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Towards an Inclusive, Safe, Resilient and Sustainable City: Approaches and Tools

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STUDENTS' PERCEPTIONS OF INNOVATION IN SUSTAINABLE DEVELOPMENT TECHNOLOGIES AND THEIR ROLE TO OPTIMISE HIGHER EDUCATION'S QUALITY

Hella Ben Brahim Neji, Adel Besrour

Abstract

Technological innovation and scientific research have always helped industry and other economic sectors to evolve, allowing them to reduce their production, operation and maintenance costs, and in return, the fields of engineering and innovation widened increasingly. The objective of this research is to evaluate the importance technological innovations in sustainable development (especially, green energy) on the quality of higher education improvement. The study is based on a survey conducted among a sample of students from the High School of Technology and Computer Sciences (ESTI – University of Carthage, Tunisia), pointing out the need to integrate teaching staff, researcher and students, in identifying and optimization technological solutions.

Keywords: Technological innovation, contingent valuation method, energy saving

LE PERCEZIONI DEGLI STUDENTI RIGUARDO L'INNOVAZIONE DELLE TECNOLOGIE SOSTENIBILI ED IL LORO RUOLO NELL'OTTIMIZZARE LA QUALITÀ DELL'ISTRUZIONE SUPERIORE

Sommario

La ricerca scientifica e l'innovazione tecnologica hanno da sempre contribuito all'evoluzione dell'industria e degli altri settori dell'economia, consentendo di ridurre i costi di produzione, esercizio e manutenzione, e di ampliare sempre di più i campi dell'ingegneria e dell'innovazione. L'obiettivo di questa ricerca è quello di valutare l'importanza delle innovazioni tecnologiche nello sviluppo sostenibile (specialmente l'energia verde) sul miglioramento della qualità dell'istruzione superiore. Lo studio si basa su di un sondaggio condotto su di un campione di studenti della Scuola Superiore di Tecnologia e Scienze informatiche (ESTI, Università di Cartagine, Tunisia), evidenziando la necessità di coinvolgere il corpo docente, ricercatori e studenti, nell'individuazione e ottimizzazione delle soluzioni tecnologiche.

Parole chiave: Innovazione tecnologica, valutazione contingente, risparmio energetico

1. Introduction

Technological innovations and scientific researches have always been the domain of higher education institutions' expertise, helping industrial and many other economic sectors to evolve. This free assistance implies for industrials a reduction of production, operation and maintenance costs. In return, science and innovation widened more and more. The development of technical solutions can be performed in situ, which is to say, developed at the company or in school of engineering and technology's institution. The work is supervised in part by field worker and secondly, by the teacher – researcher who tries to adapt, new technology and scientific methods, to the industrial organization's problem. Indeed, through the projects graduation, masters and doctoral theses, several technical solutions were presented to industry depending on the size of the problem to be studied. Among others, we can mention technical solutions developed by researchers and students to help reducing energy consumption and preserving natural resources.

In emerging countries, case of Tunisia, this interaction in research and innovation between students and professors is beneficial to all the entities, a question may arise: can we exploit these trilateral relations to help improving working conditions (ergonomics) in public higher educational institutions?

Indeed, there are several ergonomic problems that hinder the normal course of educational sessions such as heating, lighting, painting, etc. (Mokdad, 2005). It is possible to develop a number of technical solutions to these problems with the help of the teaching staff (researchers) and financial aids of industrials and other national and international agencies (Foo, 2013). These solutions would be especially relevant only if they could meet environmental standards and could allow to save energy (Multon, 2000) and therefore to reduce financial costs.

This paper is related to energy conservation and environmental needs in higher education institutions, especially in the case of an emerging country such as Tunisia. The first objective of this research is to measure the importance of teaching sustainable environmental management in higher education in general, and engineering in particular, according to students' point of view (Azapagic *et al.*, 2005; UNESCO, 1992). The second objective concerns the students' appreciation of the idea to learn in a building, respecting environment standards. Also, we'll try to introduce the idea that students can to participate in innovation of new technologies helping to reduce Energy consumption.

This research is compounded of three main parts. In the first section, we will attempt to identify the main ergonomic constraints (including energy problems) that can reduce the performance of students and teachers in classroom. This part of the article has required conducting a survey among students. In the second part, we indentified most effective technical solutions and economically profitable that solve major problems mentioned (heating, lighting, noise, etc). In this study we consider the fact that student refuses to participate in the payment of expenses (results from the analysis of data survey).

