

A Comparative Study of Lecture-Based and Multimedia-Based Training Method on the Second Year Students Competency in General Electronics Course in the Technical and Vocational School

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Abstract

The aim of this study was to investigate the effect of multimedia training method and lecture on second year students' competencies in General Electronics Course in technical and vocational school of Isfahan city. The research statistic population consisted of all second year students of technical and vocational school in the academic year 2015-2016. These two high schools were selected by random cluster sampling, data were collected from the tests and analyzed by using of covariance analysis. The results indicated that the electronic functional skills training score on multimedia-based group was significantly higher than lecture-based group. Also the students who were weak in electronics lessons have benefited significantly more than the stronger students from the multimedia-based training programs.

Keywords: multi-media method, lecture method, learning, students, competence

1. Introduction

Education is the basis and foundation for the growth and development of human resources. Creation of an educational system with the ability to train people to live in a changing world, is the important priorities of modern society. In this regard, the information technology are among the important achievements of recent decades that have a significant role in qualifying the teaching process and leads to the potential of improving learning results (Duncan and Cator, 2013).

Up to now the various results have obtained from many researches all over the world in relation to efficient training methods. (Molla zade, Kameli, Jafari Chogani, Mir Hosseini and Shojaa, 2015). One of the common methods of teaching is the lecture method that uses the expression orally (Azizi, 2003). Lecture is a fast, simple and inexpensive in the presentation. Today integrating the lecture with appropriate audiovisual equipment cause to increase the efficiency of this method. However many experts believe that if this method would desirably present can provide the effective learning and it is necessary that trainers use the lecture method in combination to other techniques for understanding the issues. (Shabani, 2010; Salimi, Shahbazi, Mojahed, Ahmadiéh and Dehghan poor, 2008). Material that is presented in the lecture can be used for the person passively involved in the training process and however student in other methods such as problem solving or multimedia based training have the opportunity to participate in question actively and involve in various cases. (Gabr and Mohammed, 2011; Docherty, Hoy, Topp & Trinder, 2005). In methods of multimedia training the content are given to the person and he should seek to learn and cope with solving the questions (Golshiri, Sharifi rad, Baghernejad, 2012). Fardanesh (2004) defines educational media as: "Media training are the tools to present comprehensive training and is naturally part of the learning and educational technology process, not all of it." He uses an analogy to define the above explanation: "If we call compressive as the consumer and the education as consumer goods, the media is the means that deliver the product from the production or distribution place to consumers. In other words,

education, learning, goods, learner, consumer, and media are the tools for delivering the product to the consumer or to compressive education. According to the above analogy, we conclude that for example in many cases the main factor is teacher training, media training is also the teacher. If learning to be invited to a training program and receive all education from television, in this case training media is the television. So training media is a device or a factor that education is offered compressively through it. Training media are the physical means by which a training message is transmitted by them. (Ganiyeh Varizer, 1983, p. 5). Media is a mechanism in which people learn through it, so enough time should be considered for its potential evaluation. This method involves activities that individuals can actively engage in learning personally and collectively. (Mir shahzadeh and Tootoonchi, 2008). Gardner (2003) discuss about the use of Assistive Technology in the interdisciplinary units of Special Education. He supports the improvement of teaching method by showing how to combine them in the curriculum and finally its positive effects by presenting examples of multimedia tools combination and software related to subjects as well as network activity to improve teaching methods. Studies have shown that multimedia-based education can help students' comprehension and retention (Capel, 2009; weeb and Anta, 2008). In fact, educational multimedia, are involved in media system due to their multi -sensory nature that can be easily adapted to a variety of learning styles and provide easy and stable learning by various forms of interaction. In addition, Scerri and Vacaner (1997) counted computer-based training advantages compared to traditional education (teacher-centered) as providing immediate feedback, avoidance of subjective and biased judgments, facilitating individualized training process, given the increasing range of attention and motivation of learners, different learnings (Beach and Avayda, 1992). Multimedia application in educational situations has many advantages, some of which include: 1. the use of multiple senses for learning. 2. The more exercise to achieve domination, (3) facilitating participation for making relationship between concepts. 4. To facilitate the course repetition for re-application. 5. Effectiveness by economic points. 6. Flexibility of the program to the needs of learners (Razavi, 2008).

