Innovative Methodology for Blended Learning Education

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ABSTRACT

The goal of this paper is to present the results from a research focused on the creation and evaluation of innovative model for blended learning education combining: Honey and Mumford learning styles, David Kolb's experiential learning cycle and definition of the most efficient innovative ICT technologies supporting the educational process for each learning style in the experiential educational cycle methodology. The presented in this paper methodology was used as a basis for the development of educational materials for Master degree university course in the field of "Innovations and Innovation Management" and gave opportunity for evaluation of the developed model: part of the course was presented with traditional lectures without the application of the presented innovative model and part of the course was presented with the application of the presented innovative model and the prepared for it educational materials. During the experiment the students filled in questionnaires in order to evaluate the used methods, educational materials and tasks in the course, level of gained knowledge, levels of involvement and satisfaction from the course. The results confirmed the successful application of the presented in this paper methodology and the students' preference towards education based on the presented in this paper methodology. The results from this experiment are also presented in this paper.

Keywords: Honey and Mumford learning styles, ICT technologies, computer-aided learning, David Kolb's experiential learning cycle, results from experiment.

1. Introduction

The advances of information and communication technologies have impacted all spheres of our lives and so much the education process. The classical educational process is still applied in most of the educational institutions around the world [1], but everyone is noticing that in the last several years' things have changed a lot and the old model doesn't seem to work anymore [1,2]. One of the things which have changed is namely the abundance of information and data easily available because of the development of ICT technologies in the last years. In the previous decades the difficulty of acquiring information was widely spread and the acquiring of information was equal to power and success. For this reason, a classical educational process where the teacher was the source of knowledge and the students were eagerly listening to the lecture and writing down as

much information as possible which later, they would study, and exercise was a very well working model. Lectures were the best way to gather information and the classical methods of education worked well, without the need of colourful presentations, videos, games or additional activities. Nowadays the information is everywhere. The students are the first generation that has grown up with ICT, receiving tons of information they didn't ask for from a very small age, including advertisements, etc. The fact that any information is easy to acquire, and the informational overload are a normal state in the last decades. And for the children and students to protect their minds from this overload, a new set of skills have been formed – the ability not to pay attention to information and data, which they do not immediately need. This is one of the reasons which lead to the ineffectiveness of the classical educational methods and which implies that new methods should be developed which take into account the state and needs of the students, also their habits of learning and gathering information, as well as the current ICT technologies. This is actually the focus of this research which started in 2015 as work on an EU project "Innovative Teacher – Motivated Student: Collaborative Problem Solving" and later on continued with the support of the Bulgarian Ministry of Education and Science under the National Research Programme "Young scientists and postdoctoral students" and which results are published in this paper.

2. Existing methodologies

An interesting fact is that although there is an increase in the availability of information, a decrease of the skills of graduated students is observed [3]. This leads to a conclusion that purely providing information is not enough for gaining real skills – the students should have a higher level of involvement in the educational process and deeper experience during the process of education. The most widely used learning theory is Kolb's experiential learning cycle. And for these reasons this, together with the learning types model, are the basis of the presented in this paper methodology. All this however should relate to the needs of today's world and the wide spread of ICT technologies usage.

Following the needs for developing an innovative methodology for education which takes into account the innovative ICT technologies and the different needs of the students a unification was made of: Honey and Mumford's learning types, David Kolb's experiential learning cycle, existing ICT technologies in blended learning and a specific matching of the used ICT technologies in education for each of the phases of Davis Kolb's experiential learning cycle were made.

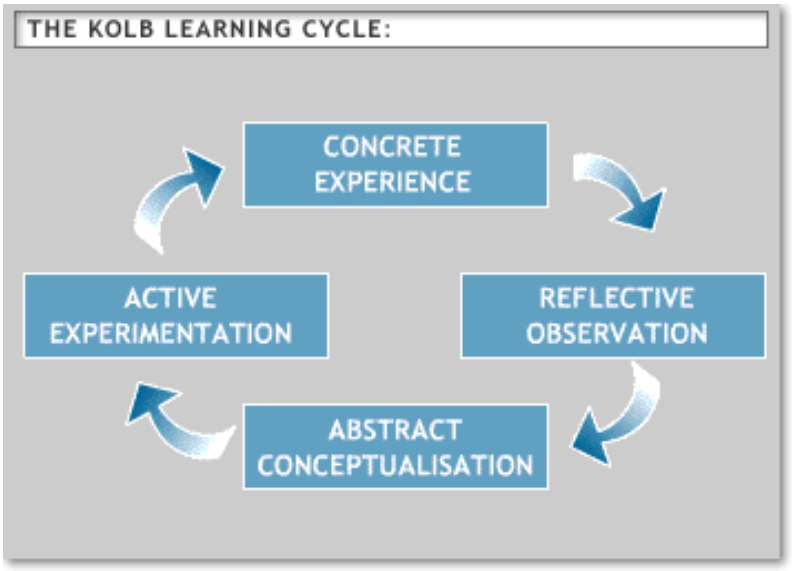
David Kolb's experiential learning cycle

