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WYKORZYSTYWANIE TECHNOLOGII INFORMATYCZNYCH W ROZWIJANIU KOMPETENCJI TWÓRCZYCH STUDENTÓW

THE USE OF INFORMATION TECHNOLOGY IN DEVELOPING OF STUDENTS CREATIVE COMPETENCES

Słowa kluczowe: kompetencje twórcze, rozwój kreatywnego myślenia, i-Lab2, laboratorium innowacji, innowacje w edukacji.

Keywords: creative competences, development of creative thinking, i-Lab2, innovation laboratory, innovations in education.

Streszczenie

Kreatywność studentów to umiejętność tworzenia i zmieniania otaczającej rzeczywistości. Na Uniwersytecie Rzeszowskim jest ona rozwijana w ramach innowacyjnego laboratorium i-Lab2. W artykule opisano założenia organizacyjne i metodologiczne laboratorium oraz przedstawiono wyniki sesji przeprowadzonych ze studentami. Nasze doświadczenia pokazują, że zastosowanie technologii informacyjnych w procesie nauczania przyczynia się do rozwoju innowacyjności i kreatywności uczestników sesji, którzy pracują nad problemem, począwszy od administrowania istniejącymi rozwiązaniami, a skończywszy na dodawaniu czegoś nowego. Sesje w i-Lab2 sprzyjają pracy w grupach i integracji.

Abstract

Creativity of students is the ability to create and change the surrounding reality. At the University of Rzeszów (Poland), it is being developed as part of the innovative i-Lab2 laboratory. The article describes the organizational and methodological assumptions of the laboratory and presents the results of the sessions carried out with the students. Our experience shows that the use of information technology in the teaching process contributes to the development of innovation and creativity of session participants who work on the problem, from administering existing solutions to adding something new. Sessions in i-Lab2 support group work and integration.

Introduction

The global learning of the twenty-first century is continuously transformed and shaped by digital communication tools and networked applications, along following the needs and demands of learners and students[1]. In the coming years in Poland, the success of civilization and economy, to a much greater extent than in the past, will depend on the innovation and creativity of Polish science and economy.

In this paper, we assume that the innovation is a situation when we introduce a new product, process, method of operation, or change or improve existing solutions. Suggested activities in the innovation laboratory i-Lab2 are mainly aimed at seeking improvements and modifying existing solutions, and classes in the form of i-Lab2 session may be recognized as an innovative educational method.

The paper presents organizational and methodical assumptions, examples and results of sessions conducted in the newly created within Leonardo da Vinci project innovation laboratory i-Lab2 at the University of Rzeszów (Poland).

The most common definition of innovation emphasizes that innovation is a process of transformation of the existing possibilities in new ideas and putting them to practical use[2]. The concept of innovation was introduced to the economic sciences at the beginning of the twentieth century by J.A. Schumpeter. He understood innovation widely, not restricting it only to technical considerations. He believed that innovation also includes economic assumptions and appears in the field of organizational change and in the area of human relations. According to Schumpeter, a source of innovation is inventiveness of entrepreneurial and discovery unit[3].

In the interpretation of innovation there are two prevailing approaches, namely the recognition of innovation as a result or process. In the first approach innovation are changes in production, leading ultimately to new products. In the second approach innovation is all the creative thinking processes designed to apply and use improved solutions in technique, technology, organization and society. This second approach represents Kotler, according to which "innovation refers to any good, service or idea, which is seen by someone as new"[4].

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[1] A. van den Bogaart, R. Bilderbeek, H. Schaap, H. Hummel & P. Kirschner, *A computer-supported method to reveal and assess Personal Professional Theories in vocational education*, "Technology, Pedagogy and Education" 2016, Vol. 25, issue 5, p. 613–629.

[2] K.B. Matusiak, *Innovation and technology transfer glossary of terms*, PARP Warszawa 2008.

[3] J.A. Schumpeter, *The theory of economic development*, PWN, Warszawa 1960.

[4] Ph. Kotler, G. Armstrong, J. Saunders & V. Wong, *Marketing. Manual European*, Polskie Wydawnictwo Ekonomiczne, Warszawa 2002, p. 662.