In recent years, despite the increasing media facilities in some schools with adequate financial capabilities, a lesser extent of multi-media teaching methods are used (Khorami rad, Heydariyan, Ahmari Tehrani, 2012). Education system in its transforming and exchanging operation, should change its teaching methods, in a way that the learners learn the content actively, and become engaged face to face with the issues and answer the question for solving the problems. (Soleymani pour 2004). But given that still the traditional educational methods and curricula are used in schools, it is necessary that the educational system change its methods so that students actively participate in educational programs; Therefore, techniques such as problem-solving, multimedia and ... should be taken into consideration (Shabani, 2006). one of the most important IT applications is multimedia training that is presented in on line learning formats in various forms such as computer -based learning and outline learning (Pawlowski & Kozlov 2008).

The research findings indicate that virtual training and e-learning can help to the effectiveness of the teaching-learning process (Badrian et al, 2009; Momeni Rad, 2010; Chen et al., 2004). In addition, researches show that the use of computer simulations in testing, both in terms of learning and skill in conducting the same electronic circuit have a significant advantages in comparison with students who have worked in the lab with real tools. (Finkelstein et al., 2005), other examples of such research can be found in the work of researchers like Zacharia (2007, 2008), Klahr, Triona, And Williams (2006) and Denis Vavougios and Karakasidis (2008). Therefore, this research attempts to investigate the effect of multimedia application (Multi-SIM and Edison software) in general electronic course on students learning (competence).

By a review of studies it is specified that the results of studies have some contradiction on the effect of traditional learning methods and teaching electronics. (Badri, 2009; Momeni Rad, 2010; Chen et al., 2004) The lack of information in this research can be felt, that conducted on interactive and non-interactive multi-media effects on learning and concepts retention of electronic lesson. it was shown that interactive multimedia are more effective than non-interactive multimedia learning and retention (Sabbaghan et al, 2011: 156) This study aims at using teaching methods based on constructivism and Edison multi-wire software E5 version in the Virtual Lab on a general electronic course, to evaluate at first the different aspects of students learning curriculum and can remove the research gaps in this area and identify and assess the potential obstacles in effective usage of virtual labs and developer labs factors in electronic lessons.

By regarding that the curriculum electronic book (1) is new In the second year, many questions are provided to the students for which according to the time limit it is not possible to answer them (Zarifan and et al. 2014). The use of virtual software in simulation testing is one of the authors important recommendation about this curriculum, the effectiveness of virtual experiments in this study requires the scientific investigation. In total less studies are conducted on the effectiveness of constructivism approach in virtual training. By regarding what was said, this research by considering Edison multi-SIM software and general electronics lesson review its impact on learning in the second degree students of secondary (vocational) school. This study aimed to compare the practical skills learning in electronics lessons with lecture and software multimedia method in second degree student (son) of Vocational School that the hypothesis formulated

based on this goal were as follows:

1. There is a significant difference between the students' functional skills in electronics lessons that have been trained with multimedia approach and the students that have been trained on lecture method.
2. The use of multimedia software in general electronic lessons have a positive and significant affect on students' performance skills.

2. Method

This research is quasi-experimental with pretest-posttest and control group. The statistic population of research were the second year students of vocational technical school in the Isfahan city in 2015-2016. In this research, by a random cluster sampling method, District 3 Education in Isfahan was selected and then among the schools of this District, 2 school and from each school a class 33 students as the experimental group-based multi-media (Edison software and multi-SIM software) and a class of 35 students in a lecture- based control group (traditional) randomly selected and studied and in total 68 students were selected as samples. In this research Multi-SIM and Edison software was performed as the first chapter of training course at General Electronics for the second year during four-week in four hours. (Two sessions in a week and for two hours).

The teacher presented time schedule and specified lesson plan in four continuous weeks in 2 hours of testing implementation for multimedia and lecture group at the same procedure for the first chapter of second year General Electric course. At the end of training sessions of both groups, the post-test for skills and competencies was conducted. Also both group was managed by the same teacher in which teacher factor can be controlled. The tools used in this research are the Edison and Multi-SIM multimedia software in the electronic lesson by the approval of the Ministry of Education that each of them had a compact disc (CD). Two classes were taught separately with both lecture and multimedia methods. In general, the content of the training sessions was as follows:

