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Survival Engineering and the Game of Knowledge: A Ludics form to Teaching and Learning in Engineering

Alexis Tejedor De León
(Centro Regional de Veraguas, Universidad Tecnológica de Panamá)

Abstract: Within the engineering pedagogy, it must be remembered that students learn in many different ways: seeing, hearing, thinking, acting, drawing analogies and building mathematical models in the area of science and technology, than means that student participates actively; appropriates it and makes the experience a meaningful learning; transforming the process of teaching and learning in a dynamic of interaction between student-teacher and/or student-student, both in and outside the classrooms. This study provides an overview of the development of hard and soft skills from the project-based curriculum planning, in the context of engineering education; based on a ludic and motivational approach to teaching Geology in students of III year of civil engineering career named Student Contest of Survival Engineering (SCSE). The purpose of this active methodology was to encourage students both soft and hard skills, which were evaluated through practices conducted in field by theoretical and technical activities. From the results obtained, it is interpreted that students have a good expectation and felt fully motivated respected to the skills achieved. Similarly it was evident that students have good intellectual capital, however with weak non-technical skills, few of them employees and provided that the main perceptions was the regarding the impact associated with the ability to get a product at the end the course and the need to implement both theoretical background knowledge and basic science course as the common core of engineering.

Key words: soft and hark skills, teaching engineering, ludic teaching and learning

1. Introduction

Students choose to obtain a degree in engineering at the university for a variety of reasons determined by their aspirations, ability, and/or availabity at university (C. Leow, S. Marcus, E. Zanutto & R. Boruch, 2004). In fact, an important dimension of quality in higher education is the quality of the outcomes achieved (J. Warn & P. Tranter, 2001).

In the absence of formal preparation for teaching in the university context, faculty commonly learn by experience, reflection on that experience, and some form of mentoring. Faculty development programmes have traditionally focused on “how to” teach; that is, on techniques and tips conveyed into workshops or through individual consultations that have been reported by several authors (D. C. Roush, 1983; J. Walkington, H. P. Christensen & H. Kock, 2001; P. Craton & E. Carusetta, 2002; A. Clarke & S. Jarvis-Selinger, 2005; J. G. Berger,

Alexis Tejedor De León, Ph.D., Professor, Centro Regional de Veraguas, Universidad Tecnológica de Panamá; research areas/interests: engineering education. E-mail: alexis.tejedor@utp.ac.pa.

K. C. Boles & V. Troen, 2005).

The mission statements for most colleges and universities include the goals of lifelong learning, critical thinking, autonomy, and student empowerment; in this practicum setting, the educational process should not be converted into an only proposition of tautological concepts (A. Tejedor, 1997).

Nevertheless, in this context, occasionally the university teaching becomes a secretive profession. The classroom remains a private space where colleagues rarely drop in to observe or share methods and strategies about teaching that will guarantee increased student learning and cooperative learning abilities (S. Palmer, 2001). Accordingly, P. Craton and E. Carusetta (2002) explained that teaching is a specialized form of communication with the ultimate goal of fostering student learning to acquire first-rate knowledge.

But the main question is still “how to teach?”. This has been a major issue in the debate on how to raise standards in education. Despite these comments, the best teacher tend to be those who thinks about what they want to accomplish, how they are going to accomplish it, why they want students to learn it, and how they will know students have learned it.

By the other hand, depending on the overall changes, international treaties, changes in the roles of university-industry-state and the way how knowledge is acquired and the learning processes that develop are indications that engineering education should cover a set of learning experiences that enable students to build a deep range of knowledge, to develop their skills, techniques and professional proficiencies and apply them to a large number of educational projects engineering (S. Goel, 2006).

From different angles has been questioning the fact that the current demand for engineering education to engineers, it seems, have distanced themselves from the “real” world in recent years, as there is an apparent tension between two irreconcilable needs.

On the one hand, there is the need for engineering graduate student, master a wide range of expertise and on the other hand, the need also growing that young engineering graduates possess attitudes, attributes and personal and interpersonal skills enable them to develop successfully in the real professional world and be able to design, produce and manage new products and/or systems (E. F. Crawler, 2001).

