherwise there is just routine execution of a worksheet without further effect. Usage of real data brings another advantage; students will experience how science really works and what can influence the results. This type of task can be even oriented for non-technical students.

Multimedia Textbook Astronomia

Project Astronomia is a multimedia textbook established already in 2000 (and regularly updated) available online at web address astronomia.zcu.cz. It contains sorted information in Czech language about planets of Solar system, deep-sky objects, stars and other objects in the Universe. These pages are collected from many relevant sources, usually translated from the English ones. Currently there is no plan to create an English version of these pages. On the other hand, one unique part is prepared also in English mutation. It is focused on Catalogues of Astronomical Objects; it is already an integral part of Astronomia web pages. There are more than six hundred thousand objects in total volume of about 180 MB of data. Catalogues should be in general divided into three categories. Firstly as deep-sky objects (nebulae, stars clusters and galaxies) are located in three of them – NGC, Messier and IC catalogues. The second area

are stars, there is a list of constellations (88 items), Gliese catalogue (contains 3 803 nearby stars), Hipparcos catalogue (118 218 stars) and a part of astronomical database SIMBAD (118 171 stars with HIP equivalent from Hipparcos catalogue). The third area is focused on objects in solar system – planets and their moons, and a list of minor planets – till January 2015 (list is updated monthly) we have known more than 400 thousand numbered minor planets. An important issue is to update values in catalogues from credible sources with the permission of their authors.

Online Applications using Data from Catalogues

I have prepared several online interactive applications using data from catalogues of astronomical objects available on Astronomia web pages. These applications can be used for demonstration of following issues (in the brackets there is a name of used catalogue):

- Analysis of Minor planets parameters (minor planets)
- Kirkwood gaps (minor planets)
- Historical development of Minor planets (minor planets)
- Current location of Minor planets in the Solar system (minor planets)
- Kepler's laws demonstration (minor planets)
- Apparent magnitude of Minor planet calculation (minor planets)
- Surface temperature of Minor planet estimation (minor planets)
- Online HR diagram construction (stars)
- Sun below horizon, Sunset and Sunrise, Twilights (stars)
- (Circumpolar) constellations (stars)
- Length of (astronomical) night (equinox, solstice) (stars)
- Sidereal and Solar time (stars)
- Nebulae, star clusters and galaxies on the sky (deep-sky)

It is not practicable to describe all possible options and features of these applications in this contribution. Use previous list of application as an overview to be able to decide which application you can use for education at your classroom. And not only at school; application related to deep-sky can be used before visiting observatory or observing the sky at night. For more detailed description visit Astronomia for English guidepost available at link astronomia.zcu.cz/katalogy/education/.

In this article I consider just for catalogues containing objects of solar system – mainly list of numbered minor planets. There are several interesting examples of using this list – some of them are supported by worksheet.

List of Minor planets

1) The Minor planet in Opposition

Initially we should consider the following question:

“The minor planet (15925) Rokycany is in opposition.
Is it visible by telescope located at Rokycany Observatory?”

Anyone can choose any minor planet for this task. To solve this task we have to find the date where the considered minor planet is in opposition. We will find the date of this event (opposition) on the web page astronomia.zcu.cz/katalogy/minorplanet-15925 (this page is valid for minor planet Rokycany; it contains Table with information related to selected minor planet and Image with the location of the minor planet in the Solar system) by changing the day, the month and the year (see Fig. 1) – the opposition occurs when the Sun, Earth, and the minor planet are approximately in a straight line. Then we will calculate the apparent magnitude of the minor planet and compare it with the limiting magnitude of the telescope. Apparent magnitude m (as seen on the night sky) of the minor planet should be calculated by simple formula

$$m = H + 5 \log \Delta + 5 \log r \quad (1)$$

where H is absolute magnitude of minor planet (available from the table above the image), Δ is distance in astronomical units of the minor planet from the Sun (available from image at au), r is distance in astronomical units of the minor planet from the Earth (also available from image at au).

More exact value (with influence of configuration of all related objects) of the apparent magnitude is written on the image with the location of the minor planet in the Solar system.

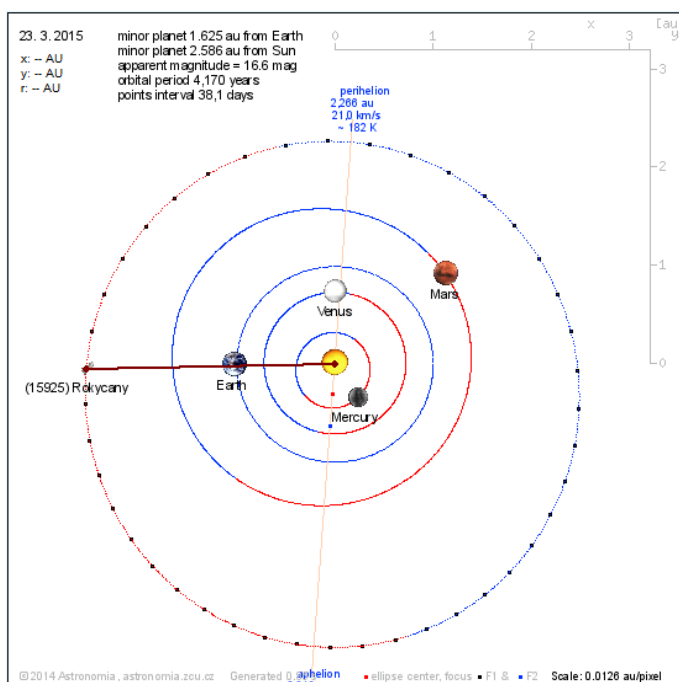


Fig. 1: Minor planet (15925) Rokycany in the opposition during 2015

In the above case for the opposition during 2015 the apparent magnitude of the minor planet (15 925) Rokycany is calculated by application to 16.6 mag. Calculation by formula (1) give us the result $m = H + 5 \log \Delta + 5 \log r = 12.9 + 5 \log 2.6 + 5 \log 1.6 = 16.0$ mag. The estimated telescopic limiting magnitude given by www.cruxis.com/scope/limitingmagnitude.htm is 15 mag (for telescope aperture 508 mm, power 150, reflector and naked eye limiting magnitude near the zenith for nearby of village 5.0 mag). Comparison of both values (15 mag < 16 mag; note the brighter the object appears, the lower the value of its magnitude) means that the minor planet Rokycany is not observable by the observatory telescope with naked eye. There is also the influence of type of opposition, whether the opposition occurs during the aphelion or the perihelion.

