Creativity and play in modern teaching of structural design

Ján Ilkovič & Ľubica Ilkovičová

Slovak University of Technology in Bratislava
Bratislava, Slovakia

ABSTRACT: This article deals with the methodology of modern teaching, using suitable ways to educate architecture students, stressing activity, creative thinking and the motivation of students. Looking for a new innovative formula in an age full of computer technologies is not easy. The aim of this article is to identify and define problems, the use of alternative methods with the possibility of overlaying knowledge. In education, fulfilling the *pyramids of knowledge* in is essential; civil engineering (structures) subjects are among the more demanding ones. In the pedagogical process, looking for methods and procedures, which enable an interactive transmission to the subjects in the structure of teaching at the faculty is inevitable. The conclusion provides a methodological line: defining the problem (definiteness from the teachers' side); identifying alternative solutions (creativity and innovations from the side of a student); and finding solutions as a result of cooperation between a student and a teacher (motivation through real application).

INTRODUCTION

Architecture and building structures are two tightly connected phenomena, which have gone through history and development hand-in-hand. The assumption presented here also evokes a high level of comparison in the educational process and methods of education. The essence of the methodology of modern education is orientation towards the development of thinking, activity, creativity and for reaching the goal by using suitable methods in education. Finding the right motivation for students is always the first requirement when implementing new elements and stimulating creativity; and that is why it cannot be left out of the pedagogical process. The methods implemented in teaching traditional problems (subjects) are effective only up to a certain level, then, there is stagnation and the process becomes obscure. *New recipes* are desired, but their discovery is not easy. A suitable way is to build a methodology of education based on teaching problem-solving. The essence is to define problems and, then, to look for alternative methods in the context of a *knowledge pyramid* [1]. It is a challenge mainly because of the difficult content of education from the area of structure and building structure in the Faculty of Architecture at Slovak University of Technology in Bratislava. Students share this opinion; that is why the aim is to enrich education and look for methodological steps based on a *play*, which will enable more natural gaining of knowledge and experience from the structure of civil engineering, overlaying of knowledge and their application in further education [2].

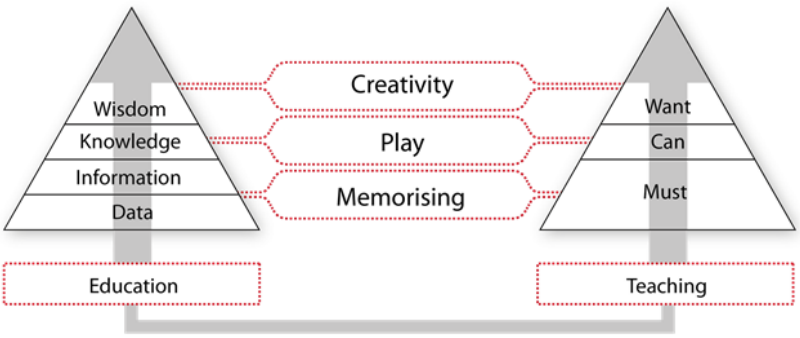

Figure 1: Knowledge pyramid in the creativity context.

DISCUSSION - CREATIVITY, PLAY AND EDUCATION

The beauty of the pedagogical sciences is reflected in their high level position. If the minds of students are filled by wisdom, the status of their minds leads to general harmony of virtues [3]. The development of creative thinking undoubtedly belongs to the harmonic development of a personality. Creativity can be understood as a specific activity

leading to creative, new, progressive and communicable products, which help to form a personality of a person in a long-term way [3]. That is why it is beneficial when one applies creativity as a major means of education and also *play/game* connected with it (with architecture) in the process of design. *I like to play with architecture! It is my favourite game*, this is a statement by prestigious architect Jean Nouvel; it supports the importance of a play in architectonic creation. Play should remove barriers to a concept in a relaxed way or to use limits, so that they are applied in favour of an architectural design to give a new meaning. If an architect transforms the limits for the opportunities of a construction (combination of a shape, range and material) she/he creates opportunities for a solution [4]. The word *play* has many variations in architectonic creation. One plays with lights, one plays with levels, one plays with windows, one plays with space, one plays with staircases, one plays with everything (architectural office: *play in architecture*). This is also a signal for the need to connect play and education, play and creative education of construction in architecture.