Innovations are the basis of economic development. The experience of economically developed countries confirms that innovation is the source of the success of many companies operating in the free market[5].

According to the international methodological manual of statistical innovation research recommended by the OECD countries and the EU's countries, innovation is the implementation of a new or significantly improved product (good or service), new or significantly improved process, a new marketing method or a new method of organization in terms of business practices, workplace organization or relations with the external environment[6].

The use of innovation in the teaching process is also possible[7]. It can be used not only for technical subjects, but e.g. in pharmacy[8]. The Faculty of Mathematics and Natural Sciences of the University of Rzeszów (Poland) established an innovative laboratory i-Lab2 for the development of creative thinking. It uses information technology and the method of brainstorming to conduct classes in the form of a session.

Organizational and methodological assumptions of innovation laboratory

The first innovation laboratory (i-Lab) was established in Royal Mail`s Futures and Innovation Group in Rugby in the UK. The original idea of the laboratory was to simulate an environment, as a way to introduce new factors that could potentially prevent the disorganization of processes of planning and organization and to help management teams in developing new solutions. However, in the course of work it turned out that tying in the group interactions increased openness and mutual trust and fostered cooperation and innovative thinking. Therefore, the modified i-Lab idea was to set up a space where groups and teams could effectively explore and develop thinking processes and innovative activities[9].

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[5] A. Pomykalski, *Innovation management*, PWN, Warszawa–Łódź 2001, p. 18.

[6] The Oslo Manual, *Guidelines for Collecting and Interpreting Innovation Data,* Organizacja Współpracy Gospodarczej i Rozwoju, Urząd Statystyczny Wspólnot Europejskich, MNiSW, Departament Strategii i Rozwoju 2008.

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[9] J. Religa & M. Kacprzak, *Innovation Laboratory – Good Practice Guide*, Wydawnictwo Naukowe Instytutu Technologii Eksploatacji – PIB, Radom 2008.

The main idea of currently created i-Lab laboratories is a combination of the three components of their structure in such a way that they contribute to support the development of innovation:

(1) separation of space providing adequate working conditions,

(2) use of the software support team working in the i-Lab,

(3) moderation techniques – a person (moderator), who can actually take advantage of opportunities created by space and software to support group using resource of laboratory[10].

Coexistence and mutual interpenetration of these elements is the basic assumption of each of the existing i-Labs.

Organizational-methodological assumptions of the i-Lab2 created at the University of Rzeszów

Innovation requires creativity and inspiration, which are products of the subconscious although they may be consciously stimulated by generating an appropriate environment. I-lab needs to be a space where people feel free, safe, focused and away from other problems, limitations of the environment. The feeling of comfort and security is conducive to the development of creative thinking and the generation of original and unusual ideas.

In organizing the i-Lab2 at the University of Rzeszów much time was spent on selection of suitable premises, which had to meet several conditions:

− rooms should be placed at the side of the building, where there is peace, quiet and no noise distracting participants during the session;

− decor of rooms should give a feeling of security. Entering the lab session, participants should have a sense of peace and security;

− decor of spaces should differ from the typical design of the classroom, they should be interesting and stimulate creativity;

− i-lab should be built from two rooms: one to work with using computers, the second for creative work. Therefore, it was necessary to find two rooms side by side or a large room that could be divided into two smaller rooms;

Each of the resulting innovation laboratories is different. Within i-Lab2 project there were created 4 new laboratories: in Germany, in Slovenia, in Romania and at the University of Rzeszów in Poland. Our i-Lab2 consists of two rooms located next to each other: a computer room and a room for creative work in groups. An important function in the laboratory performs the entrance door, symbolizing the moment of entering into another particular environment. The psychological effect of closing the door of i-Lab2 gives participants the feeling,

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[10] *Ibidem*.

that they are isolated from their everyday environment, life and problems. The intention of i-Lab2 designers was that participants could found themselves in a space different from their normal working or studying environment, hence the colorful furniture and specific location of computers[11].

