Educational Scenario of a Technological – Vocational Course, using ICTs, in the Context of Constructivism, Pragmatic Model and Cross-Thematic Integration

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Abstract—In this paper an Educational Scenario of a Technological–Vocational course is documented and presented. In this the potentials of ICTs are exploited, as management tools of the information and as back up tools of the teaching method such that Constructivist learning environments can be established inside the classroom and achieve a smooth and successful integration of the ICT in the main cognitive subject of the Technological–Vocational course, which is examined at the Higher Education entrance exams. The Scenario has characteristics of a model useful for other Technological–Vocational courses as it suggests Practical Educational Techniques and Cross-thematic integration approaches and promotes the Metacognitive skills of the Vocational Upper Secondary School (EPAL) students with a specialization.

Index Terms—Constructivism, Cross-thematic integration, Educational Scenario, ICT, Metacognition, Pragmatic Model, Technological – Vocational course.

I. INTRODUCTION

The Upper Secondary Formal Vocational Education in Greece is mainly offered, in Vocational Upper Secondary Schools (EPAL). The Technological – Vocational Courses (TVC) of EPAL aim at transmitting the required technical and vocational knowledge and at the development of their associated skills [8]. Especially at the examined courses of the Higher Education entrance exams, we face the problem of the students’ interest differentiation for learning process, due to the varying goal of each student since the very nature, structure and function of EPAL promotes as goal of their graduate both their admission to the Higher Education and their entry into the labor market immediately after. Appropriate approach to teaching is required [by making properly designed Educational Scenarios (CF)] so that they respond to the requirements of all students regardless of their post graduate goals after Upper Secondary School and motivate them to attend and for further occupation [13].

In modern knowledge society, it is essential to adapt the teaching strategies and the technology integration strategies in educational process as well as to promote the Metacognitive goals [26]. The term Metacognition refers to “…one’s knowledge concerning one’s own cognitive processes and products or anything related to them…” [7].

Metacognition is also described as “thinking about thinking”, as “self-monitoring”, as the tendency to illustrate the educational material to itself as to the underlying knowledge of the cognitive sector “self-explanation”, as “analogical reasoning”, as the ability of someone to search, properly assistance in their education [3]. This means that the educational environments, nowadays, is indicated to provide opportunities for feedback from both the teacher and even more from the student itself as he becomes more and more self-knowledgeable and experienced in observing of what happens during his education [15].

Basic priority for Vocational Education and Training in Europe is to ensure high quality vocational education which must keep up with the rapid changes in work processes and the curriculum framework. Particular attention should be paid to the way the teaching personnel learning and innovation of Information and Communication Technology (ICT) is utilized [27]. For the development of Vocational Education and Training, the European Union, at all educational levels and environments, such as vocational schools, requires flexible learning provision as vocational learning, open and distance learning and e-learning [27]. The e-skills approach suggests that, in order for students to prepare for the digital future, a series of skills related to the use of digital media should be instructed. The approach is quite attractive a long as there is a goal; education constitutes a vestibule to the workplace, and based on this it explicitly links a competitive economy with a competitive education [14]. Doukakis, Giannakos, Koilias & Vlamos [6] claim that attendance or relevant ICT courses in secondary education is beneficial and contributes to the success of the students that attended them, in relative courses in Higher Education. These mean that utilization of ICT in the teaching of Technological – Vocational courses, will stimulate the interest in the course and will ultimately “help” in their future studies and the students that who are aiming at higher education and even Departments of a similar subject with their specialty as EPAL students.

During teaching, the teacher is obliged to take into account his student previous knowledge, since research has shown that students’ “pre-scientific” previous knowledge is not easily eliminated but constitutes important cognitive barriers to building new knowledge [23]. And ultimately, in the context of Discovering learning, to guide them in the extraction of concepts, conclusions, knowledge, that is to apply the Guided Discovery learning rather than the Unguided Discovery, as it is claimed that this is more effective than it since it helps the students to learn and to transmit the knowledge, to aim at the discovery of information [18]. Therefore, it is concluded, that in a modern CF it is appropriate to apply the Constructivist approach of learning which suggests that students set their

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own knowledge for themselves through discovery processes and exploratory strategies by themselves [17], [21], mention that teaching by using and pedagogical utilization of ICT, which indicate that ICT provide enough potentials for the reassurance of the Constructivist Learning Environments in the classrooms, have been tested and continue to be tested in schools. They can “…support exploratory and discovery kind of type learning situations (in all cognitive subjects), to favor activities for solving problems, for decision making and for development of critical thinking…” [23].