First session: the students were trained to prepare them how to use the computer and the CD before its implementation, this instruction was done in order to do not waste a lot of time during the test implementation and also reduce the learners anxiety so the charm and the novelty of training by computer has been reduced, in a way that we could minimize disturbing factors during implementation. In this meeting a short presentation of the first chapter contents of the general electronic textbook as the title of "look at the basic concepts and basic electronic components" in second degree of high school was implemented that was used in the same manner for both groups. Training period lasted for the 8 meeting of 4 hours in four-week. Their learning in terms of Performance skill dimension was measured. Multi-SIM discussions in accordance with Chapter 1 in General electronics are as follows: (1) differentiate the electronic components from each other (2) Close the simple electrical circuit (3) observe the wave form in two types of constant and altering direct current (4) measure the frequency and altering time (5) observe the electrical resistance and its different units (6) Measure the voltage, or potential difference at the end of each components (7) see the capacitor and its different units (8) distinguish between the capacitors (9) observe some transformer and their difference (10) observe some of electronic converters. Edison software is also an electronic circuit simulation program in a real and three-dimensional form that more electronic components including batteries and lamp wire inductor and multimeter and ammeter can be used by it as in a real environment and 3- dimensional form in orbit and thus the result can be seen in three dimensional form and current and voltage and other electronic components can also be evaluated in the measurement instruments plates.

Data collection was done by teacher-made tools that was performed for both groups at the end of training program. This test was teacher-made tests and questions were similar for both intervention groups. According to Pintrich & DeGroot (1990) teacher-made tests are similar to schools regular test and as research instruments are more suitable than standardized tests. It is made of a list of seven items to measure students' performance skills according to the educational purpose. To examine the reliability of performance skills test, the split-half (half off) was used. Therefore, the school conducted tests on school students and then the questions were divided into two individual and couple group and first the Pearson correlation coefficient and then the reliability was calculated that reliability coefficient obtained 0/78. In this study Lavshy model was used for content validity. The opinions of eight teachers who had teaching experience in general electronic lessons (5 people), General Psychology (1people), Educational Research (2people) was used to calculate this indicator. The calculated ratios for each item compared to the numbers provided by the Lavshy and if the number is greater than the values of the table, the content validity of item was confirmed. In order to estimate the reliability of the scoring, the papers after the first scoring was given to another teacher and it was observed that the agreement between the two scoring was 0/86. In this study the content validity was used by Lavshy model. To calculate the index, the opinions of eight teachers was used who had teaching experience in the general Electronics course (5),

General Psychology (1), Educational Research (2).

Implementation: experimental group were taught at general Electronics course by using Edison and multi-SIM software and the control group were trained in a traditional method. Overall and slight goals and objectives of its content, implementation method, questions which should be during class, implementation time and required homework were individually designed for each session and was included in the lesson plan. The lesson text was selected, the general electronic books (1) in second degree of technical and professional high school (including concepts such as the electrical circuit, technical signs and electrical and electronic equipment, electrical current, current direction and the way of its measurement, series and parallel circuits, types of flow, periodicity time and the unit of frequency, voltage, resistance, capacitance, capacitor units and its capacity, transformers and converters), which was used for both groups equally. Duration of training was 8 sessions of 90-minute in the four weeks, their learning was tested in dimensions of cognitive ability, academic attitudes and behavioral skills.

Data collection was done by using SPSS software and mean and standard deviation were described by using descriptive statistics and then the statistical parametric analysis of covariance was used in order to generalize the findings.

3. Findings

For data analysis, descriptive statistics indices such as mean and standard deviation was used and to measure variables and normality the Kolmogorov-Smirnov test was used and in order to evaluate the main hypothesis of the research the analysis of covariance test was used that the results are presented below.

Table 1. Mean and standard deviation in the pre-test and post-test

| group | stage | number | mean | Standard deviation | minimum | maximum |
|----------------------------|-----------|--------|-------|--------------------|---------|---------|
| Multimedia- based training | Pre-test | 33 | 17/76 | 2/96 | 11 | 20 |
| | Post-test | 33 | 13/34 | 5/40 | 8 | 19 |
| Lecture-based training | Post-test | 35 | 13/27 | 4/05 | 10 | 20 |
| | Pre-test | 35 | 14/51 | 3/29 | 8 | 17 |

The information included in Table 1 shows the mean and standard deviation of test scores in pre-test. Comparing post-test of mean scores in competence electronic lessons in two groups of multimedia based training (17/76) and lecture-based training on (13/27) showed that there are differences between two groups at post-test. To verify the normal distribution of scores between two intervention groups, the Kolmogorov – Smirnov test is used as described in Table 2.