Another important element for the proper functioning of the innovative laboratory is software – Virtual Brainstorm (VBS), created in Polish for the i-Lab2 by the Institute for Sustainable Technologies – National Research Institute in Radom. Within the Leonardo da Vinci project there were created four language versions of the software VBS: English, German, Romanian and Slovenian. The software has been developed to maximize the correctness of creative thinking processes and methods of its development. The advantage of the software is clarity and simplicity in use. It offers the possibility of submission of ideas, their segregation and proper moderation. Thanks to VBS software each participant in the session may enter any number of ideas, has the ability to read the ideas registered by others, can read the files attached by the teacher (if such have been prepared) or participants, vote for the best idea by secret ballot, see what ideas have been best rated, refer to the report from the course of the session.

The advantage of the software is the ability to choose the type of session – anonymous or not. Using the anonymous reporting of ideas may be useful in the case of shy persons, reluctant speakers at the forum group (and this is in accordance with the rules of brainstorming). The possibility of anonymous reporting of ideas helps many people share ideas freely, breaking the fear of evaluation and criticism. In addition, the ideas of others are often the inspiration for the creation of new ideas. The result of anonymous writing of ideas for solution of a given problem is to obtain a large number of ideas in a short time.

Another important link of the i-Lab2 session is moderation, which aims to stimulate the creation of new ideas through the use not only the environment and technology, but also the dynamics of group work and other techniques for managing the process so that participants use their ideas in the most effective way. Moderation of the session is necessary to ensure efficiency and reaching the success[12].

Besides planning and conducting of the session, the moderator prepare a final report of the work performed in the i-Lab2, including the list of submitted ideas and photographs of results written on the boards during the session[13].

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[11] A. Koziorowska & M. Romerowicz-Misielak, *Problemowa metoda nauczania jako forma zajęć na kierunku biotechnologia*, "Edukacja – Technika – Informatyka" 2014, nr 5/2014-1, p. 476–480.

[12] A. Długosz, *The use of the innovation laboratory in the development of creative thinking of students,* "Edukacja – Technika – Informatyka", 2014, nr 5/2014-1, p. 116–121.

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Moderator skills guarantee high quality of the results obtained in group work sessions carried out in the i-Lab2. This applies not only to the ability to use appropriate knowledge resources, skills and presenting appropriate attitudes to achieve the expected results, but also includes the ability to achieve good results in different situations, environments, with use of different techniques.

Examples and results of sessions in innovation laboratory i-Lab2

Classes in the laboratory have always a specific purpose: the solution of a problem. But is it only this? We must definitely answer they have not! The laboratory does not resemble a typical classroom, it is an intended effect. Entering the i-Lab2 we have the feeling that we are moving to a different space. The decor of the rooms and their location in a quiet place contributes to the fulfillment of this condition.

The condition of the success of the session is to create the right atmosphere. For this purpose at the start of classes, the moderator suggests exercise stretching, "ice-breaking". This exercise is to relax the participants before the session, and in the case of new groups allows participants to get to know each other. Many interesting examples of exercises that can be used contained, amongst others in the book Innovation Laboratory – Good Practice Guide[14].

Then the moderator presents participants a problem that they have to solve during the session and explains rules of work (typing new ideas, prohibition of evaluating ideas during typing, no discussing during classes, communication using software VBS selection of the best ideas, the ability to analyze reports from a session).

In our i-Lab2 we held several sessions attended by teachers, students of secondary schools, students and academic teachers of our University. One of the sessions was attended by second year "Safety engineering" students of our University. The problem, which was formulated during the session concerned vision for the development of mobile phones.

The ideas obtained during sessions were very different. First ideas referred to the existing technical solutions. Among the ideas the students drew attention to that the phone should have better technical parameters, should be resistant to shocks, falls, water, be energy efficient and environmentally friendly. The battery should work for a long time and it should charge itself. The phone itself should protect against web viruses, which are increasingly attacking not only software but also mobile phones.

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[14] D. Koprowska, *Innovation Laboratory – Good Practice Guide,* Wydawnictwo Naukowe Instytutu Technologii Eksploatacji – PIB, Radom 2014.

The phone should be cheap so that everyone could have it and it should have free internet access. Internet should be fast and available everywhere. Information from web sites should be read by the teacher, so that the user could do something else and not strain their eyes looking directly at the small letters. With the ability to use the internet on the phone, it should give the possibility to watch movies in technology 5D or 7D and fully experience the happening situations, for example smell a scent.

