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TECHNICAL PROBLEM BASED E-LANGUAGE INSTRUCTION FOR VOCATIONAL STUDENTS

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ABSTRACT

We discuss an intervention in mother language instruction in a Greek Vocational Lyceum combining Web 2.0 tools with electronic writing pedagogy. During a full school year (2012-13), forty six 11th grade students with typically low literacy skills participated, randomly separated in control and experimental group. The latter systematically dealt with Technical Problem Solving and completed online (Edmodo) increasingly complex writing tasks. Encouraged to reflect on and solve technical problems, they activated language skills for communicating their solutions through the synthesis of technical text-genres. Meanwhile the control group followed the conventional teaching method using the usual literary texts. Pre and post-test measurements demonstrated that, while both groups improved, the experimental group made significantly more progress in their language efficiency and writing.

KEYWORDS: E-learning Activities, Language Instruction, Literacy, Problem Based Learning, Vocational Education, Technical Genres

INTRODUCTION

Post Compulsory / High Secondary education in Greece provides educational instruction for students during the period from ages 15 to 18 (for grades 10-12) and consists of three types of schools: General Lyceum (of academic orientation), EPA.L (Epaggelmatiko Lykeio-Vocational Lyceum for job-oriented education) and EPAS (2-year Professional Schools of apprenticeship).

Vocational Lyceums' (EPA.L) curriculum combines academic and vocational curriculum elements. In the first (10th) grade of Vocational Lyceum, students apart from the academic subjects choose a vocational course, which determines the Sector's choices made in the next grade (11th). Finally, a correlation exists between the Sector a student will follow in the 11th grade with the Specialty in which will continue in the 12th grade. Separation of sections (as in early Secondary Education as well) is strictly alphabetical -by the last name's initial - according to the Ministry's official instructions (2389/05.29.06, P.D. 483/77, par.1). Students attend all together the academic subjects (Modern Greek language, Foreign Language, Maths, Physics, Chemistry), but they are separated in order to attend the Sectors and Specialties' subjects. The degree of academic performance by vocational high school students is noticeably lower than that of general high school students. They feel little competitive with peers of the General Lyceum and abhor the theoretical, non-laboratory courses. 'The majority of students who choose to study at vocational schools are characterized by low school achievement, often lack basic literacy (Ministry of Education-Pedagogical Institute, 2009, p.17) and apparently

present language expression deficiency in most subject areas.

Individual teachers-researches[1] in Greek public education highlighted the problem of vocational students' literacy weaknesses against students of the General Lyceum in basic curriculum subjects, such as the Modern Greek Language and Mathematics. Students language deficiency in vocational lyceums is attributed on the one hand to the social origin of students[2] and on the other to the teaching methods[3]. International studies (Breland et al, 2004) attribute unsatisfactory writing ability to factors such as: a) the characteristics of the subject, b) knowledge and interest in this issue and c) the general linguistic competence of the student. In turn, these language development factors are related to the social and economic situation of the family, education level and interests of parents, gender, social environment, etc. as participation in the vocational track is much more common among disadvantaged students (Kreisman, D., Stange, K., 2015).

Since learners are more comfortable in learning environments that reflect their own dominant learning style (Sankey & Birch 2005), it makes sense for vocational educators to adapt educational materials and methodologies to their students. So, it's up to us, as teachers, to create learning environments that take into account students' preferences on teaching in learning in vocational education (Cook-Sather, A., Bovill, C., & Felten, P., 2014). Teachers are challenged to redesign vocational learning pathways in order to raise students' engagement substantially (Placklé, I., et al 2014) as students seem to prefer opportunities to practice self-regulated learning, problem solving and collaborative learning (Placklé, I., et al 2013).

For the present study the question is how new teaching approaches tailored to vocational students' characteristics, can effectively be applied in Modern Greek language through which students are expected to foster their world and language consciousness. In what way can language teaching become more appealing and effective for today's students of Vocational Lyceum, who, like most of their age, communicate with smart devices, play digital games, use social networks, whereas, as students who have rejected (or disposed of) general education, they chose to become artisans and exit quickly to the labor market? One way to help vocational students to achieve better language competency performance is by planning content and language learning objectives that guide the design of content-language integrated learning materials. (Kong, Stella, 2015). At the same time, there is a growing research literature in the field of information and communication technology (ICT) helping students with learning and writing difficulties to overcome them (MacArthur, C. A. 2000) and there seem to be ways that ICT can provide students with opportunities to become involved in a quality writing program (Johnson, D. 2002).

