Construction of interactive Card Game as appliance for the learning in discipline Transport's Systems in Civil Engineering course of Universidade Federal do Paraná

Prof.ª Dr.ª Márcia de Andrade Pereira Bernardinis
Universidade Federal do Paraná
marcia_pereira@ufpr.br

Matheus Silva Freitas
Universidade Federal do Paraná
matheusfreitas@ufpr.br

Rodolfo Augusto da Costa
Universidade Federal do Paraná
roaucosta@gmail.com

Waldney Bruno Lima de Araújo
Universidade Federal do Paraná
waldneybruno@yahoo.com.br

Abstract

The objective of this research is to present and discuss the results with the inclusion of an educational alternative – Construction of Card Games – in order to enhance students learning in the discipline of Systems Transports in the Civil Engineering course of UFPR, when compared with classes that did not perform the activity. Through this discipline sought to assess if the students would be able, with the proposed approach, of absorb new knowledge and more interesting, without compromising the traditional programmatic content. For this, the decks were made in class times. The results, by the final ratings of discipline, when compared with three other classes in the same discipline, taught by other professors who did not develop the activities, show that this tool contributed in some way to the improvement of the traditional methodology, seen that among the groups showed the highest average compared to others, with positives results for learning.

1. Introduction

The use of new communication and information technologies and pedagogical strategies that value the professional formation has revolutionized various educational segments. The formation of engineers, for example, must be increasingly debated and studied at national level, since there is still little action of organizations concerned with education in engineering.

According to Pereira and da Silva (2009), transport engineer ends up encountering today with the difficult task of not only apply the acquired theoretical knowledge in engineering school, but also to gain knowledge of new techniques, skills and expertise to meet the requirements labor market. Faced with this context, the institutions responsible for engineering education cannot ignore this market trend and need to ensure the the extensive training that the future engineer needs. So, this new form of activity that gets to be required by both the labor market and society, begins to influence the functional engineer potentialities and therefore to be considered in the educational model.

Based on experiences in Canada and Netherlands, several schools in Brazil have seeking to adopt the PBL (Problem Based Learning) in their curricula. That information has had important repercussions, which according Berbel (1998), can be both positive, by the new ways of teaching and learning, and negative, by the natural resistance to change.

Having as the motivation this need for change in the educational model of engineering courses, this study discusses the inclusion an educational alternative for improvement and adaptation of the teaching-learning process, through a case study using PBL conducted in a civil engineering course in discipline Transport Systems.

2. Objectives

Introduce and discuss the results obtained with the inclusion of an educational alternative – Construction of Playing Cards - in order to improve student learning in the discipline of Transport Systems of UFPR Civil Engineering Course, compared to groups that did not perform the activity.

3. Theoretical Foundations

3.1. Process of Teaching-Learning

Nowadays, more and more information invades the routine of people. The events occur and alter very quickly and, in many cases, imperceptibly. Moreover, according Colenci (2000), the concern and actions toward improving the quality of engineering education have been growing significantly, which has occasioned numerous experts to seek new strategies for the educational process.

One aspect that leads to the search for a new model for teaching and learning is the remarkable disparity between teaching and practicing the present stage of technological development characterized by real market demand for qualified professionals. The challenge in terms of quality of engineering education is based on seeking a new model that incorporates the technological and social changes and offer alternatives that enhance the teaching-learning process.

Given this, some educational institutions in different countries are modifying teaching methods in their degree programs in Civil Engineering as incorporating new techniques into their educational systems. This applies, for example, Purdue University (Eidson and Bullock, 2001) and the University of Iowa (Nixon, 2000), who have been using online videos, web pages and other forms of media as tools for research in MacMaster and Masstricht (Berbel, 1998), adopt the Problem-Based Learning in their curricula, among many other authors. The main difficulties of learning, are directly related to the teacher-student relationship. In the teaching-learning process interest, both the teacher and the student, should be common.

Until relatively recent past it was possible that they were graduated engineers to work in a little competitive market with technologies that remained in use for a long time. Today, with a globalized labor market, it has become extremely competitive. In parallel, the technologies have been shown with ever shorter life due to advance ever faster computerization (Linsingen et al., 1999 and Lima, 2002). Thus form an engineer with a suitable profile to the times means first of all, give you conditions to realize the changes and be organized quickly a new approach to the teaching-learning process.