Table 2. Kolmogorov-Smirnov test for normality of the variables measured

| indices | multimedia based group scores | | Lecture based group scores | |
|--------------------|-------------------------------|--------------------------------|----------------------------|--------------------------------|
| | Pre-test | Electronic course competencies | Pre-test | Electronic course competencies |
| sample number | 33 | 33 | 35 | 35 |
| K-S statistic | 1.165 | 1.140 | 1.223 | .960 |
| Significance level | .133 | .117 | .101 | .316 |

According to table 2 the significant level confirms the assumption of normal variables, it means that statistically and with 95% confidence it can be claimed that the variables of the scores of the two intervention groups, were followed by a normal distribution. So in order to answer the research hypothesis the covariance analysis was used.

The research hypothesis: there is a significant difference between the functional skills of electronics course in students who have been trained with multimedia and the students who were trained by lecture.

Table 3. The mean of two groups in Electronics lessons functional skills scores

| Dependent variable: Electronics lessons functional skills | | | | | |
|---|----------------|-------------------|-----------------|----------|-------------------|
| Variance source | Sum of squares | Degree of freedom | Mean of squares | amount F | Significant level |
| pretest | 107.597 | 1 | 107.597 | 2.649 | .108 |
| Difference between groups | 2117.250 | 1 | 2117.250 | 15.132 | .001 |
| error | 2721.095 | 67 | 40.613 | | |
| total | 107239.498 | 70 | | | |

In Table 3 Summary of covariance test results have been reported in relation to the first hypothesis. In this table squares, degrees of freedom, and mean square and value of F (Sig = 0/001 F = 15/132) have been calculated and reported. If the achieved significant level of researcher error tests is smaller than ($\alpha=0/05$), the significant difference between the data is concluded. In this test, we achieved a significant level of error that was much smaller than $\alpha =0/05 < P (0/001)$.On this basis we can say with 99% confidence that there is a significant difference in the rate of progression of functional skills lessons on students with multimedia – based training, Compared to students by lecture-based trainings. According to the two groups’ scores in the post-test of electronic functional skills, the development of competency of this course in multimedia –based training was higher than lecture-based group.

4. Discussion and Conclusion

The purpose of this research was to investigate the effect of multimedia training and lecture on competence of general electronic course (1) on students of secondary schools in Isfahan. The research results showed that the mean of resulted scores, represents a significant difference between the functional skills of electronic course in students who were used multimedia Edison and Multi-SIM training , Compared to students who were trained by lecture method. Accordingly the first hypothesis was confirmed. The results of testing this hypothesis with the research results of this study are consistent with studies of Asghari, et al., 2010; Liu, 2014; Takiudin Taher Khan, (2015); Kulufel and De yong, (2013).

Along with the mentioned studies about consistency with our findings we can say that modern methods of training such as multimedia method is better than traditional methods (lectures) and it is able to enhance the learning more memorable and engage the students in the learning environment , and try to increase their performance . maybe this enhancement in multi-media group is due to clarity of lessons, organized Presentations, be actively engaged with lessons when studying, enjoying audio and video features for more attraction ,better understanding the content and increase work efficiency and provide the ability to use behavioral skills to a comprehensive database . This multimedia approach that leads to better competencies in understanding the electronics and electricity issues, maybe because that the learner is faced with the problem more sensitively and concepts are arranged hierarchically that by easier pervasive mind the issues are analyzed by order information. The differences between the findings of other research can be found in the nature of trained courses, the conditions of study and statistic population.

The areas that in recent years has been faced with the influx of information technology by fundamental purpose are education and learning. If the last decade of twentieth century were called the information decade, so the first decade of the twenty-one century is called consciousness and purpose of this naming is the comprehensive development of knowledge and human consciousness. Education is said to any activity or measure of planned training that is aimed at creating learning in learner, while learning is the creation of a relatively permanent changes in potential behavior of learner if these changes occur as a result of experience (Saif, 2005).

So learning is a purpose and education is one of the means or methods to achieve these purpose (Ghadirian and Asili, 2005). "In the education and training subjects, an education is effective that first lead to learning and second learning is stable. To achieve this purpose the help of technology to support teaching and learning activities according to the existing shortcomings can be effective. Development of ICT in education and training programs is the significant and lasting step which can provide a qualitative change in the objectives, programs and procedures and thus followed by effectiveness of education.

The second hypothesis results showed that training by the multimedia software is effective on progress of students in electronic course that are consistent by the results of Lee, 2014; Asghari, et al., 2010 that represents better academic progress in electronics course in the experimental group who were trained by multimedia computer program and concluded that multimedia training have been effective in electronic course progress and learning.