Regarding the basic principles and techniques in teaching of Technological Vocational courses, Pantazis [20] states that course should apply in situations of profession practice that has been chosen by the students in order the student to understand the technical concepts of their educational specialty. This means that it is considered important, that the EPAL students acquire discovery skills of the new knowledge and for the reason that it is necessary, after their studies and upon their integration into the labour market, to have the ability to search and access new knowledge and techniques in a professional environment whose cognitive background is constantly evolving.

II. THE EDUCATIONAL SCENARIO

A. Theoretical approach

The teaching of the proposed Scenario is based on the learning theory of Constructivism. According to DeVries [5], Constructivism “… is based on the idea that the dialectic or interactionist process of development and learning through the student’s active construction should be facilitated and promoted by adults”. Essentially, instead of providing knowledge and guidance at the on solving a problem, the student should be given the opportunity to seek knowledge and solve the problem himself [19]. Davis, Maher & Noddings [4] consider that “… learners have to construct their own knowledge- individually and collectively”. According to Brooks & Brooks [2], for the practical application of Constructivism to the educational process should be used cognitive terminology such as “classify”, “analyze”, “predict”, or “create”, search for previous experiences of the students about a pre-teaching concept, to encourage communication between the teacher and the students, as well as between the students. It is supported [9][22], that Constructivist approach, which is based on exploratory learning, searching and discovery of information and the generation of knew knowledge from them through personal experiences, is the theory of knowledge, at whom application can be structured an “Efficient” CF for teaching a Technological – Vocational course. The word Effectiveness here is used in the sense of meeting the educational goals of the course and the persona vocational or ultimate educational goals of the students. In order to ensure its effectiveness, the proposed CF utilizes as a “tool” the Technologies of Information and Communication. Regarding the effort to integrate the ICTs in the Scenario, the Pragmatic “Factual” model is followed, and this is chosen because in the case of the cognitive subjects of Technological – Vocational courses of EPAL, a way that ICTs can be used during the attempt of their integration into education, is the application of this model. This model, as a combination of the Techno-centric model and the Holistic model, is presented as a solution, as a transitional stage, in order to smoothly and successfully integrate ICTs in these cognitive subjects because it seems that is combines the pedagogical advantages in terms and conditions of feasibility [11], [16].

With the development of an Educational Scenario, designed to achieve the examination of technological concepts from multiple perspectives, from various fields of knowledge and fields of science, so that they are multipurpose illuminated [1], [29] and their application in the classroom or the laboratory during teaching of a Technological – Vocational Course, especially as an examined course at Higher Education entrance exams, the fulfillment both educational and student, of higher vocational or educational, goals is feasible. The CF refers to a course module and offers to the students’ knowledge and skills in addition to those provided by the Curriculum Framework (CF). Thus, this scenario moves along the lines of Constructivism and Discovering Learning as a Guided Discovery, to develop Metacognition, to characterize and exploit the Cross-thematic integration with other courses and is also designed in order to stimulate the interest of all students. These can be structured with the integration of the tool of Information and Communication Technologies in the context of the Pragmatic Model. Finally, at the CF the hybrid system of the Scheduled teaching is being followed, as a first stage, and that of the Project Implementation method is being followed as a second stage. Thus, in the scenario, the course content is organized in such a way that the student, in the first stage, to be self-educated by proceeding inductively, in small steps according to his own pace of speed, taking as a feedback the information of the correctness or otherwise of his energy and this promotes the permanent learning which proceeds with specifically steps from the known to the unknown “knowledge” [28]. It is noted that the transition through the stages of application of cognitive learning theories, of Discovering learning and the Guided Discovery takes place after a Behavioral Techniques’ learning stage in an appropriately organized, mainly digital, environment. Finally, the basic way to develop Metacognition skills to the students, at the proposed Scenario, is to present methods of solving problems and to minimize presentations of solutions to these problems and to develop skills to retrieve and create new knowledge through them [24].

A student assessment is provided at CF. This Assessment, follows the steps of the Constructive framework and the stages of a Scheduled teaching and the Project Implementation in every Activity. This has informative characteristics and aims at controlling the road of the students to the achievements of the individual goals of each Activity. Information is extracted that are required for the possible modification of the Scenario in order to achieve the identified goals [12].

B. Methodology approach

The proposed CF has essentially resulted, from the synthesis of individual scenarios which have been applied in a real classroom. It is structured in three successive

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Activities/Tasks and attempts to achieve four teaching goals. The activities concern the calculation of the basic gear sizes, the design of its profile and finally its photorealistic representation. Each of three Activities/Tasks is trying to achieve each of three first Objectives of the Scenario, respectively. The fourth Objective is carried out in parallel with the evolution of all Activities/Tasks and their framework from common applications with ICT support. Each activity is complemented by a corresponding Evaluation process, as described above. Software is utilized which are found or can be found easily in EPAL’s computer laboratories and the students have already been taught their basic principles in previous or the current class. The latter also boosts the cross-thematic integration character of the Scenario. A relevant evaluation is being carried out which also reflects the processes of the Constructivism teaching techniques that preceded it.