After 20 minutes destined for writing ideas, each participant was supposed to evaluate some of all written ideas. Participants made the ideas rating in secret, assigning points to the best ideas (there was 10 points for use, each participant could allocate points for the best ideas in free way – 10 point for one idea or 1 or more points for more ideas).

The effects of voting can be analyzed immediately. Participants have the opportunity to see reports.

Students in groups of 5 persons supplemented and developed two ideas that were the highest rated. This part of the work took place in the second room (relaxation), where the participants of the session in comfortable armchairs and with the sound of quiet music worked in two groups. After about 40 minutes, each group presented the results of their work.

In students' opinion the phone could have a built-in breathalyzer, so that in case of doubt, the driver could check whether he or she really can drive a car. Students added to this idea other amenities, e.g. the phone could read emotional states of the owner and try to help and inform the owner in state of mental breakdown or sadness.

The second group worked on developing the idea of the phone with built-in printer

With the addition of the print function they could print interesting materials sent by friends or previously ordered tickets for matches, concerts, movies, without standing in line. It would save time. There would be no need to wait for tickets from a cashier.

The solutions presented by individual groups have been a reason for further discussion. The session was summed up by moderator, who thanked everyone for their commitment.

The session in the laboratory i-Lab2 can be an alternative to conduct classes for students within the technical subjects. In addition to classic laboratory excercises after several standard classes the i-Lab2 session can be used to summarize the material (written ideas during the session testify to the students' knowledge), an attractive alternative to monotonous exercises in the classical lab.

An example of such use of the i-Lab2 was the session conducted with the students of third year mechatronics course from the classes on "drives and controls". Students had to present their vision of multimeter electrical quantities,

which would facilitate their work in the laboratory. Knowledge of students both from the subject of electrical engineering, and other technical subjects allowed them a broad view of the problem of measurement, measurement errors, data and method of their analysis.

Students reported many ideas. One of them was the idea that the multimeter would have a bluetooth module to send data to mobile devices, to be able to create appropriate graphs online. The possibility of extension measurement systems was suggested by synchronizing a few multimeters installed on a single network connection with the use of large touch panel-driven controls with icons simplifying navigation between functions of the multimeter. Students proposed to expand the memory so there would be possible to save multiple measurements and the use of the USB connector to read and download the measurements.

Students offered 26 ideas, report shows the best 10 of them, the first 3 received successively 11, 10 and 8 points in the vote (Photo 1).
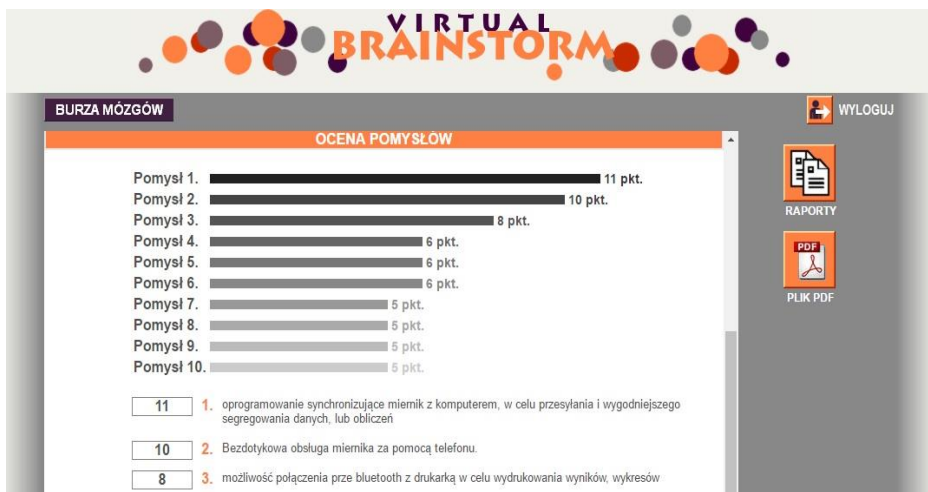

Photo 1. VBS software print screen of the results of ideas evaluations

(Print screen translation: burza mózgów – brainstorm, ocena pomysłów – evaluation of ideas, Pomysł 1...10 – ideas 1...10, raporty – raports, 1. Oprogramowanie synchronizujące miernik z komputerem w celu przesyłania i wygodniejszego segregowania danych lub obliczeń – Synchronization software of multimeter with a computer to transfer and convenient sorting of data or calculations, 2. Bezdotykowa obsługa miernika za pomocą telefonu – Hands-free operation of the multimeter via a mobile phone, 3. Możliwość połączenia przez Bluetooth z drukarką w celu wydrukowania wyników I wykresów – Possibility of connecting via Bluetooth with the printer to print the results and charts).