In this research, I decided to engage students in e-learning technical problem solving activities where they had to deal with digital, multimodal learning materials in a specially constructed LMS platform (Edmodo) and, by manipulating them as data, to come up with their own technical-professional genres. The learning and teaching process was integrated in a more practical and empirical framework that practically means that: the use of educational materials (technical resources of various fields of business applications supported by demonstrations, videos, drawings and other representational media) consists of data of which "their functionality within the communicative approach lies in their ability to be used as the

[1] See: i) Rapti, Katsanou (2007). 'The language ability of students of General and Vocational Lyceum'. Research conducted during the 2006-2007 school year to 170 students of high school, from four General and four Vocational Lyceums of the city of Ioannina in Greece b) Theodosiadou Kyriaki (2013): 'The role of the school in school performance configuration'. The Educational, Issue 105-106. The survey focused on the school performance of 393 students from secondary schools, general and vocational upper secondary schools from Pella prefecture.

[2] Baslis, I.N., (1988). 'Aspects of psychology and social consequences in the teaching of language'

[3] Sofronis Hatzisavvidis. 'Factors that influence the language proficiency of students: findings from a' Case Study '

empirical basis or as parameters of specific communicative situations within which specific types of discourse or genres are produced' (Tsiplakou, S., Haji & Constantinou, 2006). The technical problems derived from the actual workplace and got linked to optional professional fields that students had chosen from their curriculum. The aim was twofold: first, the students should acquire new knowledge in relation to their professional field (motivation increase), secondly, they should develop skills in handling the professional language and generally develop greater fluency as future technicians-professionals. Thus, the Greek language was not taught as a separate subject or as a mean of general discussion and information about the world (a methodology traditionally applied to Greek education with an emphasis on linguistic learning, academic tasks and the use of scholar 'genres'), but as a tool for professional improvement through critical thinking on technical real life situations.

LITERATURE REVIEW

PBL is originated in the medical field. Barrows, who tested the PBL model in medical science (Barrows, HS 1986), considers that this method is appropriate to the nature of the scientific method as the scientist is invited to answer questions, to speculate and find the omitted information. The basic philosophy is that the best learning takes place when the student is looking to solve a real (authentic) problem and connect new knowledge with that, than when knowledge is presented linearly, disjointed according to the classical model of teaching. Main purpose is to learn students how to learn (SDSU, 2013).

Keeping an analogue to the classical sciences, all these mental processes to solve the problem, can also be applied to various technical apprenticeship fields. At this point, the aid of technology is added. The technologically mediated problem solving has paid off both in terms of students learning and professional development of teachers. Exploiting an instructional architecture to electronic learning management system, which uses elements of PBL and Learning by Design model has proved effective in several studies (Walker, Recker, et.al., 2014). Additionally, there are scientific articles that highlight the importance of the way in which technology controls the success of problem-based learning (Vasiliou, Ioannou, Andri, et al. 2013, Watson, George 2002, Sung Hee Park and Peggy A. Ertmer 2008). Talking through paradigms, a series of studies in real vocational school classes, reinforce this assumption. A web-based problem-based learning (PBL), combined with web-based selfregulated learning (SRL) is successfully utilized by vocational school teachers in Taiwan to enhance students' computing skills in a short-term module of deploying Microsoft Word (Shen, P. D., Lee, T. H., & Tsai, C. W., 2007). In an other country (Iraq), PBL is used as an alternative teaching method in the engineering sector: vocational students are encouraged to solve problems in basic electrical circuits based on an e-learning system and the results indicate that students are highly satisfied with the problem-solving method and the e-learning format (Khazaal, Hasan F., 2015). In Greece, PBL is more often met in Informatics/Computing skills school teaching. A representative example from the Greek secondary vocational education (EPA.L) is the small scale study conducted in the 1st EPA.L of Lamia: on line educational materials were delivered through the Moodle LMS platform and teaching activities based in PBL were designed to engage students in interdisciplinary (Computer Applications and Physics), collaborative tasks. Although the lessons were directed to traditionally weak students, the results were encouraging (Katsaounos George, Zachos George, Siolou Maria, 2014).