Many authors study a new paradigm that prepare future professionals for contemporary professional practice: Gaspareto et al. (1990), Soriano et al. (1992), Leon (1995), Dantas (1993), Ruiz (1994), and Schiefler Beltran (1995), Pereira and Bazzo (1997), Naegeli et al. (1997), Martin Son (1997), Kuri (1998), Ribas et al. (1998), Ribeiro (2000), Lima (2002) and Pereira et al. (2003, 2004 and 2005), cited in Pereira (2005).

A study by Ribeiro (2000) points to the main differences between the new and traditional paradigms of higher education, summarized in Table 1.

Table 1: Relationship of traditional and new approaches to teaching and learning process.

Source: Pereira (2005), adapted from Ribeiro (2000).

PARADIGMS OF HIGHER EDUCATION	
Traditional Approach	**New Approach**
University isolated knowledge center in society	University working in partnership with society
University seen as a city	University seen as an idea
University focused in itself	University focusing on market and society as a whole
Courses of 4-5 years	Continuing education
Teaching in the institution classrooms	Teaching anywhere
Reproduced knowledge	Built knowledge
Learning based on memorization, repetition	Learning based on problem solving (learning to learn)
Fixed academic calendar	Operating year-round. Flexible schedule
Technology as an expense. Little use of technological resources	Technology as a differentiator. Indispensable use to support the teaching-learning process

According Colenci (2000), teachers, in general, follow the scheme chalk and blackboard and students take notes and study for exams. It's the traditional model of existing education to form labor and not a multifunctional professional able to think and act with flexibility and initiative. The student, upon receiving the knowledge ready, does not bother to look for new solutions to existing problems, or even identify new problems and when he entered the labor market, will deal justly with new situations. As for the teachers, even by lack of educational materials in their training, do not use teaching methods that develop in student's new ways of acting and thinking, despite abundant material available. Usually they give lessons on how learned in his student days.

Thus, it can be concluded that the teaching method focused on the teacher, where this brings the ready content and the student merely passively to listen to him, is still widely used in engineering education, but the only application of this model makes the ineffective teaching-learning process. The question is not to label the technique as traditional and reject it as a teaching method. It happens that teachers with traditional attitudes may become an authoritarian class, dull and uninteresting, either expository or not. It is the exception that you are not disqualifying the lecture; only suggests that it is not overused. Thus, the object of study of this research is the PBL - Problem Based Learning.

3.2. Problem Based Learning – PBL and the Educational Games

PBL, according Sakai and Lima (1996) is the main axis of the curriculum theoretical learning some institutions, whose educational philosophy is student-centered learning. It is based on the study of the problems proposed in order to make the learner to study certain content. The authors emphasize that this methodology is training as encourages an active attitude of the student in search of knowledge and not merely informative as is the case with traditional pedagogical practice.

According to Oliveira (2014), identifies which teachers and learners recognize the advantages and even changing requirements as to the form of education through the adoption of more active approaches such as PBL.

There are several possible forms of evaluation into the curriculum based on problems. Define, for example, content parts to be addressed in an integrated way, are defined modes of action to teach, to learn, to manage, etc. The Problem-Based Learning, according Berbel (1998), has a sequence of problems to be studied. At the end of one starts the study of the other. The knowledge gained in each subject is evaluated at the end of each module, based on objective and scientific knowledge.

Sardo and Dal Sasso (2008), for example, used educational games in the Problem-Based Learning which proved to be extremely positive, and this will be the focus of this research.

The game is not only a free activity, but also presents rules and requires the participant's reasoning to solve the problems presented. According to Melo and Lima (2013), the literature shows several educational games in engineering and exact sciences, as studied by Balceiro et al. (2003), and Romanel Freitas (2009; 2011) and Vasconcelos et al. (2012), including Melo and Lima (2013).

Thus, this work proposes the use of educational games, but specifically, the production of TRUNFO® game playing cards as a learning tool, giving students involvement in the design, development and implementation, as well as in their use and acquisition of knowledge, in that you can awaken interest in learning. The topics covered in the cards are the contents of the Transport Systems course offered in the second year of the Civil Engineering course at the Federal University of Parana.

4. Methodology

4.1. Definition of the card decks

The types and the quantity of cards of each deck than would be made was defined in meetings between PET group and discipline's teacher and the cards were based in the subject of the class.

The number of cards of each deck was defined lately, according to the number of lessons available for the making of the cards. So, the following values were defined:

Schedule #2: Number of cards.
Source: Author.

	Highway	Railway	Waterway	Ductway	Airway	Total
Vehicle	3	3	2	-	2	10
Way	3	2	2	2	-	9

These values are referents to the number of card made for each group of students. This way, each deck would have six times those numbers, having in the end 60 cards in the vehicle deck and 54 cards in the way deck.