For this exercise I did not prepare worksheet. The main message is just the initial question about the minor planet in the opposition and its visibility. Students can evaluate influence of type of opposition. They should find the rule how to decide whether the minor planet is visible or not. Another issue should be to find the method how to improve the visibility. By using this application (on Fig. 1) teacher/student can demonstrate the position of Earth, Sun and minor planet during the discovery. This date is listed in the table above. All these result could vary time to time because list of minor planets are regularly (monthly) updated. It is basically up to teacher how to use this task (just the initial message and nothing else – as problematic exercise; all together and go step by step with teacher; prepare some questions and let students to find answers), several hints were already mentioned before.

2) Kepler's laws

All three Kepler's laws describing the motion of objects around the Sun should be demonstrated with the same application as previous example (Fig. 2), including showing the location of foci and the centre of the ellipse, the perihelion, and the aphelion.

The Kepler's first law is placing the Sun at one of the two foci of an elliptical orbit. Position of the Sun is marked with a yellow symbolic image; the black square shows the position of the first focus. The second focus is shown by a blue square. The red square indicates the centre of the ellipse. As a note to students should be given an information that red one (centre) and blue or black ones (foci) are not the same. Distances of the minor planet at the perihelion and the aphelion are calculated including the velocity at these points.

The Kepler's second law says that a line segment joining a minor planet (planet or object in general) and the Sun sweeps out equal areas during equal intervals of time. The orbital radius and angular velocity of the minor planet in the elliptical orbit vary – see different values of distance and velocity at perihelion and aphelion on Fig. 2. The equal areas can be demonstrated by interactivity of the application. The light blue highlighted area has from 0.496 au² to 0.498 au² and it is calculated automatically by Heron's formula (all three side lengths of the triangle are known). Small difference (error is around 0.4 %) between areas at perihelion and aphelion is given by simplifying of calculation to triangle instead of circular sector. The base of the isosceles triangle is not really the line segment for the elliptical orbit. This small error

given by simplicity of an application is not an obstacle to show to students validity of this law, but we should mention them these discrepancies.

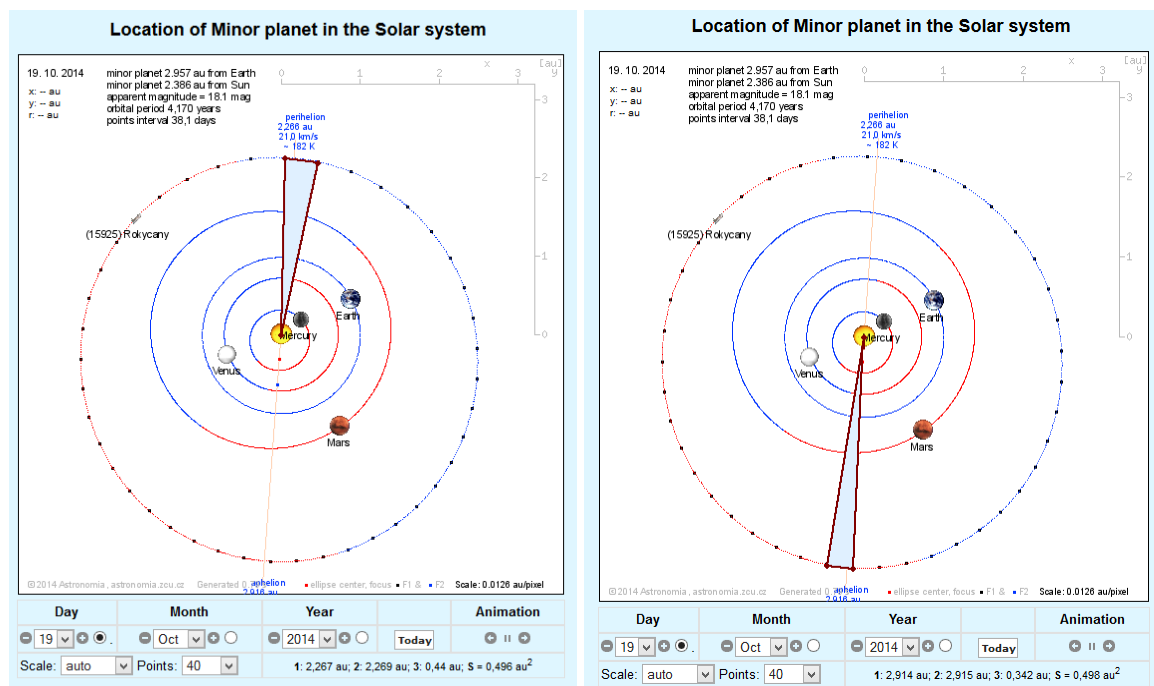


Fig. 2: Comparison of the area in the perihelion (left) and the aphelion (right). The area is almost the same = 0.496–0.498 au².

The Kepler's third law is equation that says that the square of the orbital period of a planet is proportional to the cube of the semi-major axis of its orbit. The semi-major axis can be calculated from distances of minor planet at perihelion and aphelion. The sum of these two distances divided by two is equal to the semi-major axis. The orbital period axis can be calculated from the semi-major and compared with the value given at catalogue.

I prepared worksheet for Kepler's laws (available in PDF form in Czech/English language on astronomia.zcu.cz/katalogy/education/, see Fig. 3) using described application. Worksheet contains six areas – description of ellipse, introduction of list of minor planets, selection of minor planets, all Kepler's three laws study and analysis.