The most widely used learning theory is Kolb's experiential learning cycle. There are four stages starting with Concrete Experience and followed by Reflective Observation, Abstract Conceptualisation and Active Experimentation (see Figure 1.). This cycle allows the students to experience the natural steps in acquiring knowledge: having an experience, reflecting on it, drawing their own conclusions and putting their theory into practice. This experiential learning cycle is applied in all sphere of learning and is the most appropriate to apply in today's education,

due to the informational overload in students and their ability to focus only on information which is necessary for them in the current moment.

Kolb's experiential cycle is directly connected with the different learning types identified by Honey and Mumford and includes activities involving all four learning styles in its four phases, which makes it a perfect basis for educational methodology and applying it in any educational group and type of education.

Figure 1: David Kolb's experiential learning cycle



Source: University of Leicester

There are different activities suitable for each of the four phases in the experiential learning cycle [4] and they will lay as a basis for the further development of the methodology.

The basic activities suitable for phase 1 - Concrete experience are: readings, examples, fieldwork, laboratories, problem sets, trigger films, observations, simulations and games, text reading, etc. The basic activities suitable for phase 2 - Reflective observation are: logs, journals, discussion, brainstorming, thought questions, rhetorical questions, etc. The basic activities suitable for phase 3 - Abstract conceptualization are: lecture, papers, projects, analogies, model building, etc. The basic activities suitable for phase 4 - Active experimentation are: projects, fieldwork, homework, laboratory, case study, simulations, etc.

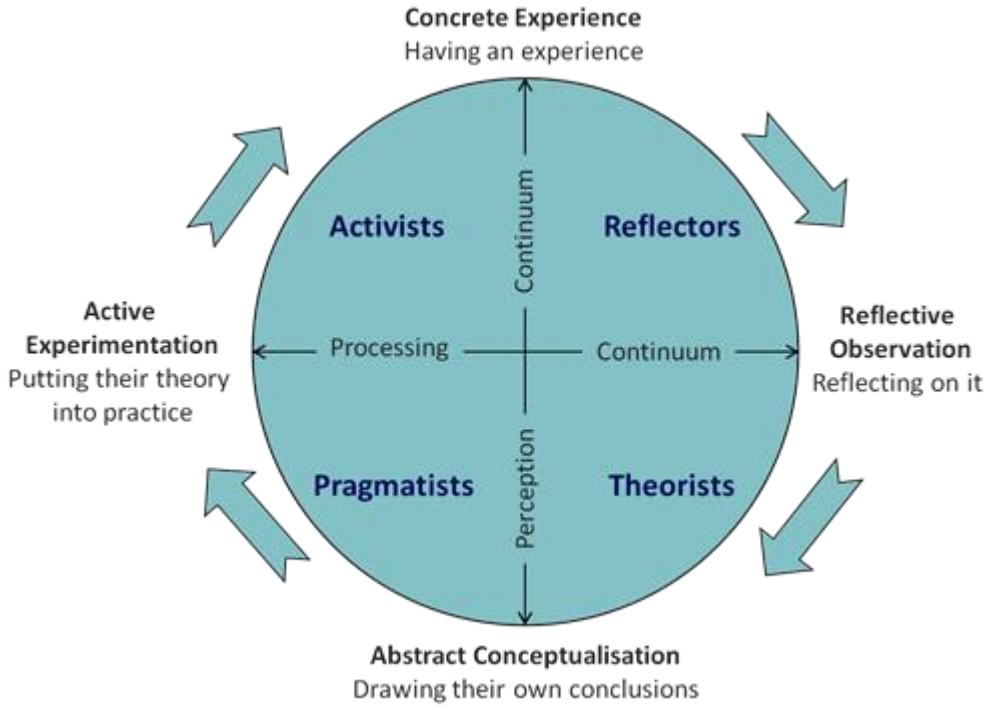
In order to create an effective methodology for blended education involving the appropriate ICT technologies, the specific learning types of students should also be considered.