Working in a laboratory i-Lab2 with students of higher years of the study requires the preparation of an universal and wide topic of the session that would allow for the use of their extensive knowledge. These kind of sessions were new

to students but were adopted with curiosity and interest. The possibility of a broad view of the problem of measurement and use of knowledge in many subjects made the discussion more attractive.

Conclusions

Laboratory of innovations i-Lab2 created at the University of Rzeszów under the Leonardo da Vinci program can be successfully used to develop a number of key competences needed in today's labor market, i.e. the competences of creativity, innovation, communication, information, teamwork etc. Sessions in the laboratory i-Lab2 offer the possibility to develop new solutions to the problems, enable students to exceed traditional ways of thinking. There is a space for greater creativity and creative freedom.

The moderator before classes can prepare some materials in the form of files that each of participants can view before the session. In the case of new topics, participants can be asked to prepare in advance or they can have time to look for information during the session (they can browse the internet before they give the ideas). In order to obtain valuable solutions the moderator should plan a session for several hours. At the beginning, there can be used any technique of group integration called "exercises for breaking the ice". Introduction of the session participants in an atmosphere of relax and security makes them more readily and they will share their ideas without much concern. This is a very important part of the session and the moderator should pay the special attention on it, because it determines the further work and its effects. The use of different forms of organization and methods of work in the laboratory gives much better results than a traditional problematic lesson. The key to the success is the emotional commitment and a desire to find a solution to the problem posed by the moderator.

The session in the laboratory can be divided into two parts – in the first part (in the computer room)there are developed information skills, creativity and innovation. In the second part (the room for creative work in groups)we develop creative powers along with the ability to listen, talk and work in a group.

The composition of each group usually is determined by drawing lots, to "mix" the participants and put students in the work situation with other persons who are possibly unknown or disliked. Looking at the work of individual groups, and presented at a forum, organizers should pay attention to a few things. At the beginning, participants of individual groups sit together in a circle and try to establish a plan of action. The command to detail the idea in a small group forces all members to get involved. The motivating factor to work is the desire to present the work effects well, also there is a small element of rivalry between the groups. This part of the work on the problem is conducive to developing skills of group work.

Each session in the laboratory is different, but the same is a big commitment of participants. Sessions carried out in the i-Lab2 laboratory before, met with great interest among participants who spoke positively about them (30 sessions, 300 participants).

Sessions can be used to solve a problem but also to systematize and summarize knowledge. Conducting the session in order to systematize the knowledge is a good opportunity for self-assessment but also supplement of the knowledge. Classes in laboratory conducive to learn. The moderator does not give ready-made answers but organizes work, conditions, motivates to independent work. His role is to help and provide advice, guidance and assistance in overcoming difficulties. To take full advantage of the laboratory we must remember that the success depends on many factors such as: the design of the lab, the way to set the furniture, providing the space to write – to develop the idea, the way of introducing the topic of the session, the pace of work, the preparation of the group and its commitment, preparing of support materials for the participants, skillful directing for new solutions rather than solving them by the moderator, the freedom to say anything what a participant wants, working in a group, possibility of leaving a group for a moment to view the problem in silence, listening of quiet music.

Conducting the session requires a good preparation by the moderator and a technician. Conducting classes in the laboratory requires not only choosing the right problem to solve, preparation of materials (not only in paper form but also various types of attachment), but also psychological skills (how to integrate the group, encourage them to work) and information technology (maximum use of the opportunities provided by software VBS). It also need time to develop good ideas during the session therefore, i-Lab2 sessions should last no less than 3-4 hours of teaching. It gives very good results, to come back to the issue the day or a few days later.

Disclosure

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