Ellipse is the fundamental of Kepler's first law. During my worksheet analysis on 77 students (from high school and university, autumn 2012) I found that just 13 % of students correctly solved all issues (describe ellipse, mark Sun location, eccentricity) regarding ellipse. Common mistake for more than third of the students was to describe the distance from focal point to centre as eccentricity, correct answer is $a \cdot e$ (semi-major axis times the eccentricity). Most of the students did not answer the question related to Sun location; just third of them correctly marked it at one of the (common) focal point.

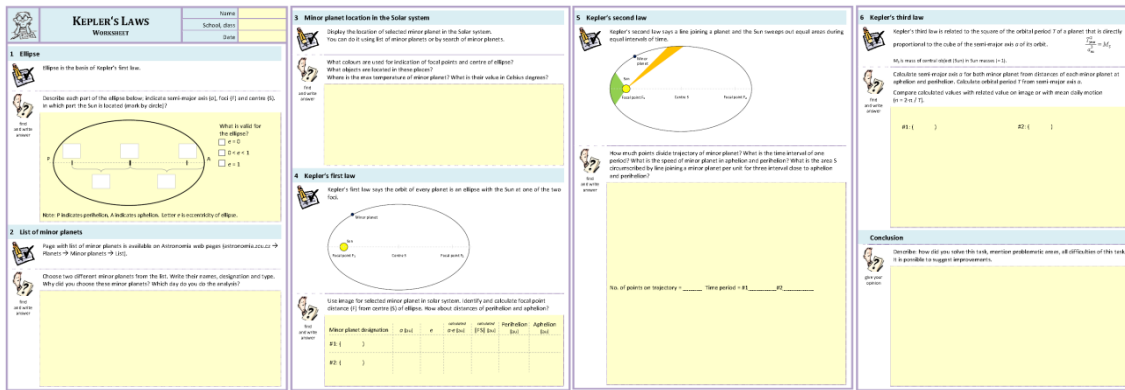


Fig. 3: Worksheet for Kepler's laws, available in PDF form at Astronomia

During the introduction of list of minor planet students have to select two minor planets and describe the reason for their selection. Some of the reasons was interesting – selection of last discovered minor planet (it means student realize regular updating of this list), selection of name related to some location (town, city) or minor planet visible by naked eyes (it is just one – 4 Vesta). Students were also asked to type the date of analysis – most of them use the date when lesson held, one of them uses date of birthday. In this case teacher should inform students about the influence of time on calculating a location of minor planet at solar system.

For aphelion and perihelion there is a calculation of temperature of minor planet at those distances from the Sun. This temperature is for information only; there is not calculation of the influence to non-spherical shape of some minor planets, their rotation, varied albedo etc. With this one teacher can explain that distance from the Sun is not indicative for the formation of seasons on Earth; e.g. minor planet (40786) 1999 TR30 with very similar eccentricity to Earth has temperature difference between aphelion and perihelion 3 K only.

Second part of worksheet is focused to Kepler's laws. Students are using online application, filling the tables and finding answers to questions. In case of Kepler's first law around two third of students successfully solved task related to semi-major axis, eccentricity, distances, aphelion and perihelion. Around half of students solved task related to Kepler's second law focused to comparison of several areas per unit time close to perihelion and aphelion. Finally Kepler's third law is more numerous; students should calculate semi-major axis (and then orbital period) from distances of minor planet at the nearest and the farthest points. Analysis said that one fifths of students were able to solve this one; there is a questions what was the reason; whether lack of knowledge of students or placement of this point at the end of worksheet. More experiments for Kepler's third law are in the topic called Kirkwood gaps.

3) Kirkwood gaps

A Kirkwood gap is a gap or dip in the distribution of main-belt minor planets by semi-major axis (or equivalently by orbital period). They correspond to the location of orbital resonances with planet Jupiter. There are very few minor planets with semi-major axis near 2.50 au, period 3.95 years, which would make three orbits for each orbit of Jupiter (hence, called the 3:1 orbital resonance). This part is also suitable to practice of Kepler's third law.

A relatively small number of minor planets (the Alinda family and the Griqua family) have been found to possess high eccentricity orbits which do lie within the Kirkwood gaps. These orbits slowly increase their eccentricity on a timescale of tens of millions of years, and will eventually break out of the resonance due to close encounters with a major planet.

They were first observed by Daniel Kirkwood in 1886. When he arranged minor planets by their distance from the Sun, he noted several gaps, now named Kirkwood gaps in his honour. He also correctly explained their origin in the orbital resonances with Jupiter. There were just 91 known minor planets by 1866 (Fig. 4).