[4] Walker Andrew, Recker Mimi, Robertshaw Brooke, Osen Jeffrey, Leary Heather. 'Integrating Technology and Problem-based Learning: A Mixed Methods Study of Two Teacher Professional Development Designs' - in this research professors were trained to combine problem-based activities with technological skills in order to identify, incorporate and utilize appropriate electronic sources electronic teaching environments.

But what happens when PBL meets languages? In what terms Problem Solving is associated to language competency? Text writing is a complex process. It is a constructive meaning's construction activity, similar to the problem solving process, where the student-author must simultaneously manage problems both of content and language (Flower, 1994). So, as writing itself is a demanding, high mental task, a lot of research (e.g Flower, L. S. & Hayes, J. R., 1977) has focused on how teachers and learners can set problem solving techniques to overcome writing difficulties, to reduce language command frustration by connecting language activities with students lives situations (Richards, Jack, 2015). From a similar point of view the problem can be given in the form of speech and text synthesis through rules as the writing process is perceived as a problem solving situation (Bourke M. James, 1996). The problem-solving procedure commences with problem-posing and proceeds through data analysis, hypothesis forming and testing, frequent rule re-structuring, to the final rule formulation. Generally, PBL incorporates innovative teaching and learning methodologies that are relevant and meaningful, including strategies to teach language and content, actively engage learners, and provide comprehensible input and linguistic competency (Booth, Diane et al, 2011). Other times, problem based model is almost identical to project based or task-based method in second language learning where a topic is selected and students must work on it. The activity-based or task- based teaching or, more recently, the Problem Solving approach is one of the various teaching methods used in second language acquisition processes. The communicative language teaching makes use of activities that involve information gap and information transfer and in task-based language teaching learners work on specially designed task activities or tasks reflecting the real world (Richards, J. C., & Rodgers, T. S., 2014). Ideally, problems should be related to the students' lives to increase interest and motivation, require students to make decisions and judgments (the problem they work on should be an actual problem, not just an information-gathering task). Similarly national language teaching and related subjects in various national curricula, problem solving usually refers to debate, argumentative, discussion topics where students follow real world -related writing prompts to practice argumentative speaking and writing (e.g the Problem Solving, Writing Solutions unit in English Language Arts by LEARN NC, a program of the UNC School of Education, for innovative practices in K-12 education for the teachers and students of North Carolina -US). Often, language teaching is applied through interdisciplinary connection with STEM area subjects and PBL. Recent emphasis on science, technology, engineering and mathematics (STEM) education coupled with English language learning can be successfully incorporated into the PBL model (Boothe, D. et al, 2011). Through this approach the scope of real world connection is highlighted. 'By applying language skills to the workplace, students develop survival skills for the working environment, increase their workforce marketability, and prepare themselves for lifelong learning. The PBL model ensures that language skills are strengthened by experience with a broader scope of disciplines at the same time' (Boothe, D. et al, 2011).

In relation to the PBL application for strengthening the mother language efficiency of secondary vocational students (even through professional, technical language), we realize that research literature is very poor and a new research area is opened for further exploration, experimentation and interesting findings.

THE RESEARCH

Adjusting the Problem Based Learning method in E-Problem Solving Language Instruction for Vocational Students

Recent studies on technology have shifted from the emphasis on technology skills alone to integrating pedagogy and content with technology, which is termed technological pedagogical content knowledge (TPACK). The TPACK framework constitutes a complex interaction among content, pedagogy and technology that produces the types of flexible

knowledge needed to successfully integrate technology use into teaching (Koehler, M. J., & Mishra, P. 2009).

More specifically, a problem-based pedagogical approach can create critical but safe opportunities for teachers to better understand that while using technology, teachers may have to re-evaluate their teaching practices and to rethink the nature and scope of the subject for which it will be used (Kharade, Kalpana, Peese, Hema, 2014). From this point of view, technology is better utilized when the integrated pedagogy is stimulating and motivating for the student and creates a constructive, interacting environment for study and work.