Honey and Mumford's learning types

There are four basic learning types developed by Honey and Mumford (1982), based upon the work of David Kolb. The basic learning types are: Activists, Theorists, Reflectors and Pragmatist. Each of them needs different elements and methods of teaching, as well as different ICT technologies connected with the specifics of each learning type [5]. The four phases of the experiential cycle also fully correspond to the learning needs of all learning types.

AD:\a short overview on each of the learning types should be made that will allow to limit the most appropriate educational activities for the innovative methodology for blended learning.

Figure 2: David Kolb's experiential learning cycle and Honey and Mumford's learning types



Source: University of Leicester

The first learning type to consider is Activist. Activists are those people who learn by doing, who need to "get their hands dirty" and "dive in with both feet first". Activists have an open-minded approach to learning, involving themselves fully and without doubt in new experiences. They like to involve themselves in new experiences, they will always be the volunteers when you ask for during the educational process and will "try anything once". They tend to act first and consider the consequences afterwards and for this reason activities which relate to actions are most appropriate for them.

The next learning type to consider is Theorist. Theorists like to understand the theory behind the actions. They need "models, concepts and facts in order to engage in the learning process and prefer to analyse and synthesise information, drawing new information into a systematic and logical theory". They enjoy seeing the big picture and create a structured view on the theory and for this reason activities, including classical lectures which present a clear view of the theory, including schemes are most appropriate for them.

The next learning type to consider is Reflectors. Reflectors learn by "observing and thinking about what happened. They may avoid leaping in and prefer to watch from the side lines. They prefer to stand back and view experiences from a few different perspectives, collecting data and taking the time to work towards an appropriate conclusion. They like to consider all the possible angles and implications before coming to a considered opinion. They spend time listening and observing and tend to be cautious and thoughtful." Following this classical definition, the most appropriate activities for reflectors are discussions and activities, where every participant can share their knowledge and ideas.

The fourth learning type to consider is Pragmatists. Pragmatists need to be able to see "how to put the learning into practice in the real world. Abstract concepts and games are of limited use unless they can see a way to put the ideas into action in their lives. They are experimenters, trying out new ideas, theories and techniques to see if they work." The pragmatists are the ones who will hire a personal trainer in today's world and will highly evaluate any activities, helping them to reach their goals. For this reason, activities giving them guidelines and instructions how to do certain things and allowing them to apply directly the knowledge into practice are most appropriate for them.

Based on these specifics of the four learning types and their needs and focus, a unification between David Kolb's experiential learning cycle, the four learning types, the most appropriate activities and the most appropriate ICT tools should be made.

3. Unified model of activities and ICT tools in the educational process

Creating a unified model of the activities and tools for each phase of David Kolb's experiential learning cycle is connected with: (1) identifying all types of activities suitable for both – the learning type and the focus of activities of each phase in the cycle and (2) identifying specific ICT tools, suitable and supporting the identified in step 1 activities in the educational process.

Identifying activities suitable for application in each cycle's phase according the corresponding learning type

A comparison and unification of the intersection between the activities suitable for phase 1 Concrete experience and the Activities suitable for learning type Activist have been made. The resulting list of activities satisfying both categories has been shown in the third column of Table 1 - Unified activities suitable to be applied in phase 1 and suitable for learning type Activist.

Table 1: Activities suitable for phase 1 Concrete experience.

Activities prescribed to be suitable to apply in Phase 1	Activities suitable for learning type: Activist.	Unified activities suitable to be applied in phase 1 and suitable for learning type Activist.
readings examples fieldwork laboratories problem sets trigger films observations simulations and games text reading	brainstorming problem solving group discussion puzzles competitions role-play action games Looking for and finding things	fieldwork laboratories problem sets trigger films simulations and games brainstorming problem solving puzzles competitions role-play action games Looking for and finding things, answers, etc. Etc.