Among the limitations of this research we can refer to the lack of precision in answering questions by students that in this regard the research purpose was specified to participants and they were given enough time to minimize this

problem. Also Coordination for holding class and use of informatics room had some problems that were managed.

In a total and final conclusion the result of research can be stated by previous research support, so that the new computer and multimedia are capable of transforming the learning environment in functional skills training course in electronics and make it attractive and attracts the students and learners to the learning process, reinforce the stimulus injected into the process of teaching and learning and help to stabilize the consolidation of learning and teaching materials and leads to improve the quality of education. Also cause to increase the learner's motivation and thus their efforts to learn more and gain better scores and performance in relation to courses such as electronic skills of students that always are faced with a negative attitude and learning difficulties in this lesson, that it is likely that they trust to their abilities (positive self-concept) and ultimately can lead to better learning and skills in courses such as electronics. Based on the following reasons, the teachers are suggested for the use of multimedia software in teaching electronics:

1. In presenting educational issues by using Edison and multi-SIM educational software the interest of learners should be attracted and therefore causes to active learning and increasing their skills.
2. By using of educational software and create a positive attitude in students towards it ,provide the situation to change teaching methods in order to participate more in teamwork and less lecture presents by the teacher.
3. Teachers by using Multimedia software, especially Edison and multi-SIM can reasonably assess its impact on students' scores on regional and country test and at the same time pay to study the learners' participation in classrooms.
4. Evaluating the software and computer programs in various lessons and their optimization is recommended.
5. It is recommended to study and investigate the effect of multimedia teaching in class test and students' attitude and motivation to participate in class activities and learning.
6. While using a computer and the training software and training through traditional methods, it is suggested to check and study the learners' focus on class board, the teacher and other classmates, the computer screen and the overall state of focus, thought and finally their reaction when they are learning by these two methods.

References

- Asghari, Mohammad, Sdralashrafi, Masood. , Nikoo Nejad, Mohammad Hossein 2011. Effect of Virtual Lab on attitude, knowledge and competence of third degree high school students in mathematics District 16 of Tehran. Abstract articles in modern teaching methods conference: Tehran: martyr Rajae University.
- Badrian, Aabed; Shekarbaghani, Ashraf sadat; Asfa, Arezoo, Abdi Nejjad, the Taleb. Efficiency of pattern accreditation of lab model to carry out activities in secondary school empirical Science Education. Magazine: educational innovations »winter 2009 - N 28 [Journal] (28 pages - from 129 to 156)
- Khorami Rad, Ashraf; Seidi, Masoume, Heidari, Akram, Ahmari Tehran, Hoda. Comparison of two tutorial methods (CD and book) to train general phisicians in reporting diseases. Iranian Journal of Medical Education, 2012, Volume 11, summer, N 2, Pages: 149-158.
- Razavi Seyed Abbas in 2008. New topics in educational technology. Ahwaz Chamran University publication.
- Soleymanpoor, J. (2004) "skills of teaching and learning", first edition, best publications, Tehran.
- Salimi, Tahere; Shahbazi, Lily, Mojahed, Shahnaz; Ahmadiyah, Mohammad Hossein; Dehghan pour, Mohammad Hassan. Compare the effect of lecture and work in small groups on drug calculating skills in nursing students. Iranian Journal of Medical Education, 2008; Volume 7, spring, N 1, Pages: 79-84.
- Seif, Ali Akbar. 2005. Psychology Education. Tehran: aware.
- Shabani, Hassan. 2006. Advanced teaching methods (teaching skills and thought strategies). Tehran: side.
- Sheibani Smatt, Mehdi, Moradi, Nezam, Jaheshi, Jafar. 2011. The chemistry lab role and position and its presentation, abstract articles on modern teaching methods Conference, Tehran martyr Rajae University.
- Sheikh Zadeh, Mostafa. And Mehr mohammadi, Mahmoud. – Elementary mathematic education software based on constructivism and assess its effectiveness. Journal of Educational Innovations, 2005 3 (9), 48. 32.
- Fardanesh, Hashem. 2004. Theoretical Foundations of Educational Technology. Tehran: Semat Publication.
- Fashami, Mohammad. (2010). Comparison of computer-based training and traditional teaching on student learning in math classes Zanjan, Angouran region in the academic year 2009 -2010. Thesis. Ministry of Science, Research and Technology - Arak University, MA.
- Ghadirian Abbas Ali and Asili, Gholam Reza. 2005 new learning mechanisms and their effect on the development of stable competitive advantages in companies. Presented at the Second International Conference on Management.
- Golshiri, Parastoo, Sharifi rad, Gholam Reza and Bagher Nejjad, Fateme. Effect of lecture and tutorial method on the mothers' knowledge and awareness about growth and nutritional development stages in children less than three years. Journal of Medical Sciences (Journal of Educational Development) / winter 2012: 927 / (5) 10.
- Momeni Rad. E-learning, opportunities and challenges, educational technology conference in the age of information and communication Ahwaz martyr Chamran University, march 2008.