As far as the present research field is concerned, a multimodal e-learning environment had been constructed to teach to instruct technical writing as a process of solving the problem in as much as possible authentic communicative contexts. The e- environment supported and guided the students in his/her technical problem solving in a constructive way: by offering supplementary and supportive resources, by indicating strategies of e-text production with the use of various auxiliary tools and stimuli (key-vocabulary help, text structure, appropriate questions), by providing appropriate e-tools (e.g control tools, easy publishing tools, searching tools in embedded libraries or in the web) according to the 'scaffolding' method (Vygotsky, 1978), with gradual transfer of responsibility of learning to the students themselves.

The teacher-researcher, therefore, planned and implemented an instructional web-based program with a series of problem solving activities connected to the vocational/technical curriculum (Sectors and Specialties subjects) of the lyceum, adjusted, though, to real work situations. The educational social-media platform of Edmodo offered the opportunity for easy disposal, sharing, re-use of digital learning resources and for managing the activities, operations, evaluation and monitoring in a multimodal e-environment. The educational content presented was interdisciplinary, connecting mainly the language lesson not only with the objectives of a typical language course (production of narrative, argumentative, descriptive or directional speech), but also with the language functionality in technical course areas and specialties of the middle vocational school. The connection of writing activities with business/real market interests so as to guide students - largely negative to traditional school practices - to write texts with technical, utilitarian characteristics (technical writing, Wright, 1987) functioned as a facilitating and motivating practice with great impact to students' attitude. In this way, authoring skills were associated with the skill of solving a technical problem. These technical problems were problems that usually an employee or apprentice technician (engineer, agriculturist, car mechanic, electrician) is confronted with in his/her work. The students were divided into work groups according the professional sectors they attended. A mechanical damage or an electrical problem was presented to the student as a problematic situation and the student needed to utilize specific data and information to find the solution. In order to achieve that, he/she had to bridge the existing with the new knowledge, the actual experience with critical thinking.

Initially, the experimental project presented to the students surprised them. In Greek Vocational schools there is no provision for trainees to produce technical texts in the sense that they are especially trained in the technical writing. Nor there is any prior instruction or commonly shared experience on writing in asynchronous or synchronous electronic learning environments. Furthermore, the students themselves spontaneously linked writing tasks with difficult, frustrating academic activities, without realizing that they could be educated in another type of writing and language literacy that mainly serves their professional development.

The Sample

The research took place in the 1st EPAL (Vocational Lyceum) of Lamia city where I worked as a language teacher

for the 2012-13 school year. The sample was consisted of forty-six (46) students, more precisely, of two randomly selected 11th grade student departments/sections of twenty-four (24) and twenty (22) persons each, respectively. The first section served as the control group and the other as the experimental group.

The general characteristics of the two groups were put into comparison mainly through their responses to a questionnaire delivered to them (by asking about parents' profession, parents' working situation, students' access to internet, whether students work alongside schooling etc.). The emerging compliance proportions as to students' profile can be found in Appendices (Table 1).

As for the experimental group, in more details, I can say that: most of them (59%) had no access to personal computer and internet connection from home or from mobile. However, almost all had profiles on facebook and, also, many frequented Internet cafes. Eleven (11) out of the twenty (22) students surveyed (50% of the team) worked alongside school in rural work, cafes, machine shops or garages. Five (5) out of 22 (23% of the group) had mild learning difficulties (dysorthografia, attention deficit) and half of them (50%, 11/22) had mild school delinquency in the form of complete indifference towards course content - manifested by utter ignorance of relevant books or taught modules even their respective teachers. Several of them did absenteeism. Sixteen (16) out of 22 faced financial problems in their family, while four very important economic problems (with one or both of their parents unemployed). Three students -a small percentage of 12.5% -were bilingual, but because they had no difficulties with the Greek language, their bilingualism was not treated as a special parameter to the research results. Almost all, had a negative feeling towards school, they faced it as a compulsory service imposed to them through rules of study and behavior which did not want to follow. They didn't seem to have strong, internal motivations for learning, as they had disconnected their personal professional-social development with success in school.

