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Application of the Experiential Learning Theory in Engineering Education

Ramona CLINCIU
Transilvania University of Brasov, Romania, r.clinciu@unitbv.ro

Abstract
The paper presents some aspects on applying the experiential learning theory in engineering education, focusing on the issues related to teaching graphical subjects. The experiential learning theory describes the process of learning from experience and presents learning as being cyclical, with four stages - experience, reflection, abstract conceptualization and experimentation, each stage being related to a certain learning style. As an important fact, the paper presents the organization of laboratory applications for graphical subjects as descriptive geometry and technical drawing, the case study considered in the paper being related to projecting prismatic parts. The paper outlines features that may help students increase their creation capacity and may help them to develop appropriate learning styles and also, would help to improve students learning, by gaining experience continuously and transforming it into knowledge.

Keywords
engineering education, experiential learning, cycle of learning

1. Introduction

Experiential learning theory represents one of the main contemporary learning theories [1, 2]. It is an important concept which describes the process of learning from experience. This concept was introduced by David Kolb, in 1984, and since then, it influenced teachers and trainers working in different areas. It is indicated as being suitable for cases in which students are elder than 16 years [1-4]. The main idea of the concept of the experiential learning process is that, at any point in the stage of the education of a certain person, the knowledge is achieved by learning from experience [3, 4].

The theory of experiential learning presents the process of learning as a cyclical one, with four stages – experience, reflection, abstract conceptualization and experimentation, which is the last stage in the current cycle of learning, but also it represents the input in the next cycle of learning. Figure 1 presents the four stages of the process of learning, as well as the four distinct learning styles, as described by Kolb [3, 4].

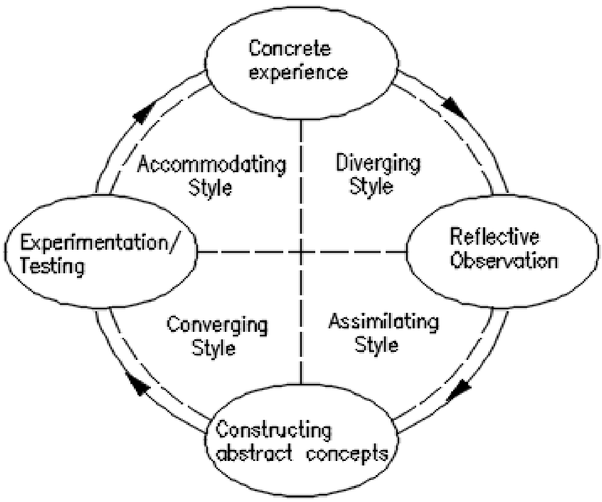


Fig. 1. The cycle of learning and the four learning styles, according to Kolb [3, 4]

The applications offered in this paper are meant to clarify aspects on applying the experiential learning theory in engineering education, focusing on the issues related to teaching a graphical subject –technical drawing.

The original contribution of the author is represented by the organization of the laboratory applications, according to the principles of the experiential learning theory, for a subject technical drawing. The case study presented refers to projecting prismatic parts. The software used for designing the parts presented in the paper is the AutoCAD programme.

2. Applying Experiential Learning Theory in Engineering Education

Graphical subjects are very important in engineering education, they are considered as being fundamental subjects for the students attending the classes of an engineering program. They create the conditions for developing the spatial abilities of the students and their professional competencies related to operating with fundamental concepts from the field of engineering sciences, as well as to designing constructive solutions and designing manufacturing technologies [5, 6].

A very important course in engineering education is represented by technical drawing. As to this subject, it is very important to design properly each laboratory, such as to develop the ability to view in space and to create conditions for the students to understand the principles of representation of the parts and at the same time, to design various challenging exercises for the students, such as to create conditions for them to reflect about the abstract concepts assimilated and to enable their imagination, their creation capacity. Such a laboratory will be presented as follows, it is constructed according to the experiential learning theory, respecting the four stages of the cycle of learning – gaining experience, reflection, abstract conceptualization and experimentation.

One of the first labs of technical drawing is involved with project arrangement. As to the projections arrangement, students are taught that the part to be represented is to be placed, imaginary, inside a projection cube and that one obtains an orthographic projection of that part on every inside face of that cube, according to a projecting direction, perpendicular to the respective face. Also, students are taught that the projections obtained need to be arranged according to the projecting method used [7, 8].

The lab starts with an example in which students are invited to construct the six orthographic projections for a certain part (Figure 2).