Source: Assist. Prof. Sia Tsolova, Ph.D.

The following method of has been replicated and used in order to identify all activities suitable for both – the current phase in David Kolb's experiential learning cycle and the learning type mostly involved with the activities at the corresponding phase. Table 2 shows the results for Unified activities suitable to be applied in phase 2 and suitable for learning type Reflector.

Table 2: Activities suitable for phase 2 Reflective observation.

Activities prescribed to be suitable to apply in Phase 2	Activities suitable for learning type: Reflector.	Unified activities suitable to be applied in phase 2 and suitable for learning type Reflector.
logs journals discussion brainstorming thought questions rhetorical questions	paired discussions self-analysis questionnaires personality questionnaires time out observing activities feedback from others coaching interviews Finding answers	discussion brainstorming thought questions rhetorical questions paired discussions self-analysis questionnaires paired discussions self-analysis questionnaires interviews Finding answers Etc.

Source: Assist. Prof. Sia Tsolova, Ph.D.

Table 3 is presenting the results for unified activities suitable to be applied in phase 3 and suitable for learning type Theorist and the list of activities it shows is the closest to most of the educational courses and lectures in universities nowadays.

Table 3: Activities suitable for phase 3 Abstract conceptualisation.

Activities prescribed to be suitable to apply in Phase 3	Activities suitable for learning type: Theorist.	Unified activities suitable to be applied in phase 3 and suitable for learning type Theorist.
lecture papers projects analogies model building	models statistics stories quotes background information applying theories	classical lecture presenting papers describing analogies presenting models showing statistics presenting stories sharing quotes providing background information etc.

Source: Assist. Prof. Sia Tsolova, Ph.D.

The final phase in Kolb's experiential learning cycle and its corresponding learning type Pragmatist relate to activities which put into direct practical application the knowledge acquired in the previous phases. This is the stage closest to the future steps, homework, practical guidelines for application and it is very important to have actively involvement of students in this phase, so that they have benefit from acquiring knowledge and skills from the educational process. Table 4 is presenting the results from the comparison and unification process and is listing the common for both categories unified activities suitable to be applied in phase 4 and suitable for learning type Pragmatist.

Table 4: Activities suitable for phase 4 Active experimentation.

Activities prescribed to be suitable to apply in Phase 4	Activities suitable for learning type: Pragmatist.	Unified activities suitable to be applied in phase 4 and suitable for learning type Pragmatist.
projects fieldwork homework laboratory case study simulations	time to think about how to apply learning in reality case studies (and best practices) problem solving discussion goal-oriented tasks	projects step-by-step guides homework time to think about how to apply learning in reality case studies (and best practices) problem solving goal-oriented tasks gamification for knowledge testing etc.

Source: Assist. Prof. Sia Tsolova, Ph.D.

Identifying ICT tools and concrete tools examples suitable for application in each cycle phase's group of activities

Including ICT tools in education is increasingly emerging practice in most educational institutions. However, most frequently, the incorporation of ICT tools in education is implemented randomly and without following a specific model.

The goal of this chapter is to present the result from the research, matching the types of ICT tools used in application with the activities, identified as most suitable for application in each of the Kolb's experiential learning cycle phases. The following tables show the groups of activities and types of ICT tools suitable for each of the cycle's phases and some suggestions for concrete ICT tools, which can be used at every stage of the educational process, following the methodology.

Table 5 shows the activities and ICT tools suitable for Kolb's experiential cycle phase 1 Concrete experience.

Table 5: Activities and ICT tools suitable for phase 1 Concrete experience.

Unified activities suitable to be applied in phase 1 and suitable for learning type Activist.	Types of ICT tools, suitable for application in phase 1	Concrete ICT tools, suitable for phase 1 (links and names of concrete tools)
fieldwork laboratories problem sets trigger films simulations and games brainstorming problem solving puzzles competitions role-play action games Looking for and finding things	Mind maps Quizzes Competitions Games Office tools Creativity tools Drawing tools Ideation software tools Interactive tools	Draw.io Quizziz.com Kahoot.it Getkahoot.com Cotunity.com Simventure.co.uk Thesmallbusinessgame.co.uk Makesyouthink.net Etc.

Source: Assist. Prof. Sia Tsolova, Ph.D.