- Mollazade, Hadi; Kameli, Ahmad Jafari, Chogan, Mostafa, Mir Hosseini, Fahimeh and Shojaa, Mohsen. Comparing the effect of multimedia presentations and training on the nursing basics in nursing students. *Journal of medical science North Khorasan University*. 2015; 6, 1, pp. 10-1.
- Docherty C, Hoy D, Topp H. (2005). Trinder K, Elearning techniques supporting problem-based learning in clinical simulation, *Int J med inform*, 74(7-8):527-533.
- Frederiksen, J. R., White, B. Y., & Gutwill, J. (1999). Dynamic mental models in learningscience: The importance of constructing derivational linkages among models. *Journal of Research in Science Teaching*, 36, 806-836
- Gabr H, Mohamed N. (2011). Effect of Problem- Based Learning on Undergraduate Nursing Students Enrolled in Nursing Administration Course, *International Journal of Academic Research*;3(1):154-162.
- Keller. John. (2006). motivation in online, distance, and e-learning environments the combination of instructional and narrative models for e-learning.. Available at: <http://www.mstu.edu/html>.
- Kollöffel, Bas and de Jong, Ton (2013). Conceptual Understanding of Electrical Circuits in Secondary Vocational Engineering Education: Combining Traditional Instruction with Inquiry Learning in a Virtual Lab. *Journal of Engineering Education* Volume 102, Issue 3, pages 375–393, July 2013.
- Leow, F-T., & Neo, M. (2014). Interactive multimedia learning: Innovating classroom education in a Malaysia university. *TOJET: The Turkish Online Journal of Educational Technology*, 13(2), 99-110.
- Li, Ping (2014). Electronic Circuit Teaching Aided by MultiSim Virtual Simulation Software. *Advanced Materials Research* 05/2014; 933:703-707.
- Liu, Qiu-xia (2014). Experiment teaching of digital electronic technology using Multisim 12.0. *World Transactions on Engineering and Technology Education* Vol.12, No.1
- Mirshahzadeh N, Tootoonchi M. (2007). The Quality of Books, Questions and Teaching Method of Self-Learning in Continuing Medical Education: The Viewpoints of Selflearning Program's Participants in Isfahan University of Medical Sciences, *IJME*. 7(1):129-136, [Persian].
- Pawlowski JM, Kozlov D. (2008). Analysis and Validation of Learning Technology Models, Standards and Specifications: The Reference Model Analysis Grid (RMAG), *International Journal of IT Standards and Standardization Research*. <http://creativecommons.org/licenses/byncsa/3.0/>
- Pintritch, P. R., & DeGroot, E. V. (1990). Motivational and self – regulated learning components of classroom academic performance. *Journal of Educational Psychology*, 82-32-40.
- Sankaran, A. (2001). impact of learning strategies and motivation on performance: A study in web- based instruction. *Journal of instructional psychology*. sept. 2001. Available at: http://www.findarticles.com/p/articles/mi_m_fcg/is32/aiv937.574/pg9/?Tag=content:col1.
- Zacharia, Z.C. (2007), Comparing and combining real and virtual experimentation: An effort to enhance students' conceptual understanding of electric circuits *Journal of Computer Assisted Learning*, 23 pp. 120–132.
- Vavougiou, D., & Karakasidis, T. (2008). Application of ICT Technology in Physics Education: Teaching and Learning Elementary Oscillations with the Aid of Simulation Software. *International Journal of Emerging Technologies in Learning*, Vol 3, No 2, pp. 53-58.
- Chen X., Francia B., M. Li, Mckinnon, B., and Seker, A. (2004). Shared information and program plagiarism detection. *IEEE Trans. Information Theory*, 7:1545–1550.
- Finkelstein, N. D., Adams, W. K., Keller, C. J., Kohl, P. B., Perkins, K. K., Podolefsky, N. S., et al. (2005). When learning about the real world is better done virtually: A study of substituting computer simulations for laboratory equipment. *Physical Review Special Topics - Physics Education Research*, 1(1), 010103-1.