The Research Model

The teacher/researcher undertook action research. From this perspective, my research: a) was associated with the diagnosis of a problem at a predetermined context (difficulties in writing skills of students of a part of second grade Vocational Lyceum) and tried to solve it within the given context b) was participatory, as the researcher who introduced the project also applied it within its own class in school, c) was self-evaluated during the project in an attempt of the researcher to optimize conditions, the practices used and hence the overall effect. So, we see here the classic division into two phases-stages: 'the diagnostic stage in which the problems are analyzed and the hypotheses developed; and the therapeutic stage in which the hypotheses are tested by a consciously directed change experiment, preferably in a social life situation' (Cohen, L. & Manion, L., 1994).

Additionally, the design and application of my research meets the requirements of a true experimental design. This study incorporated elements of true experiment "before and after» (true experimental design: pretest - post-test control group design) in both, the experimental group and the control group: a) first (in October 2012), measurements in both groups were made (PHASE A). Also, as I was a new teacher in the school, I used a questionnaire in order to format a documented insight for my students' profile b) as long as the research was being applied, parallel performance measurements were conducted on the students of both groups (PHASE B) and c) at the end of the research project (April 2013), evaluative performance measurements were conducted in both groups so as the researcher to establish a clear picture about in which team there were any change and to what extent (PHASE C).

Phase A

In this phase the researcher: **a)** had to diagnose and compare the linguistic level between the groups for verification of their equivalency. A diagnostic test was conducted on October 9, 2012 and concluded apart from grammatical-syntactical exercises (compulsory for the 11th grade vocational students according to official directions), the task of transforming an on purpose badly written text to a correct text. An online advice manual (advanced planting guidance techniques - distorted for the needs of the test) was posed to the examinees and they were asked to make essential modifications (orthographic – syntactical –vocabulary) to the text so as it makes sense. This particular exercise was the most important as the researcher could examine the ability of the student to write a text for specific communicative objective. The students' answers were evaluated by specific criteria as seeing below, which were used for the post-test assessment as well:

- Comprehension of a Required Problem Task
  - Low
  - Moderate
  - Full
- Critical Development of Auxiliary Data
  - Not at all
  - Minimum
  - Satisfactory
  - Full
- Responsiveness to the conventions of the text type as to style
  - Null
  - Little
  - Very good
  - Excellent
- Responsiveness to the Conventions of the text Type as to Linguistics
  - Null
  - Little
  - Very good
  - Excellent
- Responsiveness to the Conventions of the Text Type as to Structure
  - Null

    - Little
    - Very good
    - Excellent
- Responsiveness to the conventions of the text type as to communicative adaptation
    - Null
    - Little
    - Very good
    - Excellent
- Morphological analysis as to quantity of syntactical errors
    - Many mistakes
    - Several Mistakes
    - Little mistakes
    - No error
- Morphological analysis as to quantity of orthographical errors
    - Many mistakes
    - Several Mistakes
    - Little mistakes
    - No error
- Development of suitable or specialized terminology
    - Null
    - Moderate
    - Very Good
    - Excellent
- Length of Text
    - absence of text / word response
    - lower than requirements
    - satisfactory
    - the expected

- Degree of coverage of requirements of the topic/problem:
  - Insufficient coverage
  - moderate coverage
  - very good coverage
  - full coverage
- 12. GENERAL MARK (Diagnostic test – 1st Assessor)
- 13. GENERAL MARK (Diagnostic test – 2nd Assessor)

B: From the data collected regarding the social, educational profile and the linguistic level of the students, the researcher proceeded to the selection of the suitable web platform (Edmodo), the design and the gradual development of the e-learning activities which would constitute its educational content.