The reflective observation phase is connected mostly with discussion and reflection on the work that has been made in phase 1 and for this reason it is the phase with least innovative ICT tools in use, the tools in this phase are mostly focused on traditional presentation tools and technique.

Table 6: Activities and ICT tools suitable for phase 2 Reflective observation.

Unified activities suitable to be applied in phase 2 and suitable for learning type Reflector.	Types of ICT tools, suitable for application in phase 2	Concrete ICT tools, suitable for phase 2 (links and names of concrete tools)
discussion brainstorming thought questions rhetorical questions paired discussions self-analysis questionnaires paired discussions self-analysis questionnaires interviews Finding answers	Video tools Presentation tools Live view tools Virtual meetings tools Results pages tools Interactive tools	Prezzi Microsoft Office Skype Virtual rooms Whatsapp/Viber Youtube/Vimeo.com Facebook groups

Source: Assist. Prof. Sia Tsolova, Ph.D.

The third phase of Kolb's cycle is focused on presenting the theoretic principles and all types of classical and innovative ICT tools can be applied in this stage and classical lectures nowadays as well.

Table 7: Activities and ICT tools suitable for phase 3 Abstract conceptualisation.

Unified activities suitable to be applied in phase 3 and suitable for learning type Theorist.	Types of ICT tools, suitable for application in phase 3	Concrete ICT tools, suitable for phase 3 (links and names of concrete tools)
lecture papers analogies models statistics stories quotes background information	Office tools Presentation tools Scheme drawing tools Video tools Interactive tools	Prezzi Microsoft Office Youtube/Vimeo.com Quizziz.com Kahoot.it Draw.io Etc.

Source: Assist. Prof. Sia Tsolova, Ph.D.

The final phase of David Kolb's experiential learning cycle activities, suitable for learning type Pragmatist, can be supported with almost all ICT tools used in stages 1 and 3, due to the need to participate and apply in practice the study material through solving tasks and reaching goals, and later present their accomplishments.

Table 8: Activities and ICT tools suitable for phase 4 Active experimentation.

Unified activities suitable to be applied in phase 4 and suitable for learning type Pragmatist.	Types of ICT tools, suitable for application in phase 4	Concrete ICT tools, suitable for phase 4 (links and names of concrete tools)
projects step-by-step guides homework time to think about how to apply learning in reality case studies (and best practices) problem solving goal-oriented tasks	Quizzes Office tools Presentation tools Scheme drawing tools Video tools Interactive tools	Prezzi Microsoft Office Youtube/Vimeo.com Draw.io Quizziz.com Kahoot.it Getkahoot.com Cotunity.com Simventure.co.uk Thesmallbusinessgame.co.uk Makesyouthink.net Etc.

Source: Assist. Prof. Sia Tsolova, Ph.D.

The application of specific ICT tools, suitable for the needs and goals of each of the four phases of David Kolb's experiential learning cycle, which are matching the needs of the corresponding learning cycle can tremendously improve the levels of involvement of the students in class and increase the quality of education and levels of acquired knowledge and achievement of the students, which was proven by the experiment which was implemented with the presented in this paper methodology of education. The next chapter presents the overall view on the methodology, which elements were presented earlier in this paper.

4. Innovative methodology for blended learning education

This chapter of the paper presents an overall view on the innovative methodology of education in blended learning, which elements were earlier described. The methodology is focused on blended learning education, but it can be applied also in face-to-face and distance learning educational courses.