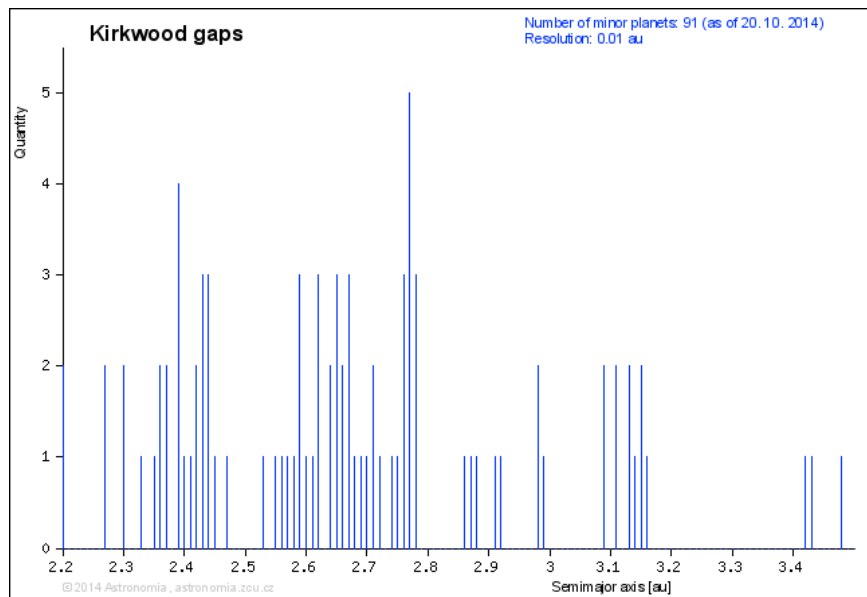


Fig. 4: Minor planets distribution by 1866 when Daniel Kirkwood discovered gaps

A part of the Analysis of Minor planets parameters is a special feature called Data Export (Fig. 5) – allow to export selected data to text file (possible to process them in Excel spreadsheet during ICT lesson) or directly as an image more suitable to Physics lessons (see at link astronomia.zcu.cz/katalogy/education/2407-minor-planets-analysis). It is possible to choose items as each want/need it. As an output format CSV or PNG can be chosen. There are three special analyses – the Kirkwood gap (contribution of minor planets on semi-major axis), the historical development (contribution of minor planets in time) and the current location of minor planets in the Solar system.

Type of Minor planet.. ..Expand/Collapse..

Data Export.. (Check All / Uncheck All) ..Expand/Collapse..

Items:

<input checked="" type="checkbox"/> ID (catalogue number)	<input type="checkbox"/> Mean daily motion n	<input type="checkbox"/> Precise indicator of perturbbers
<input checked="" type="checkbox"/> Absolute magnitude H	<input checked="" type="checkbox"/> Semimajor axis a	<input type="checkbox"/> Computer name
<input type="checkbox"/> Slope parameter G	<input type="checkbox"/> Uncertainty parameter u	<input type="checkbox"/> 4-hexdigit flags
<input type="checkbox"/> Epoch	<input type="checkbox"/> Reference	<input checked="" type="checkbox"/> Readable designation
<input checked="" type="checkbox"/> Mean anomaly at the epoch M	<input type="checkbox"/> Number of observations	<input type="checkbox"/> Date of last observation
<input checked="" type="checkbox"/> Argument of perihelion ω	<input type="checkbox"/> Number of oppositions	<input checked="" type="checkbox"/> Discovery date
<input checked="" type="checkbox"/> Longitude of the ascending node Ω	<input type="checkbox"/> Year of observation	<input checked="" type="checkbox"/> Site
<input checked="" type="checkbox"/> Inclination to the ecliptic i	<input type="checkbox"/> r.m.s residual	<input checked="" type="checkbox"/> Discoverer
<input checked="" type="checkbox"/> Orbital eccentricity ϵ	<input type="checkbox"/> Coarse indicator of perturbbers	<input checked="" type="checkbox"/> Provisional designation

Sort by: (for data volumes in the tens of thousands of minor planets may be slow, basic sorting is by ID ascending)

<input checked="" type="radio"/> Catalogue ID	<input type="radio"/> Year of discovery	<input type="radio"/> Semimajor axis	<input checked="" type="radio"/> Ascending
<input type="radio"/> Orbital eccentricity	<input type="radio"/> Inclination to the ecliptic	<input type="radio"/> Absolute magnitude	<input type="radio"/> Descending

Format:

CSV (decimal comma) CSV (decimal point) PNG

Special:

Kirkwood gap, resolution

Historical development, resolution

Current location in the Solar system, scale . view

Save

(estimated file size is 55.3 MB, the number of rows exceeds the limit for Excel 2003)

Fig. 5: Data Export from Analysis of Minor planets parameters

Special analysis Kirkwood gap shows graph of semi-major axis on a quantity of minor planets. There can be found mentioned Kirkwood gaps (most prominent are at distances 2.50 au, 2.82 au, 2.95 au and 3.27 au), see Fig. 6. They correspond to the location of orbital resonances with the planet Jupiter (3:1 – place of Alinda family, 5:2, 7:3 and 2:1 – place of Griqua family). There are totally more than 415 000 numbered minor planets in the Solar system on January 2015, the semi-major axis lies at distances from 0.6 au to 740 au. When limited to the inner (within orbit of Saturn – 9.5 au) of the Solar system, still we have majority of minor planets – 99.93 %.

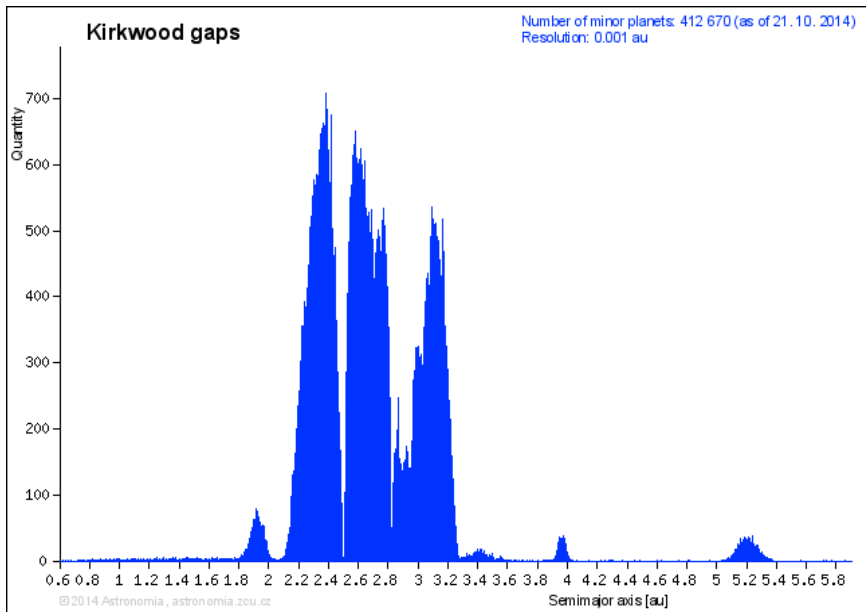


Fig. 6: Kirkwood gaps visible on distribution of minor planet in inner part of the Solar system