Within the engineering pedagogy should be aware that students learn in many different ways: by seeing, hearing, thinking, acting, drawing analogies and building mathematical models in the area of science and technology (R. M. Felder & L. K. Silverman, 1988).

That is why several studies and initiatives have been developed to recognize, identify and recommend what should be the most appropriate practices and criteria for curriculum changes in engineering education worldwide (C. Reidsema & R. Goldsmith, 2011).

However all these studies seem to agree that it should encourage more student-centered learning, to create a more interactive and motivating learning environment for both students and teachers themselves (J. M. Mesa, J. V. Álvarez, J. M. Villanueva & F. J. De Cos, 2008).

At this level, it is extremely important to establish processes and interactive episodes between student-teacher and among the students themselves, by the fact that knowledge is not only the direct interaction of the subject, but also participating in the acquisition of learning is essential.

In this vein, the present study's main purpose is to discuss some elements of the dynamics of the play activity for teaching and learning engineering competition called Student Contest of Survival Engineering (SCSE) — in the context of the co-construction for the appropriation of significant learning in the Geology subject at university level.

The ludic activity proposed as a pedagogical pillar raises is bases in the constructivism and grounded in the PBLr (Project Based Learning), where those involved in the process of teaching and learning are encouraged to participate in the construction of meaningful learning in a dynamics environment; through the development, training, generation and promotion of "soft & hard skills" and future contrasting with other learning practices for engineering education.

2. Materials and Methods

The research undertaken is descriptive, analytical and cross-country type; where a detailed study was conducted to determine any “soft and hard skills” generated in students by conducting a ludic activities in the field, day-out class.

2.1 Definition and Characterization of the Object’s Study

This study was developed within the scope of the subject of Geology, for the second semester of the third year of Civil Engineering.

The overall objective of the course is to train a future civil engineers capable of understanding the importance of solving geological problems in civil engineering environment.

The planning of the course is based on PBL in which the realization of a series of activities throughout the semester are scheduled: academic activities inside — master class and outside the classroom — day out; demonstration labs, field trips and technical tours, documentaries and reading technical reports supported the use of OER (Open Education Resources) (S. M. Johnston, 2005) and the realization of a project to complete the course.

Additionally, mobile technology tools, smartphones (with free apps) and software were used for the purpose of the formation of the engineering student.

For the skills developed assessment by the teacher, they were informed to the students on the completion on the First Student Contest Engineering of Survival-SCSE'2013 — during *Expogeologira* (geology tour) where conducting field work contemplated in three consecutive days.

The students were grouped into five (5) teams for the achievement of the different practical and theoretical activities appropriate to the subject.

In this activity type day out, different teams had to run and deploy in field engineering practices expected that they had acquired throughout the semester, accompanied by the observation of generic skills warranted. In the course 39 students were enrolled in Semester II, 2013.

2.2 Assessment Criteria and Skills Distribution

The evaluation of proven competencies the teacher made in the field, along SCSE¨2013 and they were divided into two groups: soft & hard skills as shown in the Table 1.

3. Results and Discussion

The SCSE-2013 was held in November 2013 in the rural community of La Yeguada, Veraguas, Panama, for three consecutive days.

In this ludic activity like as a didactic teaching, engineering students were grouped according to their personal affinities into five teams, which were called for: DEM, AMFE, TOPO, DESLI and GEOM respectively.

Table 1 Classification of the Skills Assessed in Field

Type	Skills assessed
Soft skills	• Confidence. • Ability to take decisions • Voluntary Arrangement help • Artistic and creative skills. • Ability to interact with others. • Punctuality
Hard skills	• Cognitive engineering skills • Results practical engineering expected. • Ability to implement theoretical knowledge acquired. • Ability to use technology. • Written and oral communication skills.

At this point it is necessary to note that engineering careers traditionally have been labeled as typically masculine careers where most of the students enrolled were on this gender (A. Powell, B. Bagilhole & A. Dainty, 2009).

At the beginning of the Universidad Tecnologica de Panamá (1981), same behavior had been going on, however, in recent years, the enrollment of female students in this university has been increasing, reaching approximately 45% by 2014.