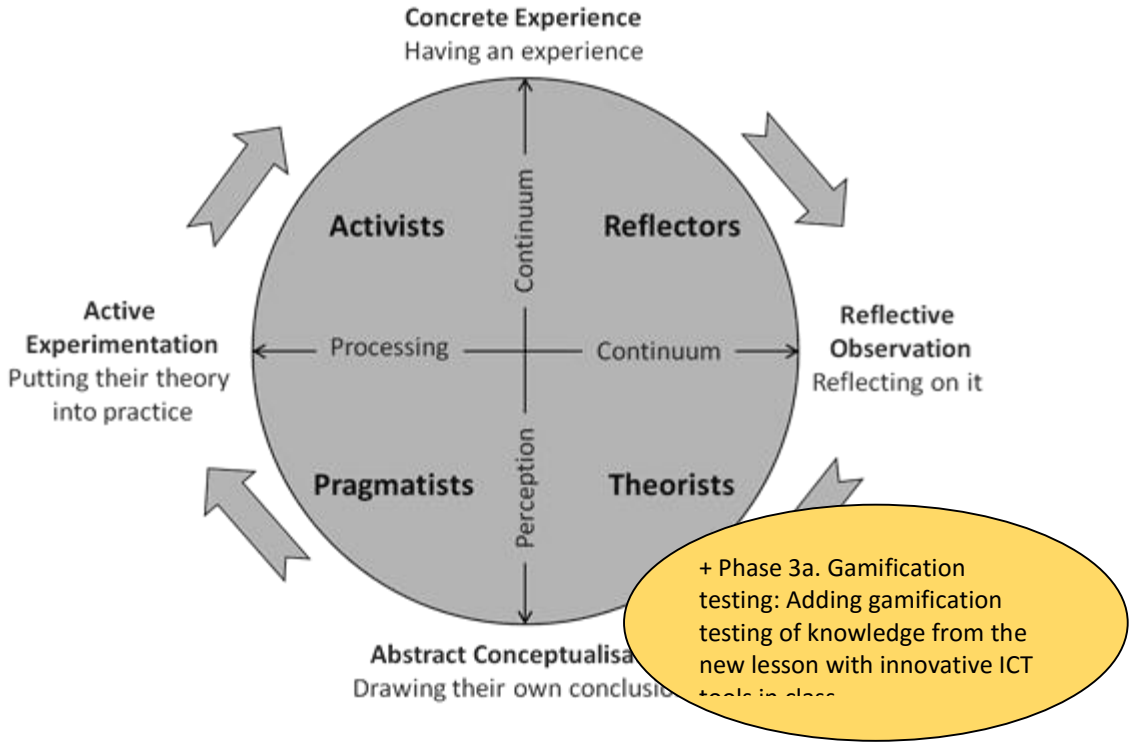
The proposed methodology includes the following steps:

1. Preparation of the course (goals, educational program, study materials, tasks, homework and projects, course assessment and evaluation). The study materials should follow the earlier described David Kolb's experiential learning cycle for each learning unit. All activities, discussions, explanations and tasks should follow the recommendations for suitability according the corresponding learning type and including the most suitable ICT tools for each phase described in the previous chapter.
2. Evaluation of the students' learning types using Honey and Mumford's full or adapted questionnaire. An online version of the testing may be implemented on address:

http://www.emtrain.eu/learning-styles/ This will allow the lecturers/teachers to notice a prevailing pattern and possibly a majority of learning types students in the class. It will also allow to pay attention to individual students' needs, based on their learning types.

3. **Implementing the course should follow David Kolb's experiential learning cycle, but with an additional subphase, following phase 3, prior to phase 4. The additional phase 3a is focused on gamification testing of the explained in phase 3 knowledge – tests to identify examples, confirming and/or using the newly acquired knowledge** (see Figure 3). Innovative ICT tools support immensely this step and our experiments showed that exactly this is the step that helps understand fully the taught educational material., the focused activities for each major learning type in the cycle and suitable ICT tools, based on the models described earlier for each learning unit.

Figure 3: David Kolb's experiential learning cycle with added phase for gamified testing of acquired knowledge between phases 3 and 4.



Source: Assist. Prof. Sia Tsolova, Ph.D.

An explanation for each phase of the proposed model for each learning unit is:

a. Phase 1. Concrete Experience – Classical phase of David Kolb's cycle.

   After starting the class an activity for reaching a goal should be introduced to the students without initial knowledge on the topic. We tested the methodology with providing 20% of the time from each learning unit for phase 1.

b. Phase 2. Reflective Observation – Classical phase of David Kolb's cycle.

   After implementing the initial activity, a reflection on all solutions proposed from the students is made. Presenting, reflecting and discussing are all part of this important stage. We tested the methodology with providing 20% of the time from each learning unit for phase 2.

c. Phase 3. Abstract Conceptualisation - Classical phase of David Kolb's cycle, with added a Gamification testing phase at the end, described in this methodology as Phase 3a.