2. Context of the study and identification of ergonomic problems in classroom

This study involved the School of Technology and Computer Science (ESTI - University of Carthage), located in the industrial zone of the city of Tunis and close to the airport of Tunis-Carthage. This is a public institution: it was established in 2002 and it is divided in three departments; Electrical Engineering, Industrial Management and Computer Engineering Departments. The school currently has two joint training systems: LMD since

2007 – 2008 (last cohort is expected for 2016) and engineering fields (started in 2010). Trainings provided within this academic institution are both technical and organizational (Diplomas in automation and mechatronics engineering, logistic and management of Industrial systems engineering (production, maintenance) and Diplomas of Computer sciences.). All departments cooperate with industrial companies, thus they participate in the development of curricula, in teaching as experts and in organizing lectures. It is also conventional to conduct joint industrial projects in the final year project. In addition, mandatory training and business visits are planned as a part of the opening of the school on the social-economic environment. These training opportunities are diverse and often laid to students recruitment (see ESTI web sites, www.esti.rnu.tn, and UCAR web sites, www.ucar.rnu.tn).

Despite the vast opportunities offered by the school to its students, factors are hindering the success of teaching experience. Indeed, the number of students has actually increased at an average annual growth's rate of 28% and about 22% for lectures and professors. The school building is rented and consists of 30 classrooms, 8 computer labs, 4 laboratories of Electrical Engineering and a reading room. The evolution of student's number and teacher's one, demonstrates that classrooms' number is insufficient. As an indicative number, the expected number of students, (once the school will offer only engineering diplomas) will be about 3000 students.

Other problems can be pointed out concerning stressful working conditions in this studied case: The lack of office space for professors to supervise students, winter heating, summer cooling, lighting suited to surfaces and orientation of classrooms, lab, etc. Currently, the ministry of higher education and scientific research is planning to build a new school building. This study proposes to respect environment standards of energy economics in this new building and to integrate special courses of sustainable development in all departments.

3. Survey design, results and analysis

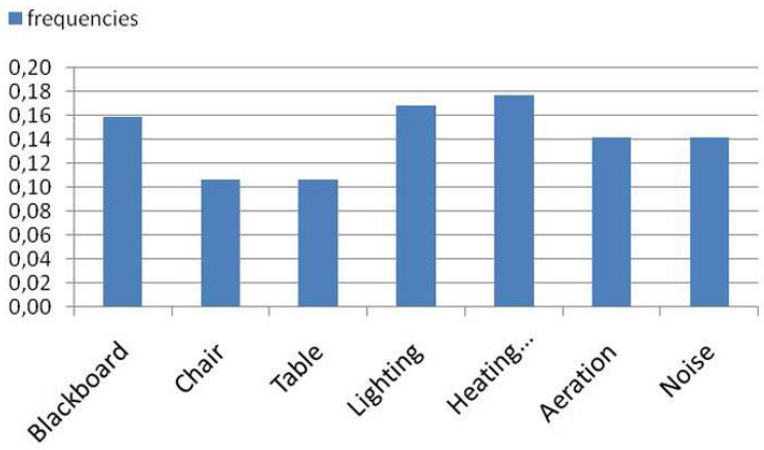
In order to rank the mentioned constraints in the last section and to determine the most important ones, a field survey was conducted among 46 students from the ESTI in 2013. In the second part of the questionnaire, a special case was advocated and that suppose that student pays monthly fees is simulated. They where guided by questions to evaluate, using contingent valuation method, the willingness to pay (WTP) for education, in an universitary building, respectful of environmental standards. Different kind of questions (direct-open, open-closed, indirect, etc.) were asked. Then, answers were used to support the introduction of environmental concerns and the need for effective technical solutions.

The ergonomic factors evaluated in this study concern the quality of tables, chairs, lighting heating, ventilation and noise. The student had to respond to the question 1 in Appendix.

Student can cross more than one case. To each case one point is attributed. By the end and for each factor, scores are aggregated and transformed on frequencies. According to students, heating and lighting represent most important discomforts in class (Fig. 1).

Recently, all blackboards in the school were changed and this problem was already resolved. The second part of the survey has guided, step by step, the student in the process of evaluating the willingness to pay (WTP) for higher education at ESTI, in an university building, respecting environment standards.

Fig. 1 – Evaluation of discomfort level (ergonomic) in university buildings' of ESTI



The first question tried to learn us if students are willing to pay for learning or not (Gourieroux, 1998; OECD, 1994). We supposed the case that university studies should become private. Only 12% of the interviewed students refused the idea to pay for education. The price estimated by 68% of students was about 20 euros/month. We went deeply in this question and we informed students about the price of private's university schools (open-ended question). The number of students accepting to pay has enhanced. However, only 20% of them accepted to pay. The expected price to be paid has varied between 100 to 150euros.