This was reflected in the distribution of the different teams; where in its conformation was observed that some of the teams consisted by students of a particular gender, not observed an equal distribution of gender among the team formed. That is the formation of teams consisting mostly by male students or female students, was observed.

This seems to show that students of the same type of genre they feel “more comfortable” working with other members of the same or equal stereotype (L. S. Anderson & K. A. Gilbride, 2003).

However, regardless of the teams formed, it was necessary to establish additional committees work, so will carry out the extra-class activity. That is, all previous activities were organized, planned and implemented by students under teacher supervision.

These working committees were not necessarily composed of the same members of each of the five participating teams.

As mentioned in the previous paragraph, for the development of SCSE-2013 the students, by own choice, they had to select the different working committees, i.e., logistics, supply and transportation; within which they must perform all activities designated for each committee so the event was given as scheduled.

Once the students arrived at the venue of the SCSE, general instructions were given to participating teams on security issues, responsibilities and what was expected reach and achieved in terms of learning at the end of the school day-out.

Figure 1 shows a photographic sequence for the realization of SCESE-2013.

During the SCSE-2013 were assessed by the teacher, the soft & hard skills in the following: hiking, recreation and sports, voluntary cooperation and support; academic poster presentation, technical article and verbal support to the project.

On the other hand, in field, five academic practices were developed namely: (i) petrographic characterization of rocks samples; (ii) slope and trees declivities determination; (iii) determination of flows in surface water sources and hot springs, (iv) recognition of soils and (v) geographical orientation in open field.