   A classical lecture's methods with usage of visualisations and innovative ICT tools are part of this phase. We tested the methodology with providing 30% of the time from each learning unit for phase 3.

d. Phase 3a. Gamification testing – A new element which is adding gamification testing of knowledge from the new lesson with innovative ICT tools in class

   Testing students' knowledge from the new learning unit with gamification elements and quizzes with examples, individual or teamwork, is an essential part of understanding the taught material. Our experiment proved that this was the element from the educational process which supported in tremendous level their understanding of the topic. The fact that it is situated immediately after giving the theoretical information makes it a key for understanding in higher extend the new knowledge and ideas. We tested the methodology with providing 10% of the time from each learning unit for phase 3a.

e. Phase 4. Active experimentation - Classical phase of David Kolb's cycle.

   Putting theory into practice for students' own projects and providing guidelines for most effective and most efficient application of the theory into practice are the best final step in the educational process, before giving time for the students to work on their projects/homework at home. Additionally support from innovative ICT tools can have a high impact on the level of involvement and quality of students' work. We tested the methodology with providing 20% of the time from each learning unit for phase 4.

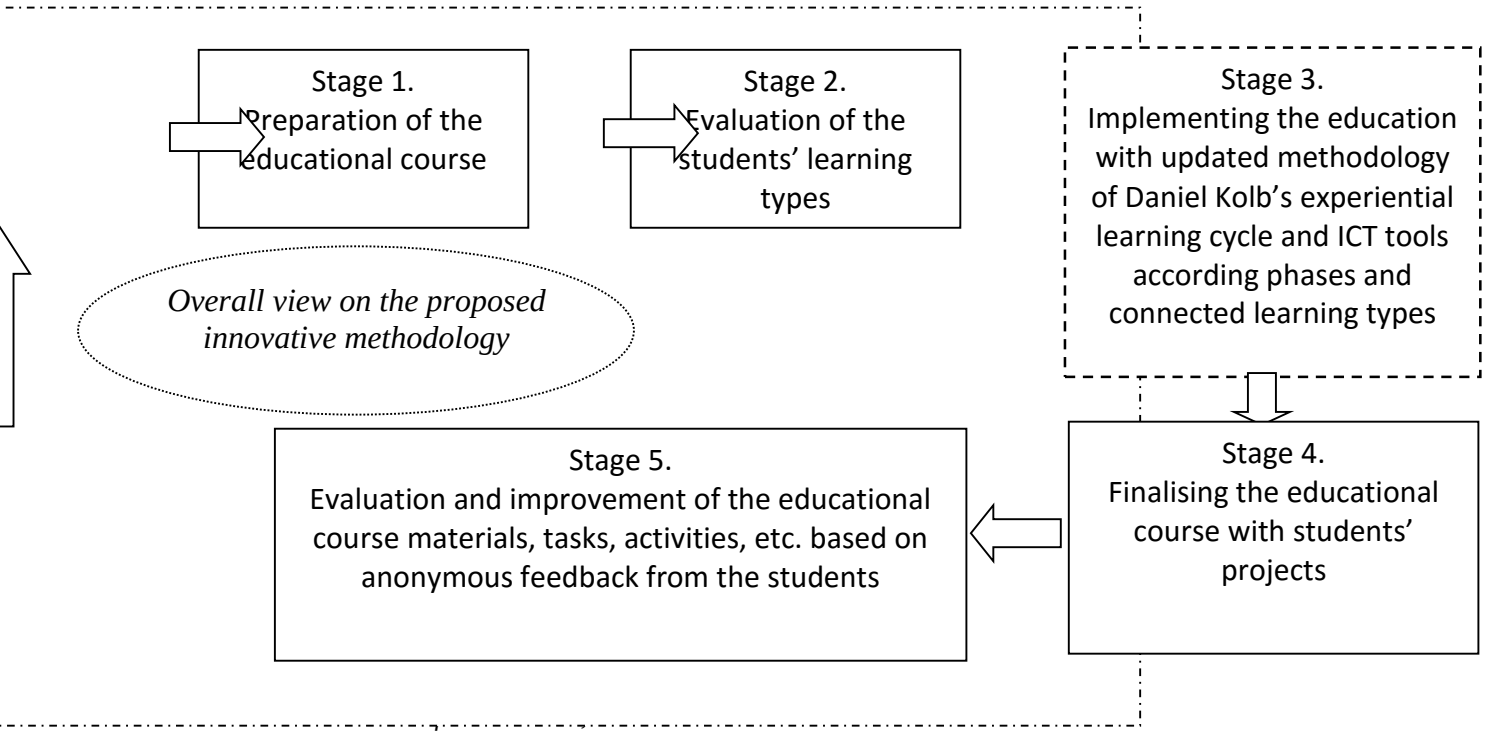
4. The course should be finalised with a general project including the need to use knowledge from the entire course chapters. The course projects could be individual or teamwork