The title of the Educational Scenario is “Digital Computing & Gear Design” and the involved cognitive areas are those of the TVC of Machine Elements and in particular of the Gear’s Teeth theory in respect to description, functional purpose and their design. Data elements of Mechanical Engineering and the Principles of Linear Design are involved. In addition, basic elements of Computer Science of the Principle of PC and Mathematics (Trigonometry) cognitive fields are involved. The Scenario can be addressed to students of each specialty of the third grade of EPAL Mechanical Engineering department. All those involved are compatible with the CF, since in CF of the course Machine Elements, the cognitive areas of the Teeth description are referred, of their functional purpose and their design and so that the students recognize them in a physical state or representation or drawing. In the unit Computer Aided Design (CAD), CAD System software, basic Commands and Functions and 3D CAD Systems, are included as goals that the students look into the Internet services and Web 2.0 applications. Prerequisite knowledge is knowledge that has either been taught in previous Course in the course of Mechanical Elements, either in other courses such as Computer Science, Design or Mathematics. However, in the Scenario, in each Activity introductory “iteration” is expected, based on behavioral techniques supported be ICT (Searching information at Internet, comparing sources of internet with school manual). The estimated duration for the achievement of the above Educational Objectives is 6 (six) teaching hours, distributed in pairs of 2 (two) in each individual Objective/Activity.

To implement the Educational Scenario, the students are required to be in a teaching laboratory environment and be given the opportunity to easily access a Computer, even if they operate it along with other students. Computers must be connected to a network and Internet, they must be able to print A3 and have installed Browser, CAD software and Office software installed. There must be capable to project on a wall display.

The Teaching Objectives are composed of those of the conventional implementation of the CF with the appropriate adjustment to the educational techniques that follow and in the related framework with ICT. So after the fulfillment of the CF, the students should be able to:

- Calculate basic characteristics of the front gears, for each module combination, teeth number and contact angle requested, in an automated way, of which they should compose the structure and the function, in the special spreadsheet.
  - Design approximately a two dimensional Gear Tooth profile, by knowing the numbers of its basic design characteristics, in the special CAD software.
  - Design approximately a 3D Model of a Gear and produce its Photorealistic display in the CAD Software, having the digital design of a Tooth profile and its conventional design.
  - Make use of the Web 2.0 internet platform’s (Blogs, YouTube and Social Media) Software/Application capabilities, in their specialty subject.

The teaching approach is based on the digital distribution of the Worksheets, one for each Activity. Through these, the following are carried out:

- Students are asked to compose new structures, models and concepts and link them with previous knowledge and mental models. They are asked to compose a specialized spreadsheet of automatic calculation of technical characteristics, in order to design the structural components, to create a photorealistic display. In each case the final request is presented.
- Discovery and creation of new knowledge is encouraged. Students should search for ways to solve mathematical equations of technical subject in the Spreadsheet by applying the technique of Guided Discovery. They are told to discover how composite geometrical characteristics of a technical part are designed, to discover a larger number of possibilities of photorealism, such as lighting, materials and environments and also adapt them to the future requirements of their specialty and to the theoretical requirements of the examinee, in the exam for Higher Education, course at the same time.
- Critical thinking is promoted on many parts motivated by the submission of open-form questions during the preparation. In many cases, students are asked to note in their notebook [let’s not forget the classical also] thoughts, opinions, meanings about their profession.
- Care is taken for the intervention of the teacher in case of unsuccessful completion of every Activity/Task but also in case of unsuccessful completion of each stage of the Activities.
- The goals are popularized, presented in the “language” of students so that they are more accessible, friendly and understandable. Verbs of cognitive terminology are often used such as, create, construct, analyze, structure, compare. They are encouraged and guided for actions with relevant guiding icons such as “ Capitals: Discover!!!”, “@: Search the internet”, “@: Listen to you teacher’s advice”.
- Care is taken for the repetition and the aid with educational manipulative, School Manuals, aids from WEB2.0 etc.
- The Assessment is done in a digital environment in simple word processor software. The student is called to answer if he has implemented the basic steps which were foreseen in the Activity during the induction process of self-teaching and to “report”, the result of the activities of the searches, experiments, tests of discovery of new knowledge. He is then summoned and notes conclusions and thoughts of
solving problems which has encountered. Finally, “delivers”, by using the platform WEB 2.0 the work he has completed such that it can be thoroughly examined by the instructor. Essentially Formative Assessment is performed despite the limited timeframe of the Scenario.