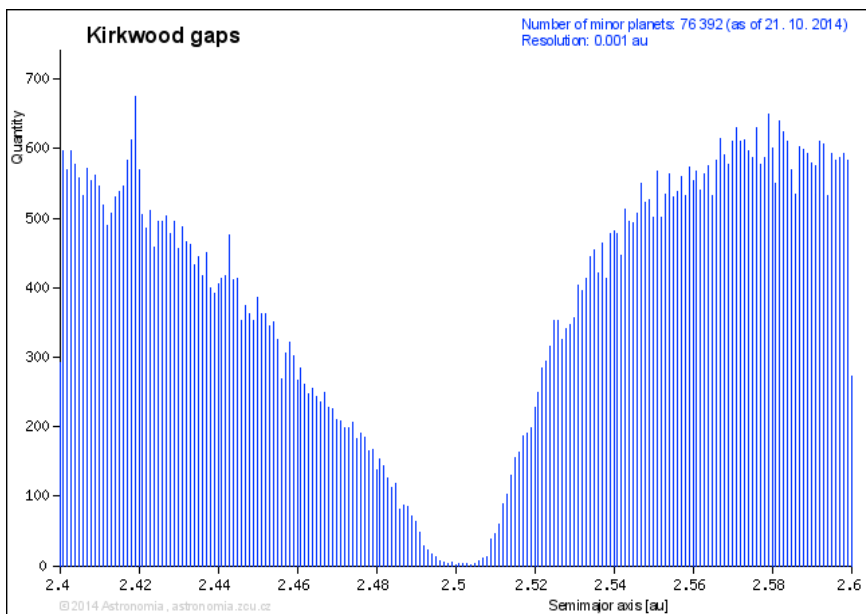


Fig. 7: Close look up to prominent Kirkwood gap at a distance of 2.5 au (resonance 3:1 with Jupiter)

Distribution of minor planets close to one of the Kirkwood gap at a distance of 2.5 au is visible on Fig. 7. There are shown more than 75 thousand minor planets with resolution of distribution on horizontal axis 0.001 au. Even with this huge amount of data, gap is still visible at around 2.5 au. It is possible to find from the exact data (CSV file) that from 2.496 au to 2.504 au lays around 25 minor planets only (average value is 3 minor planets per 0.001 au). The total average value for resolution of 0.001 au is around 380 minor planets for the distances from 2.4 au to 2.6 au.

4) Hilda family

There are only two areas on Fig. 6 where orbital resonance with Jupiter creates a stable group of minor planets. They are located at around 4 au (resonance 3:2, the Hilda family) and at around 5.2 au (resonance 1:1, the Trojan group).

The Hilda family are a dynamical group of minor planets in a 3:2 orbital resonance with Jupiter. The Hildas move in their elliptical orbits so that their aphelia put them opposite Jupiter, or 60 degrees ahead of or behind Jupiter at the L₄ and L₅ Lagrangian points. As can be seen on page with the analysis of minor planets parameters (just to choose Hilda group at Type of Minor planet), Hilda's orbit has a semi-major axis between 3.7 au and 4.1 au, an eccentricity less than 0.3, and an inclination less than 20°. There are around 1750 minor planets at this group with orbital period 2/3 of Jupiter. The Hildas taken together constitute a dynamic triangular figure with slightly convex sides and trimmed apexes in the triangular libration points of Jupiter. The minor planets stream within the sides of the triangle is about 1 au wide. See Fig. 8.

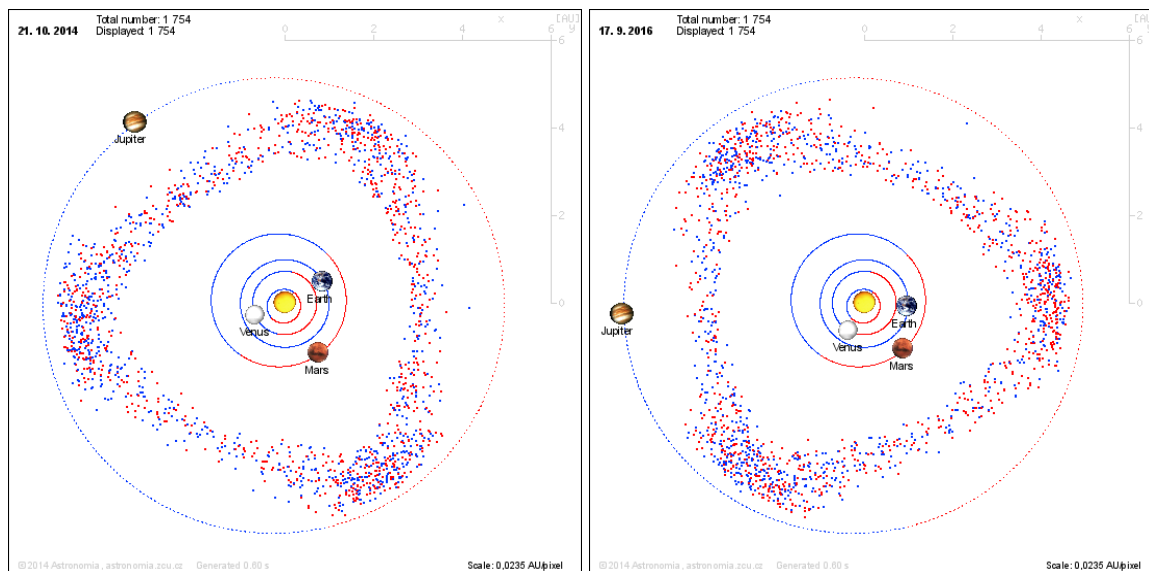


Fig. 8: The Hilda family of minor planets create in the Solar system in long-term view the equilateral triangle with apexes at Lagrangian points

The Jupiter Trojans are a large group (more than 4 000 ones) of minor planets orbit around one of the two Lagrangian points of stability (see Fig. 9). The interval of semi-major axis is from 4.8 au to 5.4 au, while mean value is 5.2 au, see the distribution that can be easily (directly as an image or as a raw data to Excel spreadsheet) created from the data from catalogue on Fig. 9. There are two options in case of raw data. Simpler one is to use special format Kirkwood gap that prepare already sorted distribution of minor planets or to use just semi-major axis distances for more than 4 000 objects. Value of semi-major axis given at 6 digits resolution should be rounded to 3 digits (resolution 0.001 au) and with using of the pivot table; distribution of minor planets can be easily calculated.