4.2. Criteria's definition

The criteria of each deck, were defined and based in concepts linked to the subject to improve the learning of the students. Each deck had 4 criteria, being these the followings:

Deck #1 (vehicles):

1. Speed (Full speed of the vehicle, in km/h);
2. Capacity (how many tons the vehicle can transport);
3. Cost (cost of acquisition of the vehicle, in R$);
4. Pollution index (index related to how much pollution the vehicle generates, dimensionless; it will be better explained in the 4.2.1 item.).

Deck #2 (ways):

1. Construction's cost (cost of construction of the way, in R$/km);
2. Maintance's cost (total maintance's cost of the way in an year, in R$/km.year);
3. Extension (total extension of the way, in km);
4. Construction time (total construction time, in years).

4.2.1. Pollution index

For this definition, was established a criterion by the authors, than toke in consideration the vehicle's fuel, the consumption per kilometer and the vehicle's capacity. By this way, was made this equation:

$$I = \frac{K * l/km}{C}$$

Been:

I = Pollution index;
l/km = vehicle's consumption in liters per kilometer;
C = Vehicle's capacity, in tons;
K = Fuel's coefficient.

The values of K were definite in function of the fuel, been bigger for more pollutant and smaller for less pollutant fuel.

Schedule #3: Values of K
Source: Author.

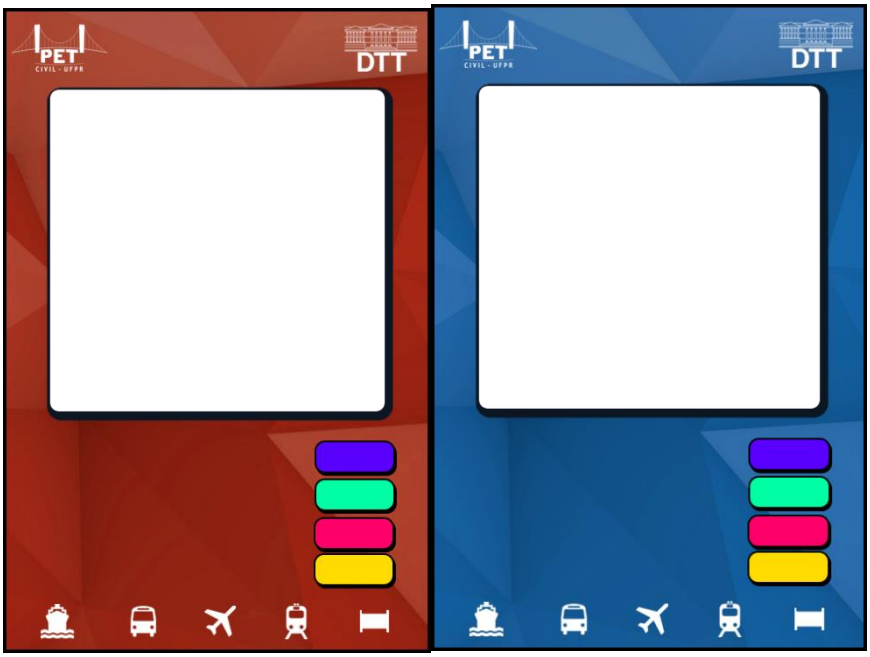
Fuel	Gasoline	Alcohol	Diesel Oil	Natural Gas	Mineral Oil
K	3000	2000	4000	1000	2500

The values of K are in 10^3 order for the last values of Pollution index be, mostly, between 1 and 100.