In each Activity, before the main part of the Task is carried out, students are informed of the necessity and usefulness of the process, both at the educational and professional level. Students are encouraged to repeat the prerequisite knowledge but also to seek new knowledge about the implementation of the Task and prepare and prepare for this by marking or printing auxiliary elements. In case the student has not successfully completed the requested result of a Task, is given the opportunity to utilize, at the preparation of the next Task, another complete project. Helpful examples are provided, they are encouraged to access relevant sources of information at WEB2.0 (YouTube, Blogs, Photodentro -educational platform- etc.) and inside the bibliography and the teacher’s intervention in considered as difficult or crucial parts, is encouraged. Finally, when the student completes the project, posts it to a relevant educational Blog.

The completion and sending to the teacher, of the Assessment Sheet in which all, of great educational gravity, steps and “discoveries” are evaluated as a reference of the student himself.

With regard to Added Value of teaching approach, the students attempt to automate the calculations, the equations, of the Gears so they recognize their geometrical characteristics and -mainly- the relationships between them by means of a simple Software tool, the Spreadsheet. In their effort, in this Activity, they apply known and discover new equations, techniques and applications in the Spreadsheet, especially for the cognitive but also the vocational field of Machine Elements. These geometric characteristics that they will calculate will be assisted in the next step, namely in the two dimensional or three dimensional design of the Gears. They design a Gear, not only schematically but in representational depiction, starting from the its most important, on a design view, characteristic, the profile of the Involute curve, the curve which defines the teeth profile of the most Gears. It is noted that over the last decades the Design, is not only “the language of the techniques” but also the language which understand special machines that can “construct” objects guided only by it. Based on the above, the student delves into previous knowledge and skills and develops new and even complementary in a cross-section integration level of courses of mechanical engineering specialty, mathematics, computer science and new technologies.

With regard to Added Value which is related to the metacognitive – educational, but also the higher vocational or educational goals of the students, emphasis is given on acquiring real experiences that are understood by their active participation in proposed processes in which the curriculum components, the content and the actions which the student is asked to complete, are related with the student needs and interests either in actual situations of their upcoming vocational rehabilitation or the upcoming Higher Education entrance examination, in the subject. Additionally, “learns how to learn”, that is to adapt to new technologies and techniques which are applied or will be applied in the future. This is accomplished by performing specific activities of searching, experiments, tests and generally actions new knowledge discovery. Most activities are carried out in a digital environment by using office or design software and are framed by the utilization of WEB 2.0 platforms.

III. RESULTS – SCENARIO EVALUATION.

The Scenario, as whole, has not been tested in its application. Thus, concerning its evaluation, it should be mentioned the empirically understood by the teacher “success” of the components of the individual scenarios and elements. The concept of “success” here refers to the satisfaction of the educational goals of CF and the goals of the students concerning the continuing of their studies in Higher Education or the direct entry into the labor market. The Scenario was formed so that it is coincident with the incitements of School Counselors, Teachers and CFs for the effective teaching implementation of Technological – Vocational courses. Thus, the Scenario was designed and formulated in such a way that it covers and meets basic evaluation criteria such as having clear teaching goals, being documented based on specific pedagogical theories and methodological approaches and in accordance with the requirements of the CF. It was designed to enhance the exploratory learning, to engage students and to be characterized by cross-thematic integration. It attempts to solve particular teaching problems that are related to the general educational purposes of the particular psycho-pedagogical framework of the Vocational Education students. It exploits ICT and represents, by modeling theoretical knowledge using innovative techniques by definition. It can be expanded and adjusted to other educational subjects, mainly Technological – Vocational courses [9], [25].

An additional evaluation procedure should be carried out as to the effectiveness of its implementation. Thus, a method is proposed from the Multi Criteria Decision Analysis which mainly focuses on the dimension of students learning behavior, the dimension of their learning performance and their feedback for their learning experience by themselves, in the way that it is approached by Kitagias [10].

IV. CONCLUSIONS – SUGGESTIONS FOR FURTHER RESEARCH.

Support for Technological – Vocational courses by ICTs can be utilized to help promotion of educational objectives but also future educational or vocational student goals. This can be done by integrating the Professional Software, General Software, and Information Management Software (WEB 2.0) in Educational Scenarios. The framework of Technological – Vocational courses with ICTs can produce educational scenarios that will be based on and promote educational principles of contemporary educational approaches like Constructivism, Discovery learning, Metacognition and Cross-thematic integration.

The proposed Scenario should be evaluated thoroughly, DOI: http://dx.doi.org/10.24018/ejers.2019.0.CIE.1294
based on well-documented research approaches (the suggested Assessment Sheets of the Scenario can be of help). So elements of high educational efficiency will be defined, that can be used mainly in Technological – Vocational courses increasing in turn the educational effectiveness of the teachings by them.

REFERENCES