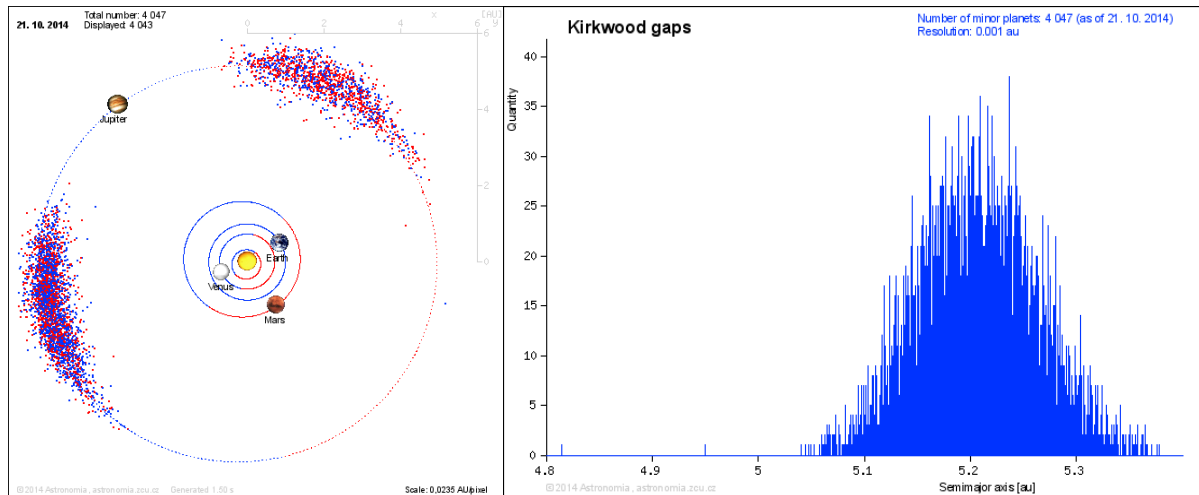


Fig. 9: The Trojan family of minor planets lies in the Solar system in Lagrangian points of Jupiter (left), distribution of the Trojan family in the Solar system (right)

Conclusion

I applied all worksheets for several times on a significant sample of high school pupils and university students. As a result I discovered that students usually do not have possibility to solve this kind of exercise (using data from catalog of astronomical objects) at school. Analysis of my hypothesis says there are less than half of students that are able to effectively use information on Internet based on some procedure (in my case worksheet). This finding is not encouraging. It should be also related to popularity of worksheets for students. Further analysis should find more interesting method. I found out that ambitiousness of worksheets is around in the middle of scale, which means students do not consider the exercises as too simple or too complex. If the ambitiousness of the exercises is too simple, students are able to use computers to solve practical exercises. Unfortunately I cannot say it is true; it means for students is difficult to solve practical exercises using multimedia.

I also realized basic research related to comparison of exercises based on raw data (first type) and online applications (second type). Both types of exercises are similar for students. Around 34 percents of students consider as too complex first type of exercises. For second type it is similar, 36 percents. In case of too simple, the situation is as follow: 30 percents for first type, 37 percents for second type. In general, this trend may be due to the low ability of students to solve Science exercises. Worksheets more focused on Astronomy appear to them as demanding as task in application (Excel) not so familiar with it. Students cannot handle basic transactions in the Excel spreadsheet, especially inserting formulas into cells, data sorting or constructing a simple chart.

This type of worksheets is not possible to solve easily without computer and access to internet to Astronomy web pages. One comment from student says: “It is not possible to find answers on Wikipedia”. I am convinced that this is the main reason to have this kind of exercises. Students have to do some activities to find correct answer not only use Google, Wikipedia etc.

Any experiences with the above applications, comments, ideas or suggestions, please, let me know. I will keep the applications updated and fully working as long as it will be possible. It means you can implement them into your education process. I will be also grateful to have a feedback (or at least information) from teachers that they are using these exercises.

References

AKTAN, D. C. *Examination of preservice science teachers' understanding levels of Kepler's laws with ranking task questions*. Journal of Baltic Science Education. Volume 13. Issue 2, 2014. pp. 276–288.

CRUXIS, R. Telescope Limiting Magnitude Calculator [online]. [cit. 17. 1. 2015]. Available from: <www.cruxis.com/scope/limitingmagnitude.htm>

KÉHAR, Ota. *Catalogs of Astronomical objects on the website Astronomia and their Application at schools*. Plzeň, 2014. Doctoral thesis (Ph.D.). University of West Bohemia at Pilsen. Faculty of Education.

Minor Planet Center [online]. [cit. 17. 1. 2015]. Available from: <www.minorplanetcenter.net>

Multimedia text book Astronomia [online]. [cit. 17. 1. 2015]. Available from: <astronomia.zcu.cz>

Near Earth Object Program [online]. [cit. 17. 1. 2015]. NASA, 2015. Available from: <neo.jpl.nasa.gov/orbits/>

OOSTRA, B. *Astronomy Teaching with Astronomical Catalogues*. The Physics Teacher, 2006. Issue 3, pages 153-156.

SOGA, M. *The planetary simulator for generalized understanding of astronomical phenomena from various viewpoints*. 12th International Conference on Knowledge-Based Intelligent Information and Engineering Systems, KES 2008. Volume 5179 LNAI, Issue 3. pp 596–603.

WHAT DO THE PARTICIPANTS OF THE ICTE CONFERENCE IN ROŽNOV WISH FOR?