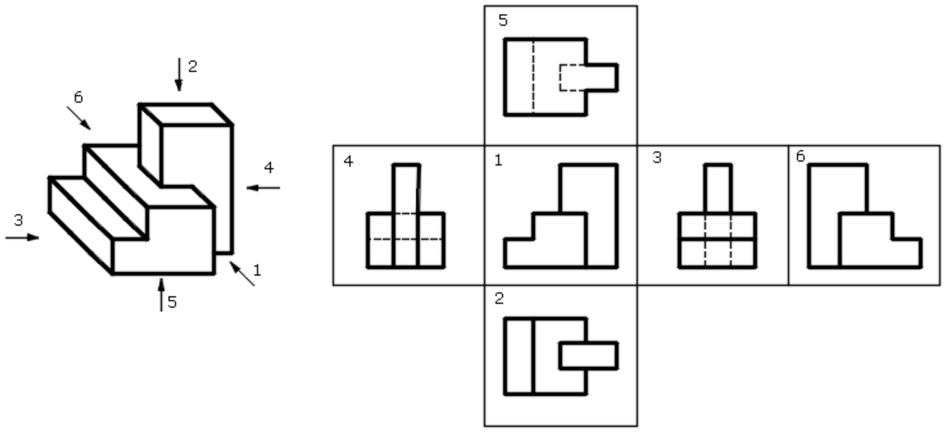


Fig. 2. Stage of concrete experience - six orthographic projections of the given part

This represents the stage of concrete experience, in which students construct six orthographic projections of the given part. It follows then, the stage of reflective observation, when students observe the symmetry between definite views and they realise that three projections may be eliminated, being symmetrical to those three projections left – main (front) view, top view and left-hand view (Figure 3). It is the moment in which students pass to the stage of abstract conceptualization, in which they think and conceptualize the theory which indicates that a part is to be represented in minimum number of orthographic projections required for describing completely the shape a dimensions of the part. By reflecting on this idea, students realize that the part can be represented in only two projections. The main view is the one which does not raise any question about its importance in the drawing. It remains to be also considered either the top view (Figure 4, a) or the left-hand view (Figure 4, b).

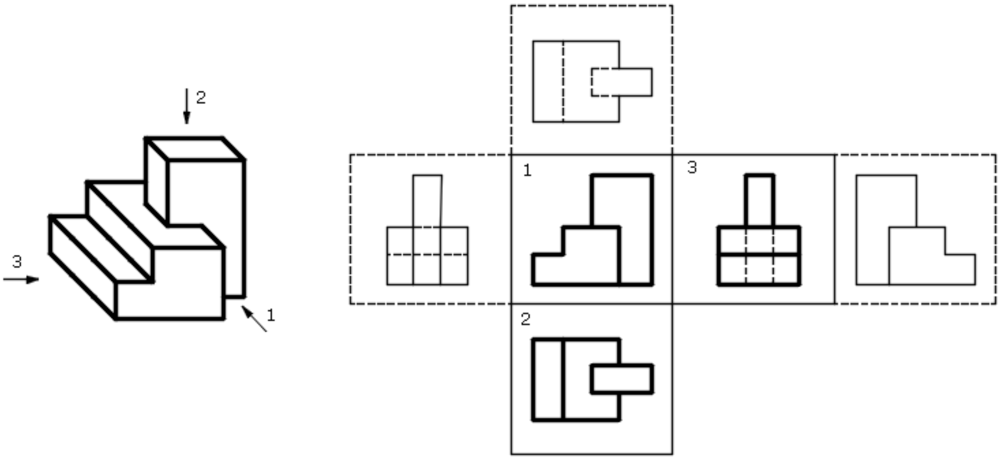
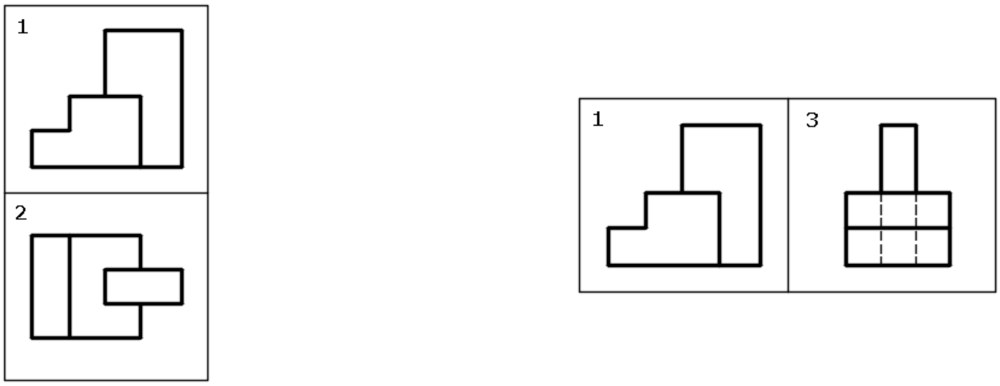


Fig. 3. Stage of reflective observation - three projections left, main view, top view, left-hand view