This article introduces a methodology for education in the structural disciplines in a non-traditional way through creative and experimental *play*. One identifies him/herself with the characteristics of creation as a production of new valuable suggestions of solutions [5][6]. The term play includes an immense range of activities, which one specifies to construction play. A small child models a sand castle, creates a composition of houses from colourful cubes or builds a Leggo country, from which she/he gets the first practical *experience* in the area of statics, tectonics and composition. Although the uncertainty of the result is present, *construction* goes on. According to specialists, play has an irreplaceable place in development of an individual. It is subjectively expressed by positive emotions; it is voluntary and that is why in play inspiration for students' natural motivation can be found [7][8].

Teachers are aware of the Latin expression *schola ludus*, by Jan Amos Komenský, the teacher of nations. Komenský used the term *school by play* in connection with the example of plays, situational and theatrical performances, which he recommends to be applied in schools [9]. There is a solution in looking for an optimal methodology in education relating to subjects chosen from the building structure area, in looking for interactive *games* for designing and modelling architectonic structures. In modern pedagogy, play as an educational method was presented in 1975 in general didactics by L. Mojžišek [10].

Play offers education of relatively more difficult problems in an unobtrusive way, and moreover, it supports creativity and brainstorming [11]. It is an invaluable matter in the education of architects. Play is transformed into an experiment at a higher level. An experiment has a specific role in architecture in comparison with natural sciences. The result of an experiment is not is countable nor exactly measurable, but its social impact and responsibility depends on the visualisation of architecture.

LAYERING OF KNOWLEDGE AND CREATIVITY IN THE AREA OF BUILDING STRUCTURE

In general, the aim of education is to gain knowledge in order to obtain knowledge, skills and habits. What transforms the *layering* of knowledge and follows the setting of vision and aims of education in the area of structural disciplines? To clarify it, the *knowledge pyramid model*, which interprets by visual demonstration how the results of educational activity are accumulated, can be used. What relationship is there between data, knowledge, understanding and wisdom? Every term appearing higher up the pyramid includes the basics from the groups beneath. Each piece of knowledge obtained consists of at least one piece of information and each piece of information contains at least one piece of data. The pyramid of knowledge offers the following:

- Data - nothing without connection;
- Information - an answer to the question *what?* (what problem has to be solved - assignment of the task);
- Knowledge - an answer to the question *how?* (methods, options - alternatives, solutions);
- Wisdom - an answer to the question *why?* (argumentation and reasoning of the solution - meaning).

For building structure subjects, the individual levels can be completed as follows:

Data refers to all numbers, facts, symbols, sings and similar. It is a basic description of a structure, its general size characteristics.

Information is data with a meaning. When typological characteristics are added to data about the structure, one gets information. Information makes data useful - based on this characteristic, one can use the structure.

Knowledge is information achieved theoretically or practically (by testing). If one has at his/her disposal information from which one can make a decision, information became knowledge. When two students work with the same information, the result of their work will not necessarily be the same. Once the structure has been suggested, there will be modification, play with shape and dimensions.

Wisdom is at the top of the pyramid. Wisdom is the ability to use knowledge effectively for personal development and benefit. By using, training, creative formation and experimenting, the personality of a student increases, and this is what a good pedagogue wants to achieve.

The pyramid of knowledge in a vertical cut of the subjects taught logically. This means that in lower classes, orientation is mainly on the data and basic information. Only in the later years of a Bachelor's degree and in the Master's degree does play and creativity start, so that students get knowledge they could apply. The quality of education at the highest level of the pyramid is that of permanent vision. The level of exactness, direct (and known) regularities in building structures give space to creativity and experiment. Determination (willingness to play) to experiment has to be present in the first place. *Will* is more important that *can*, this is the essential fact mainly in work with limits and restrictions. In Figure 1, determination can be understood as a passion in combination with persistence, due to which, it may support one's vision and experiments over a long period of time.

Creative play in architecture and building structure in the area of education, except when applying the pyramid of knowledge, has to have its own methodology. It is suitable when the methodological steps are partially parallel with real creativity (structure and architecture) and so they follow the real process and also the product of creativity (e.g. in case studies).