4.3. Making of the cards

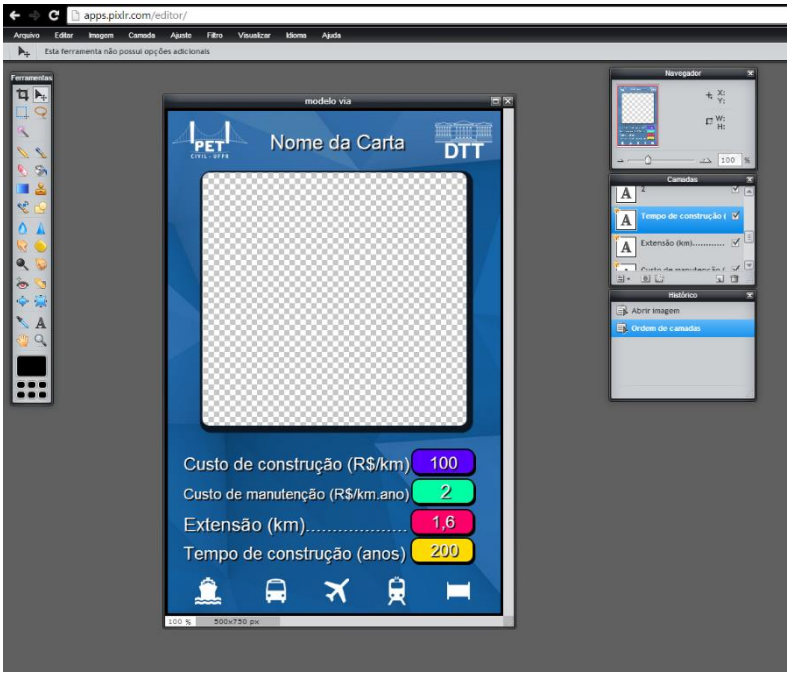
For the making of the card, two layouts were made, one for each deck, to be used like templates by the students.

Picture #1: Templates of the vehicle's and way's cards, respectively.
Source: Author.



For the students could make the cards in a easy way, didn,t needing to download any software, was used the free software Pixlr Editor®, from Autodesk© , than can be used online from the link http://apps.pixlr.com/editor/. In this software, the layout of the cards was made, with the editable texts and the transparent background, for be inputted the picture of the way or corresponding vehicle. Previously of the first making of the cards, a tutorial was given a quick tutorial of the made process of the cards, teaching the students how to edit texts and pictures on the software.

Picture #2: Template with texts in the site.
Source: Author.



4.3. Application in lessons

Firstly, an introduction lesson was made by the students of PET Civil UFPR (Tutorial Education Program, acronym in Portuguese) of how the card will be made, what were the objectives, what would be the decks, the criteria of each deck and answer any question about the project. This done, each one of the three PET's students was defined tutors of two students' groups, to help during the making of the cards.

In the end of each subject of the class, one lesson was given to make the cards. This cards were made in this order: highway vehicle, highway way, railway vehicle, railway way, waterway vehicle, waterway way, ductway way, airway vehicle. For each day, a previously search was made for the teacher and PET students to help the class students during the making of the activity.

The pictures #3 and #4 show examples of results from some cards made by the groups of the class.

Picture #3: Examples of the vehicles' cards.
Source: Author.

Picture #4: Examples of ways' cards.
Source: Author.

5. Results

The theme has four classes at the same time whit four different teachers, so it was possible to make a balance between the grades of the class when the method of construction of the cards was applied and the other ones.

Schedule #4: Classes grades average
Source: www.dtt.ufpr.br.

Class	**Aplied class**	Class X	Class Y	Class Z
Média	**78,1**	64,7	64,8	60,1

It is noticed than, in the class where the method was applied, the average of the grades was 20,7% bigger than in class X, 20,5% bigger than class Y e 30% bigger than class Z, having an medium increase of 23,7% in relation of the other classes grade's average, representing an significant increase in the grades.

It is noticed to than the insertion of the educative game, in this case, construction of the card deck, interleaved with the expository lessons of the subject in study, which has particulars to be exclusively theoretical, at least encouraged the students during the semester. It can be watched, by the results, an upgrading in the process of teaching-learning, so mixing the traditional and the innovative teaching methods.

For futures results, will be realized activities with kids of elementary school using the interative card decks, inside the project "*InterPET nas Escolas*" (InterPET in schools), from PET Civil group, which has an objective of present civil engineer to the children. The objective of the card decks is to be used like a card game, which each child has a part of the card deck, equally divided, and plays against other children card by card, each one choosing an attribute and looking whose has the best value.

6. Conclusion

Because of the great development of the communication and information networks, the process of globalization had a big impulse. With that, there was the necessity of redefine the profile and the activities of the professionals, generally, and of the engineer, particularly in this research.

Therefore, this research explored and evaluated an educational alternative (PBL) through the insertion of the construction of the card deck in a theme of the fourth period of the curse of civil engineering, which shows an exclusively theoretical feature, where the traditional methodology adhered at lectures.

In this way, was founded the challenge of avaluate if the students would be capable of made the cards during the lessons time, without interfere at the curriculum. This made they learned subjects and information off the lectures.