Pavel Kapoun

**Department of Information and Communication Technologies, Pedagogical Faculty,
University of Ostrava, Fráni Šrámka 3, Ostrava-Mariánské Hory, Czech Republic
pavel.kapoun@osu.cz**

In September 2014, the 15th annual international conference “Information and Communication Technologies in Education” held by the Department of Information and Communication Technologies of the Pedagogical Faculty of the University of Ostrava took place. Academics and PhD students from Czech, Slovak and Polish universities met in the picturesque town of Rožnov (Czech Republic) to discuss the trends of use of ICT in education and to make acquaintances during both formal and informal occasions. On the occasion of the anniversary of the conference the organizers can ponder whether the established trend (with small innovations) is sufficient, or whether the time for a radical change has come.

Colleagues from Polish and Slovak universities regularly participate in the ICTE Conference and its PhD section – the field of information and communication technologies in education (specialization in pedagogy). The 15th annual conference was dedicated, among others, to B. F. Skinner. The international conference was supported by an international organization, the Visegrad Fund.

In order to learn the participants’ views and opinions, the organizers asked them to fill out a questionnaire, which was designed to learn their opinions on general issues, the focus and program of the conference, contributions (papers) and the journal, marketing communication, technical background, and the non-formal part of the conference. The respondents were asked to describe what the conference could look like in 15 years and to try to draw a picture with the conference being an animal with its characteristic features. The questionnaire was filled out by 31 respondents, whom we want to thank once more. The research results are presented in this paper.

As far as the countries from which the participants of the conference come are concerned, nearly two-thirds come from the Czech Republic, one-third come from Slovakia, and the rest come from Poland. Guest lectures by renowned experts not only from the Czech Republic, but also from the United Kingdom, the U.S.A., Austria, or Spain are an integral part of the conference. The fact that nearly half of the respondents stated that it was their first time participating in the conference (and for nearly one-third of them it was the second or third time) proves that the conference is much more than a reunion of the same group of people who participate each and every year. The organizers believe that the new participants will participate in the conference regularly in the future.

The reasons why people come to the conference are diverse and the individual respondents mentioned several of them. Six of the respondents participated in the conference within the scope of the compulsory PhD seminar while four of them participated within the scope of the Visegrad project meeting, which was a part of the conference. Less than half of the respondents stated that they participate in the conference because of the quality of presentations and to expand their knowledge. 17 of 31 respondents appreciated the possibility of being able to personally meet with colleagues from the same field of research, a friendly atmosphere and environment. It is somewhat surprising that only three of the respondents stated the possibility to publish their papers in a journal that has previously been indexed in the Web of Science database is the reason for their participation in the conference.

With a few exceptions, all participants are content with the conference being held in September from Tuesday to Thursday. Half of the participants are content with the focus of the conference, three of them would appreciate more presentations on mobile technologies and two of them would appreciate greater emphasis on didactics of informatics. Nearly two-thirds of the participants are content with the structure of the conference. Some of them would appreciate more presentations, more workshops, and especially more posters. There were reservations about the main and PhD sections taking place at the same time. As a result, the main section has a low number of attendants while PhD students are not able to hear the presentations of renowned experts.

Another question was whether the conference should become a more international event with a greater number of participants coming from outside of Europe, or whether it should stay a regional (Central European) meeting of experts who deal with similar problems in a similar manner. 11 out of 31 respondents spoke for the greater openness toward the world. Some of them suggested that all the presentations should be presented in English while others suggested they should be interpreted from English. 15 out of 31 respondents stated that the nature of the conference should remain regional. Some of them warned that trying to make the conference a worldwide event may result in the loss of its spirit and friendly atmosphere. However, even these respondents wished for the participation of experts not only from Europe but from all over the world. Considering that the majority of respondents wished for the conference to sustain its regional character and stated that the main reason of their participation in the conference is the possibility of being able to personally meet with colleagues from the same field of research and its friendly atmosphere, the organizers opted not to change the conference format and instead decided to enrich it with guest lectures and workshops led by renowned experts not only from Europe but from all over the world.

In another group of questions the respondents evaluated the quality level of guest lectures and presentations in the main section and at the same time could suggest their own ideas for improvements in this area. Nearly half of the respondents think that the level of presentations is increasing. Among celebrities that the participants wanted to see and hear also appeared the name of Steve Jobs. This, sadly, is a wish that can no longer be fulfilled. Four of the respondents would appreciate more didactics and an interdisciplinary dialog of didacticians and IT experts at the conference. Furthermore, the respondents would like to hear from someone from the field who is more familiar with the teacher community, or a representative of the Ministry of Education, Youth and Sports. The respondents were also interested in the

actual effectiveness and possible disadvantages of ICT-supported education. As far as the main section presentations are concerned, the respondents evaluated them as good or average. There were complaints about the violation of the time allocated for presentations. One of the respondents suggested that a stopwatch (counting down the time) be attached to a lectern. The organizers promise they will make sure such cases do not occur at future conferences.

Approximately half of the respondents answered the question concerning the editorial system for posting of papers. Ten of them are content with the editorial system. However, there were complaints about irrelevant, late or entirely absent feedback. One of the participants suggested that the conference switch to the widespread conference management system, EasyChair. The majority of respondents evaluated opponent reviews as apt, useful, and professionally satisfactory. Some of the complaints mentioned that in some cases the level of opponent reviews varies; that there are cases when there are two contradictory reviews for one paper; and that reviews should provide constructive criticism and not only a two-sentence summary of the paper.

The organizers were pleased to learn that 22 out of 31 respondents stated that they continue to use the journal after the conference, i.e. they quote from it and recommend it to their colleagues and (mainly PhD) students. As far as the CD version of the journal is concerned, the conference participants would like it to include presentations and additional documents from guest lectures (including audio recordings), photographs and videos from the conference, the list of reviewers, index, and the possibility to search in the papers. Three respondents would prefer a USB flash drive version of the journal since their laptops do not have a CD-ROM drive. All of the respondents agreed that the journal should be available on the Internet (a request the organizers can promise to fulfill).