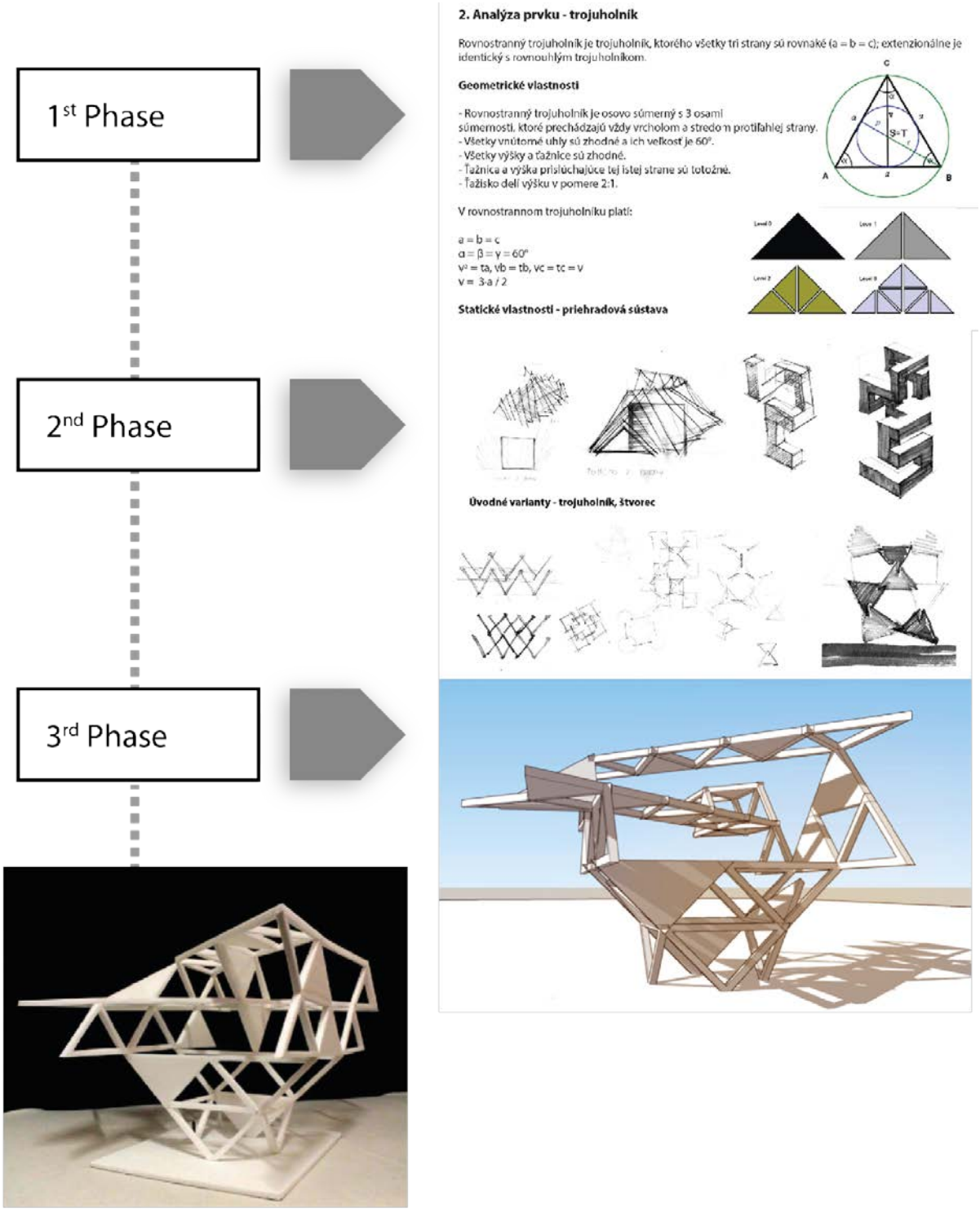

Figure 2: Methodology of model verification in creative play with structure (course unit title: Tectonics in Architecture).

INTERPRETATION OF STRUCTURAL PLAY

Envisioning *play* in modelling the structures has developed over time with all the above mentioned attributes and aims of education. At the start, there was a thought, personal experience and trends, then, it was followed by defining the task and its meaning, aims and methodology. Three groups of students worked out three functionally independent construction structures using a set of geometrical objects (shape limits) in a form of model shaping of the structure. The following were used: an air ring, a triangle (bar scheme), a triangle (area). Then, followed an analysis of basic knowledge (static-structural principles) of geometric shapes and options for their modification.