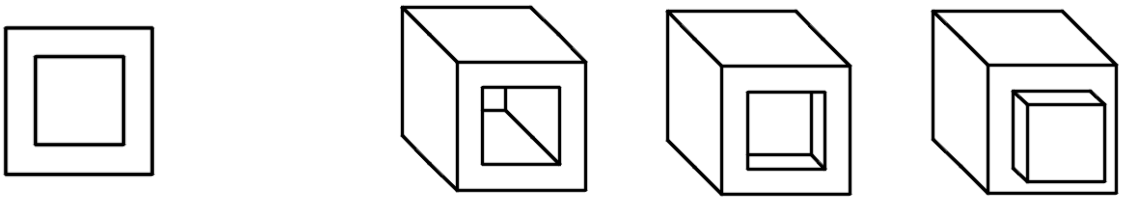
a b

Fig. 4. Stage of abstract conceptualization

(a) the part is drawn in two projections, main (front) view and top view;

(b) the part is drawn in two projections, main (front) view and left-hand view

As to active experimentation stage, at first, students are given a certain projection (Figure 5, a) as being the front view of a part and they need to imagine different parts having as the main view the given view. The first reaction of the students is to imagine parts with right faces (Figure 5, b), but then they tend to consider inclined faces, too (Figure 6).



a b

Fig. 5. Stage of active experimentation

What they realize by doing this exercise is that one needs a second orthographic projection, besides the main view, for each part considered (Figure 7). To complete the challenge of this active experimentation stage, students are then invited to imagine different shapes as being the front view of a class of parts and to construct the 3D shapes of parts included in the respective class of parts. Students can also exchange orthographic projections with their colleagues, inviting them to design the 3D models of the respective parts. Table 1 presents the ratings obtained by the students of two groups in the active experimentation stage, results which prove a good understanding of the problem.

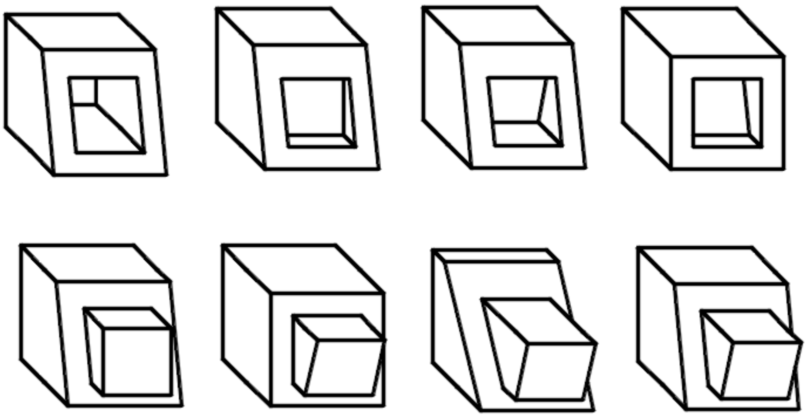


Fig. 6. Stage of active experimentation - different parts, with inclined faces - same main view

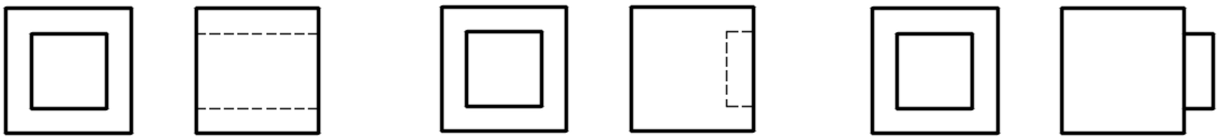


Fig. 7. Complete drawings for the parts presented in Figure 5, b – two projections: main view and left-hand view

Table 1. Results obtained by the students in the active experimentation stage

No. of students	Ratings			
	Not satisfactory	Satisfactory	Good	Very good
52	0	4	29	19

Each stage of the learning cycle is related to a certain learning style. Students tend to prefer a certain learning style, such as the teacher must help them to become more flexible to different learning situations [3, 4]. All learning styles are important in engineering education; each one seems to be adequate to a certain subject. As to engineering specializations, an important aspect to take into account is the capacity to solve problems and to find solution to practical issues. This is achieved by helping students to develop a converging learning style, which can develop abilities for performing experiments, simulations and practical applications and for solving practical problems. Also, the assimilating learning style help students understand and organize a wide range of information and to elaborate logical approaches. The diverging learning style can be useful for looking at things from different perspectives, for using imagination to solve different problems. The accommodating learning style is described by the capacity to perform different tasks, new challenges and experiences [3].

3. Conclusions

The experiential learning theory emphasises the importance of laboratory applications in constructing the knowledge of the students. Since the theory of the experiential learning states that effective learning is produced only in the case in which students pass through each stage of the cycle of learning - experience, reflection, abstract conceptualization and experimentation, it is very important to design each activity according to this concept. It is a challenge for the teacher to design each activity – course, seminar, laboratory, project, to present each subject, as simple as it could be considered to be, in such a manner as to fulfill the tasks and expectations related to each stage of the learning cycle. It is also very important to find different ways to design challenging activities, in order to increase the creation capacity and the level of self-knowledge and experience towards the respective activity.

By designing activities which will help students pass through each stage of the cycle of learning, one will create the circumstances in which students understand the tasks of each activity, learn and at the same time gain experience continuously, experience which will be transformed in knowledge.

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