(depending on the educational course). The projects should be presented at a final course event in front of all students and teacher/lecturer. Application of innovative ICT tools suitable for this stage should be supported and recommended by the lecturer. The ICT tools described in Table 8 for phase 4 of the experiential learning cycle are all suitable for application at this stage. The goal of this presentation is for the students to show an improved version of their project, parts of which they have already presented in front of the lecturer or course group. The goal is not to present an initial version of a project, since this is hardly ever good enough. The lecturer should consider the preparation for the final project as an ongoing goal in the entire course planning and created tasks.

5. The evaluation of the course and its used materials, tasks, etc. should be implemented at the end of the course from the students, so that on next round of the course, improvements should be made. The evaluation should be made by the students anonymously, in written form, after the course ends, before the evaluation tests are made and/or projects are presented.

A visual presentation of the developed methodology is presented at Figure 4.

Figure 4: Overall view on the innovative methodology for blended learning education with added phase for gamified testing of acquired knowledge between phases 3 and 4 of David Kolb's experiential learning cycle and links to the activities and corresponding ICT tools, identified during the work on this methodology.



The proposed model has been applied in practice during an educational course in the field of "Innovation and Innovation Management" at a master degree discipline in Faculty of Mathematics and Informatics at Sofia University "St. Kliment Ohridski" and the results from the final testing amongst students showed a higher level of involvement, higher results and preference of the students towards the used method in comparison with the traditional education in the course. A short overview on the experiment and the results is shown in the next chapter of this article.

5. Experimentation and results from application of the methodology

The proposed in this article methodology has been applied in an educational course in the field of "Innovation and Innovation Management" at a master's degree discipline in Faculty of Mathematics and Informatics at Sofia University "St. Kliment Ohridski". A part of the course was implemented following the traditional lectures' approach and later this part of the course was implemented using the proposed in this article innovative methodology with the corresponding educational materials, tasks and ICT tools. The final evaluation from the students was implemented by filling out anonymous questionnaires, where the following aspects of the educational course were evaluated with scale from 1 to 5 (5 being the best result).

Questions for the students in the anonymous questionnaire were:

1. Did you acquire new knowledge and skills?

2. Did the used teaching methods supported your learning?

3. Did the games, tasks and projects in the course supported your learning?

4. How much efforts did you put in the study?

The following Table 9 shows the results from evaluating the first part of the course, where a traditional approach was used in the education is shown and the second part of the course, where the proposed innovative methodology, materials, approach and ICT tools were used. The results show the self-evaluation of 32 participant students in the educational course in the field of "Innovation and Innovation Management".

Table 9: Results from students' self-evaluation on educational course without and with innovative methodology applied (scale is from 1 to 5, 5 is the best score, 1 is the worst)

Results	New skills and knowledge	Used teaching methods	Games, tasks and projects	Study efforts
Using traditional approach	4.09	4.00	4.09	4.00
Using proposed innovative methodology	4.66	4.48	4.21	3.98

Source: Assist. Prof. Sia Tsolova, Ph.D.

The provided evaluation of the application of the innovative methodology clearly shows the students' preference toward education in the described in this paper methodology.

6. Conclusion

The presented in this paper methodology is based on David Kolb's experiential learning cycle, combining the learning types methodology for each phase of the cycle with added subphase for gamification testing of the newly acquired knowledge in phase 3 and adding list of activities, most suitable for each of the stages with their corresponding learning types needs. Also additionally lists of the most suitable ICT tools for application in each of the cycles phases, according the learning types and suitable activities, were defined and examples of such ICT tools were included. The methodology was evaluated through an educational university course developed according the proposed methodology and results from the evaluation from students, participating in the course, were included. The proposed methodology can become a basis for further development of educational methodologies for all types of traditional education and e-learning.

Acknowledgements

This work was supported by the Bulgarian Ministry of Education and Science under the National Research Programme "Young scientists and postdoctoral students" approved by DCM # 577/17.08.2018**.**

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