In the second step of the questionnaire, we introduced the ecological aspects. We supposed the case that the new school building of ESTI will respect environment standards and introduce green energy technologies. The refusal to pay's rate has not changed. However, we observed that only 44% of students would like to pay monthly about 200 euro/ month to have more comfortable building which uses green energy for heating and lights.

The concept of green building (Kasai and Chiappetta Jabbour, 2014) is superfluous for the interviewees, as 22% of students refuse to pay for a building complying with environmental standards. It was observed that 44% of respondents are not aware of the existence of new environmental technologies that save energy and protect the environment. The remaining students, 56% spoke either about solar and wind power. The idea of offering students the opportunity to develop new environmental technologies in their school has been well received by 89% of them.

The aim of this research isn't the popularization of the idea of private education but rather, estimating the magnitude assessment's given by students to environment technologies. It was observed that the student gives much importance to its comfort in the classroom, as he was willing to pay to have better working conditions. The fact remains, that students are not highly trained in green technologies and rarely accept to pay for green building.

4. Conclusion

Saving technologies of energy can be developed within the same institution of higher education and the benefit from this experience would be multiple. First, the institution will benefit from the establishment of techniques to preserve the environment and make significant savings. Then the student will participate in a formal way in the development of these techniques and enrich his education with the introduction of a new dimension, namely the environment.

Finally, the introduction of these technologies will develop research in the field of energy conservation and will help the industrialists to provide more efficient, reliable and profitable models. This study helped to evaluate the willingness of student to study environment technologies. Thus, their willingness to pay to have education, integrating environment studies was analyzed. In addition, we evaluated their sensitivity to ergonomic conditions in higher education buildings, especially having access to heating in winter.

Appendix

Survey

Ergonomic conditions in classes at High School of Technology and Computer Sciences (ESTI) and green energy

Name:

Age:

Class:

Department:

Identification of ergonomic problems in class (cross)

1. Classrooms and amphitheatre

BlackBoard	**Chair**	**Table**	**Light**	**Heating**	**Aeration**	**noise**	**Others**

According to you, which element mentioned in table 1 is the most uncomfortable?

2. Practical works class

Computer	**Internet**	**Software**	**Electrical engineering material**

According to you, which element mentioned in table 2 is the less modern (functional)?

3. Academic Library

Course Material	**Exercises' Material**	**Working room**	**Others (mention)**

According to you, which element mentioned in table 3 is the biggest constraint?

4. Others:

Problems linked to education

5. Availability of education material

Data show	**Course & Exercices Support**	**Interactive method used in Class**

6. Quality of education and courses in general : (A: very good)
   A B C D E

7. Does your university building respects in general environmental norms (Energy economic, water economic, cleanliness, noise, etc.)
   YES / NOT Why?

Contingent Valuation Methods to valorise a qualitative service (such as education)
Simulation

Let's suppose that education in Tunisia and especially in High School of Technology and Computer Sciences is not free of charges. Based on current prices of private education system, we try to measure the willingness to pay of students for better quality of education and ergonomic condition:

8. Considering the described scenario, if you have to pay monthly for your university education, how much you shall pay?
9. Note that prices of primary education in private institution is around 300DT/Month (M), secondary 350DT/M and Higher education is about 500DT/M, what can be your new price? (1euro=2,3 DT)
10. Note that actually, your education costs, for the national government, about 250DT/M. Considering this new information, are you willing to pay for improvement (Mobil classroom, better quality of lighting, chairs, table, etc.) or not? And if yes how much? Yes/ No
11. Private university institutions integrate high technology and good ergonomic conditions in their institution. However, Students have to pay between 400 and 700DT/M. To have same work conditions, which price are you willing to pay?
12. How much would like to pay to have a university building respecting environment?

Working at university schools implies high fees for energy (for example, water and electricity fees varies from 1 to 3 DT/student/M. This fee can reach 20 or 30DT if used technologies' are more developed in classes and practical works classes (lap tops, mobile classroom, interactive board, lighting, video projector, central heating, etc.).

13. Do you know green technologies that help reducing monetary charges and save environment?
14. Please cite someone's.
15. Suppose the scenario of paying for high education will not be applied, are you willing to pay a small monetary contribution to have green energy in your school? If yes how much?
16. Are you interested to participate in the technological development of this kind of technologies? If yes say why?

Thanks

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