The methodology in the Tectonics in Architecture course, is shown in Figure 2, and it was applied in three phases resulting from the levels of the pyramid of knowledge:

1st Phase - defining of a problem - aim and meaning (a pedagogue):

- criteria of an optimal solution - limits;
- a creative problem - studying of a problem;
- choosing possible methods and procedures.

2nd Phase - solution (a student):

- interdisciplinary communication;
- alternative solutions - creative play.

3rd Phase - choosing of a solution (a student and a pedagogue):

- singularity, originality, experiment;
- feedback - evaluation.

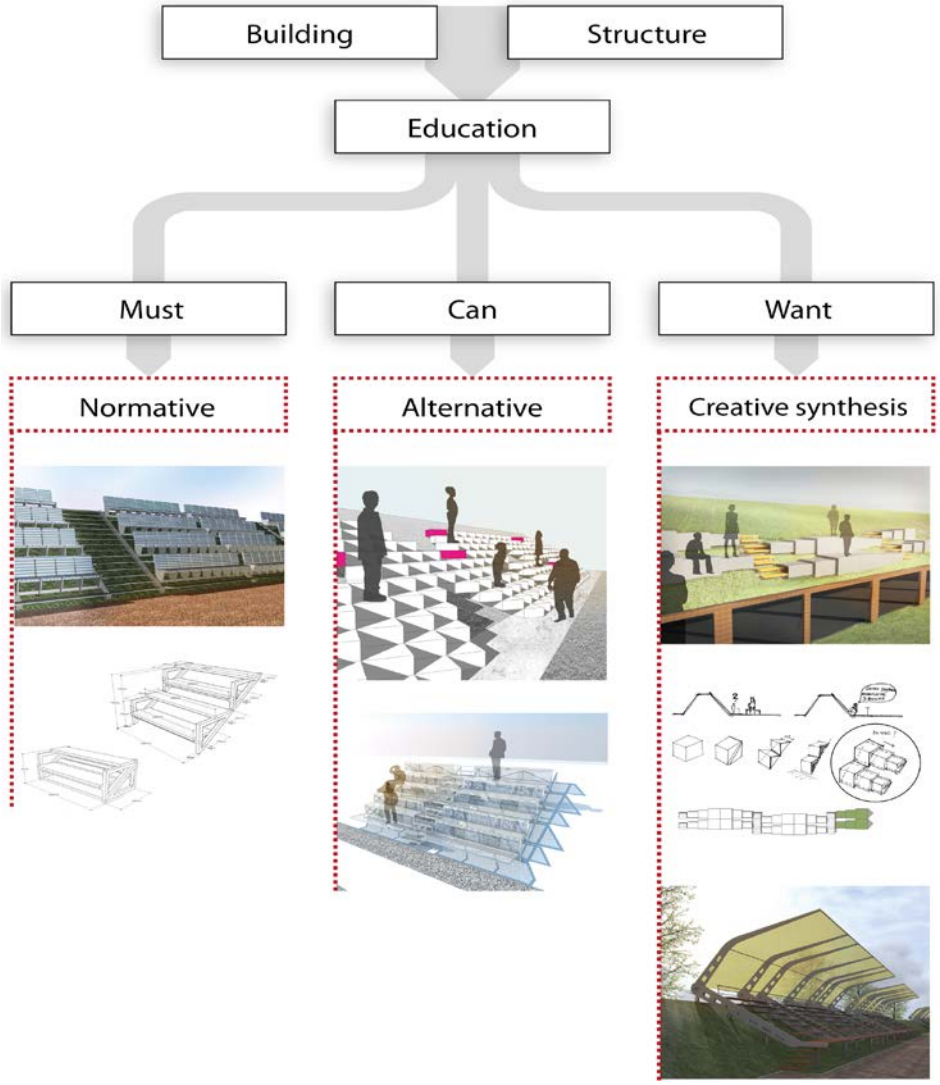

Figure 3: Gradation in the design process (case study - design of a small tribune).

An interesting relationship between the levels of the knowledge pyramid and gradation in the process of creative suggesting was shown, where a personality of a student dominates, if she/he is motivated by a pedagogue in the right way. At the same time, another parallel appears, which is graded the same way where *can* is gradually transformed into *will*. In this phase, a pedagogue dominates but a student also goes through an improvement phase.