In order to improve promotion and communication, the respondents suggested a more intense call for papers – include more workplaces and address specific people. Those who participated in previous conferences (including PhD students) should be addressed primarily. As far the target groups the members of which should be addressed are concerned, the respondents most frequently chose teachers (not only informatics), didactics experts, pedagogical associations, representatives of the Ministry of Education, Youth and Sports, and coordinators of international projects aimed at the implementation of information and communication technologies in education. There were also suggestions concerning inviting sponsors, representatives of the commercial sector, and software developers who would provide information about trends and upcoming innovations in the field of educational software. There was a suggestion about addressing foreign PhD students who could introduce the results of their research at the conference. As a result, our PhD students could compare their own work with the work of foreign students.

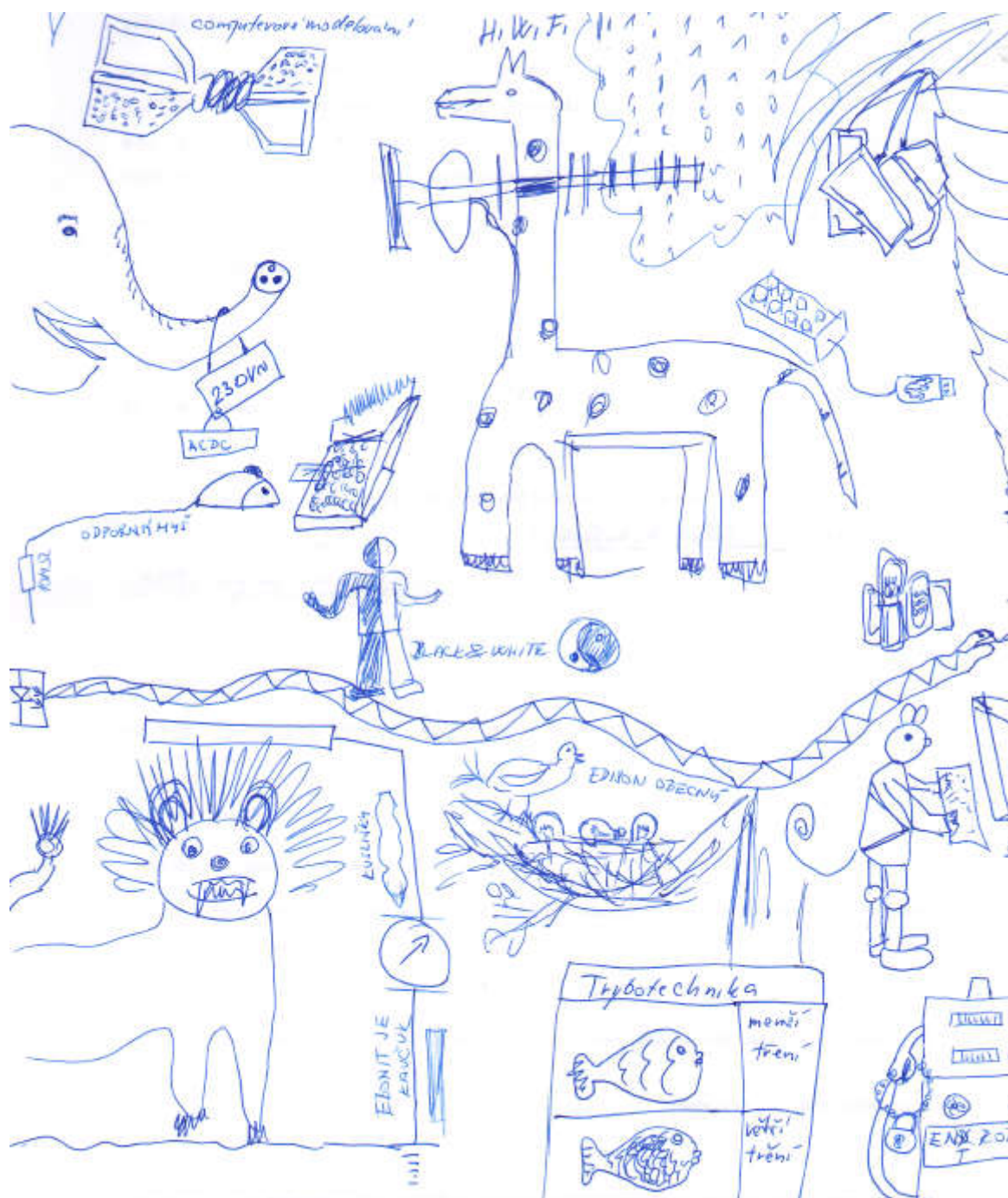
As far as the technical background of the conference is concerned, there were no crucial remarks. The respondents would appreciate a larger screen so that the text written in a smaller font size would be easy to read, a high-quality data projector with better color resolution, and a presentation remote control with a laser pointer.

The participants were content with the social and non-formal parts of the conference, i.e. backstage debates, field trips, and a social evening. They stated that this part helps with

integration, cooperation and solving collective problems. Some of the respondents even stated that the non-formal part is the most important part of the entire conference. As far as destinations of future field trips are concerned, the participants suggested places around Rožnov, the Wallachian Open Air Museum, or more remote places such as Štramberk or Kopřivnice. The organizers will take these suggestions into account when planning future field trips.

The questionnaire also had a “non-serious” part. The respondents were asked to become sci-fi authors for a moment and write what they think the conference will look like in 15 years. The vast majority of them see the future of the conference in the virtual space, i.e. they will not have to travel anywhere as they should be able to participate in the conference from their own living rooms. These, however, contradict what they appreciate the most about the conference – personal meetings, backstage debates, social and non-formal parts of the conference. Therefore, the organizers decided that in the age of virtual reality they would choose the old-fashioned way of face-to-face meetings in a friendly environment.

The respondents were also asked to draw the conference as an animal with its characteristic features. The majority of respondents draw minimalistic pictures. However, there was one complex composition the meaning of which the organizers were not able to decipher. Maybe some of you will be able to tell what the person was trying to say about the Rožnov conference.



Finally, we want to thank all the respondents who filled out the extensive questionnaire. The organizers can promise that they will take the complaints, objections and remarks into account when trying to improve the quality standard of the already traditional conference on information and communication technologies in education