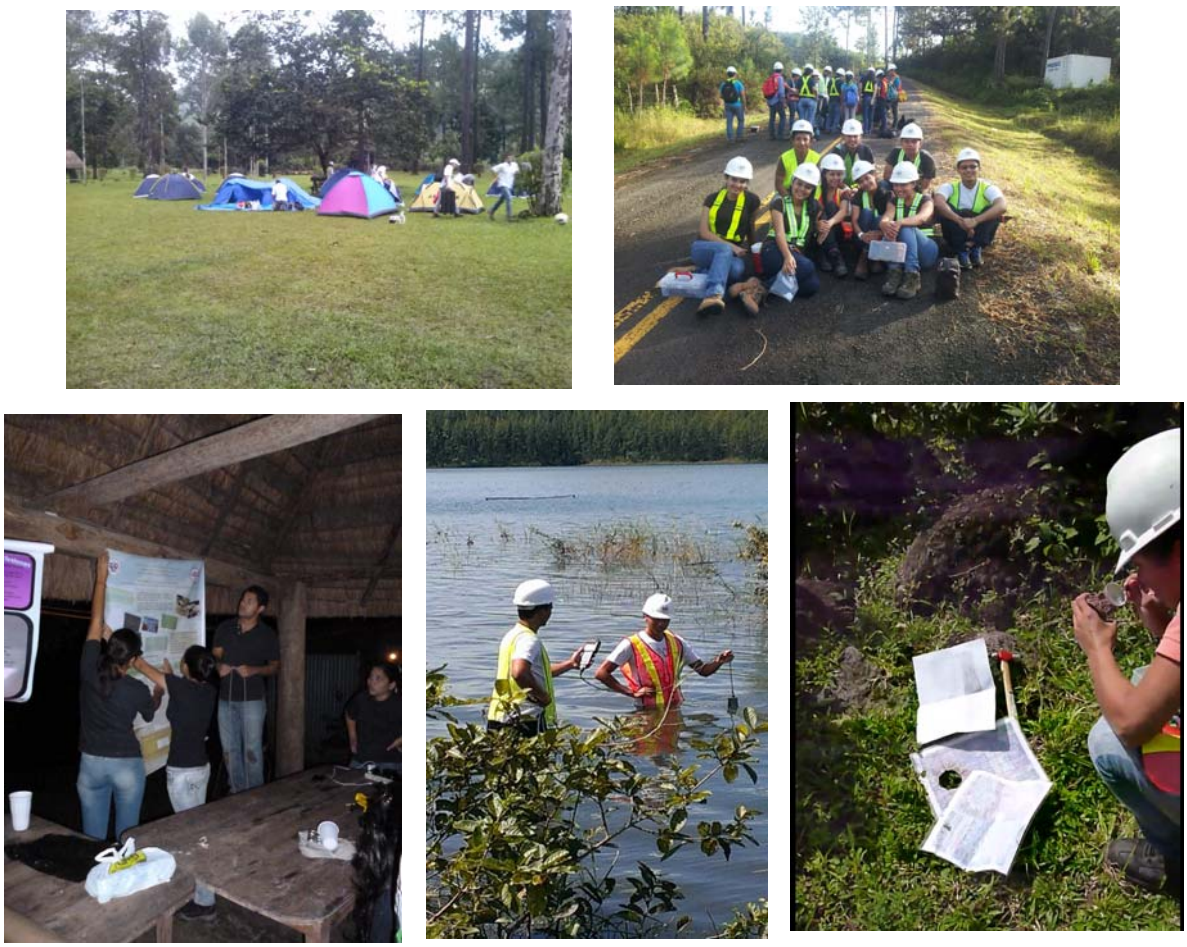

Figure 1 Civil Engineering Students Participating at SCSE-2013. From Left to Right: (i) Camping Distribution, (ii) One of the Five Participants in Teams, (iii) Oral Presentation of Academic Poster, (iv) Physicochemical Properties Measuring of Volcanic Lake, and (v) Sample Petrographic Characterization.

The above described activities should be performed by the teams according to the implements which were available at that time; i.e., trying to "survive" the activity.

This aimed to identify teams that were advancing in reaching the goals, i.e., they advanced in the student competition for survival in the field. On the other hand, those teams who were lagging behind, receiving feedback, so they could also achieve the goals of learning paths.

The results were weighted for each of the five teams and are presented in Figure 2.

Of the groups participating in the SCSE-2013 shows that the DEM team is the one with the greatest levels of hard skills, while the AMFE team is the largest levels of soft skills; however the group DESLI, which was weighted higher levels of technical and non-technical skills both in- and out-class.

This shows that some students have good intellectual capital (L. J. Shuman, M. Besterfield-Sacre & J. McGourty, 2005), i.e., cognitively they are good with excellent technical skills, but have weak non-technical skills, few cooperators; which goes against the indicated in the literature (B. Ahn., M. F. Cox & J. London, 2014) who are of the opinion that today, due to the competitive and global marketplace demands that future engineers possess "soft skills" in addition to the technical skills of the profession, and who are able to undertake projects with human, material and financial resources.

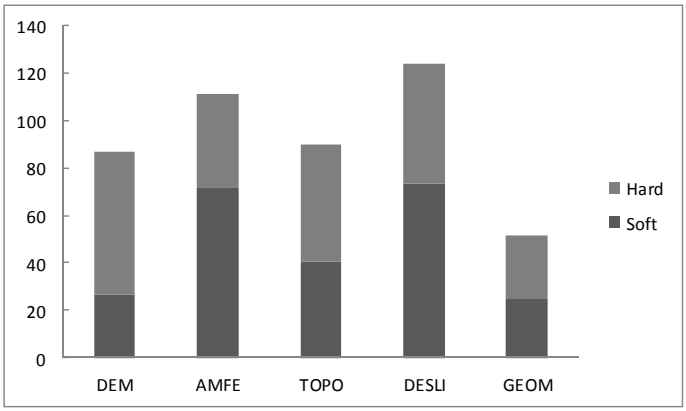

Figure 2 Soft & Hard Skills' Final Weights for Team of Student Participants at the SCSE-2013.

That is, there must be a "balance" between the technical and non-technical skills (A. S. Patil, 2005), as evidenced by the TOPO team; which are necessary to successfully enter and take professional sustainability, in the labor market; for this reason both kind of skills should be encouraged and worked in engineering education (R. M. Felder & L. K. Silverman, 1988).

4. Conclusions

Upon completion this study, we conclude the following:

- In terms of engineering education curriculum planning so it is necessary that the student has an active role in their learning.
- It may show that some students have good intellectual capital, i.e., cognitively are good with excellent technical skills, but have weak non-technical skills, few cooperators; which goes against what the desired part today in engineering students; therefore necessary to work teaching in this regard.
- The SCSE is presented as a ludic activity for effectively didactic strategies to identify and understand the type of competencies generated in students.

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