CONCLUSIONS

A methodologically chosen procedure from the known to unknown, from simple to more difficult, from general to particular, from play to creativity and experiment was proved at two levels - in a model and in a practical application. This methodology is also open to input and creative discussion with related science subjects, mainly from the area of statics and mathematics. The magic of a creative play without the influence of limits set by a user, and reversely a creation limited by practical usage was compared. The first suggestions had the same invention level, but to some extent, the final responsibility in reality caused a lower level of creativity. The gradation of creative play is presented in the course outcomes, as shown in the Figure 3.

The results presented confirmed that it is worthwhile to invest energy and time into these attempts in terms of education. Motivated students, thanks to their own active creative attitude and their acceptance of the way of creative play, acquired a sense of meaning from their work. They engage in a search for solutions, learning not only the facts of the situation and the solutions, but also the process [12]. During the elaborating of the task they were inventive and creative about what was reflected upon, and searching for a suitable material for creating the structure. Outputs were better than expected. The feeling from good work and the valuable result were more than required or anticipated, and the initial uncertainty about the result is a symptomatic phenomenon at invention.

For pedagogues, surprising is the statement, which is a proof that Komenský was really a great teacher of nations *…Let's look for a way for teachers to teach less and for students to understand more* [13]. It is hard to believe that this thought is almost 400 years old. Nowadays, with the large numbers of students and the need to be effective and to rationalise teaching, it is still appropriate and applicable. However, to teach less does not mean for a teacher to have more time to relax. *Vice versa*, it is inevitable to look for and transform modern methods for one's own conditions, which support and develop creativity in different ways, the methods, which are the most suitable way for training and education of architects.

ACKNOWLEDGMENTS

The authors would like to express their gratitude to students of 6th year of study in FA-SUT, Pavlína Brichtová, Zuzana Farkašová, Michal Detko, Martin Mesaroš and Jakub Popelka, whose design and models are shown in Figures 2 and 3.

This article was prepared under the grant project KEGA, Grant No. 039STU-4/2014.

REFERENCES

1. Frické, M., The knowledge pyramid: a critique of the DIKW hierarchy. *J. of Infor. Science*, 35, **2**, 131-142 (2009).
2. Vitková, Ľ., *Urban Design Studio in the First Degree Level*. In: Spiridonis, C. (Ed), Monitoring Urban Design Education in Eurpean Schools of Architecture, Thessaloniki: Art of Text S.A., 103-108 (2004).
3. Drlíková, E., Ďurič, L. and Grác, J., *Učiteľská Psychológia*. Bratislava: SPN, 374 (1992) (in Slovak).
4. Lehman, M.L., The Game - Like Mindset of Architectural Design (2011), 15 May 2015, http://sensingarchitecture.com/6636/
5. Zelina, M. and Zelinová, M., *Rozvoj Tvorivosti Detí a Mládeže*. Bratislava: SPN, 136 (1990) (in Slovak).
6. Orbanová, D., Prístup Učiteľov k Aktivizujúcim Vyučovacím Metódam (Teacher´s Approach to Qctivating Teaching Methods) (2012), 10 March 2015, www.1atestacna.files.wordpress.com/
7. Horváthová, J. and Haverlíková, V., Hra Ako Vyučovacia Metóda - Predstavy Učiteľov Fyziky (Game as a Teaching Method - Physics Teachers' Notions) (2010), 10 March 2015, www.scholaludus.sk/new/
8. Caillois, R. and Barash, M., *Man, Play and Games*. Chicago: University of Illinois Press, 9-10 (2001).
9. Komenský, J.A., *Veľká Didaktika.* Bratislava: Slovenské Pedagogické Nakladateľstvo, 278 (1991) (in Slovak).
10. Mojžíšek, L., *Vyučovací Metody*. Praha: SPN, 321 (1975) (in Slovak).
11. Ilkovič, J., Ilkovičová, Ľ. and Špaček, R., To think in architecture, to feel in structure: teaching Structural Design in the Faculty of Architecture. *Global J. of Enging., Educ.*,16, **2**, 59-65 (2014).
12. Olszewski, A., Kouremenos, D. and Pudlowski, Z.J., Educating urban designers through design studios. *Proc. 2nd Global Cong. on Engng., Educ.*, Wismar, Germany, 43-48 (2000).
13. Koníčková, J., Ako sa učiť? Najznámejšie techniky učenia (2014), 20 February 2015, www.eduworld.sk/