From the results lately showed, there is signs than the innovative methodology used in classroom upgraded the learning of the theme, even don't having real evidence about that. That occurred for the input in the traditional teaching method of the natural practices from PBL, like pro-activity and team work. Therefore, the students could take the knowledge from a more active way, besides strong characters relativities with the interpersonal relations and the sharing of knowledge.

7. References

BALCEIRO, L. B.; R. M. Naveiro e H. V. Medina (2003) **A criação de um jogo pedagógico para apoio ao ensino de engenharia.** Anais do XXXI Congresso Brasileiro de Educação em Engenharia, COBENGE, Rio de Janeiro v. 1. p. 1-8.

BERBEL, N.A.N. **A problematização e a aprendizagem baseada em problemas: diferentes termos ou diferentes caminhos?** Interface – Comunicação, Saúde, Educação, v.2, 1998.

COLENCI, A.T. **O ensino de engenharia como uma atividade de serviços: a exigência de atuação em novos patamares de qualidade acadêmica**. Dissertação (Mestrado). Escola de Engenharia de São Carlos, 2000.

EIDSON, W.C.; BULLOCK, D.M. **Emerging education opportunities in civil infrastructure**. In: Transportation Research Board. CD-ROM, 2001.

LIMA, R.V. **Cenário de integração do processo de desenvolvimento de produtos: uma proposta de ensino e treinamento baseada em tecnologia de educação**. Tese (Doutorado). Escola de Engenharia de São Carlos, Universidade de São Paulo, 2002.

LINSINGEN, I. von; PEREIRA, L.T.V.; CABRAL, C.G.; BAZZO, W.A. (org.). **Formação do engenheiro: desafios da atuação docente, tendências curriculares e questões contemporâneas da educação tecnológica**. Ed. UFSC, Florianópolis, 1999.

MELO, R.A.; LIMA, C.D.A. **Jogos Educativos para Estradas e Transportes**. Congresso Nacional de Ensino e Pesquisa em Transportes, XXVII ANPET, Belém, 2013.

NIXON, W.A. **Development of a graduate course in winter highway maintenance**. In:Transportation Research Board. CD-ROM, 2000

PEREIRA, M.A. **Ensino-aprendizagem em um contexto dinâmico – o caso de planejamento de transportes.** Tese (Doutorado), Escola de Engenharia de São Carlos, São Carlos, 2005.

PEREIRA, M.A.; DA SILVA, A.N.R. **Uma avaliação teórico-conceitual de estratégia pedagógica aplicada no ensino de engenharia**. 4ºCONAHPA- Congresso Nacional de Ambientes Hipermídia para Aprendizagem, Florianópolis, 2009.

RIBEIRO, L.R.C. **Programas da qualidade total e educação: reflexões sobre a utilizaçãode seus princípios no ensino de engenharia**. Dissertação (Mestrado). Escola de Engenharia de São Carlos, Universidade de São Paulo, 2000.

ROMANEL, F. B.; FREITAS, M. C. D. **Jogo desafiando a produção: ensinando a construção enxuta para operários da construção civil**. GEPROS. Gestão da Produção, Operações e Sistemas, v. 3, p. 11/1-22, 2011.

ROMANEL, F. B.; FREITAS, M. C. D. **O Jogo como Estratégia para Aprendizagem dos Conceitos da Construção Enxuta.** Anais do XXXVII Congresso Brasileiro de Educação em Engenharia, COBENGE, Recife, 2009.

SAKAI, M.H.; LIMA, G.Z. **PBL: uma visão geral do método**. Olho Mágico, Londrina, v.2 n.5/6, 1996.

SARDO, P.M.G.; DAL SASSO, G.T.M. **Aprendizagem baseada em problemas em ressuscitação cardiopulmonar: suporte básico de vida**. Revista da Escola de Enfermagem da USP, vol.42, n.4. São Paulo, 2008.

VASCONCELOS, E. S.; J. P. Silva; MOREIRA, T. S. ; CEZAR; K. L. ; SANTOS, M. L. B. e LORENZO, J. G. F. **Jogos: uma forma lúdica de ensinar**. Anais do VII Congresso de Pesquisa e Inovação da Rede Norte Nordeste de Educação Tecnológica, CONNEPI, Palmas, 2012.

OLIVEIRA, R. M. **Problem based learning como estratégia de ensino : diagnóstico para a aplicabilidade no curso de ciências contábeis da Universidade Federal do Paraná.** Dissertação (mestrado) - Universidade Federal do Paraná, Setor de Ciências Sociais Aplicadas, Programa de Pós-Graduação em Contabilidade. Defesa: Curitiba, 2014.