Phase B

This phase begins in the second week of November 2012, after the analysis of the findings of the diagnostic test (Phase A) and has a duration up to mid April 2013, about 5 months total. It included: **a)** the implementation of e-learning instructional activities which were developed and delivered by the researcher-teacher, whereas the students took 7-10 days deadline to find the solution and publish/post their answer through their mobiles, personal or school computers (for that reason regular meetings were made in the computer laboratory **b**) the teacher's observation on any behavioral changes of the participants regarding their response to the e-activities **c)** the collection of criteria based qualitative and quantitative data at two time points, at the start and the end of the experiment. The pre-test (Phase A) criteria, appropriately differentiated for the experimental group (see below), were used as the basis for the B Phase progress assessment. In Table 4, the 3d, 4th, 5th and 6th criteria were changed to 3A, 3B, 3C and 3D respectively and the 7th and 8th criteria to 4A and 4B, so the A' phase 11 criteria became now 9.

Finally, as far as the e-content itself, I am quoting some representative e-learning activity examples that students of the intervention group dealt with:

From the Group of ELECTRICIANS Sector

ELECTRICAL STUDY OF AN APARTMENT/FLAT (for the submission of a work permit from the Public Power Corporation (DEH))

Open the file with the sectional plan of the apartment. With the help of the electronic symbols, find what type of appliances exist. Write down the appliances on a table or list. Find what electrical energy on average each one has and calculate the total energy in KW which this household will consume and then decide, as an electrician, if the apartment will need a monophasic or triphasic electric supply from the Public Power Corporation (justify your answer). Furthermore, state how many independent power lines or group power lines will be needed for these appliances.

Embedded Digital Material

- One picture with the sectional plan of the apartment/flat.

- A table of typical energy consumption rates of appliances.
- A table of electrical symbols.
- Lesson notes on Mechanical Installations (Basic Parts of an Internal Electric Installation)
- Website of the Public Power Corporation with information on monophasic and triphasic power supply.

From the Group of the VEHICLE Sector

Problem with Oil Loss

Two years have passed since the purchase of my (used/second-hand) vehicle model CITROEN CE PICASSO. The odometer shows 50,000 km, most of which were driven within the city and I have had maintenance done twice. In the last maintenance I had semi-synthetic oil put in. In the beginning the car had problems of over-heating and I added oil. Since then, although I have not driven more than 3,000 km., the car burns a lot of oil even though I supply oil constantly. In the last week I see oil on my garage floor and I think that the quantity of oil loss is larger when after turning off the engine, the motor is still hot.

- What could be responsible for the problem? (justification of the problem)
- What damage could be caused by oil loss? (description of the consequences)
- How do I make the best possible choice of oil? (advice)

Instructions

For the justification of the problem, see the picture/illustration which shows the flow of oil as well as the video with the function of the motor (when does the motor burn oil?); For the remainder of the questions, consult the remaining files and links.

Embedded Digital Material

- Relative websites from companies and businesses which are active in the field.
- Electronic magazine (autotriti.gr).
- doc file with notes on the lubrication system of the vehicle.
- doc file with informational text on which oil is suitable for each type of motor.
- Video with 4 stroke engine animation.mp4
- Illustration of lubrication system of a 4 stroke engine with forced lubrication circulation.

From the Group of AGRICULTURALISTS

SMALL BIPHASIC OIL-MILL

You are a young, average (as far as olive oil production is concerned) olive producer. To a student who is interested in the production process of olive oil and who visits your work premises you:

- Explain the basic difference between triphasic and biphasic oil mills (Watch and listen to the first video).

- Describe the function of a small biphasic oil mill explaining the phases of processing the olive (you can use the first person, active voice ex: We put the olives). Follow the second video and the pdf file

Embedded Digital Material

- Website from a Production-Standardization Olive Oil company – Commercial Oil Industry Machinery.
- Online notes on the processing of olive oil and types of oil mills.
- Video with the subject matter: Managing Oil-Press Waste.
- Video with the subject matter: Small Professional Oil-Press
- pdf file with illustrations of biphasic and triphasic separator, diagrams and tables.

From the Group of MECHANICAL ENGINEERS

Problem with Smoke in a Petrol Burner

During the function of the burner (petrol, Weizer plus 12, 52,000-112,200 Kcal/h) in the boiler room of a single family home black smoke appears. It regards a single pipe system with a tank installed higher up than the burner. You are a specialist technician in the maintenance of burners and boiler rooms. What do you think could be at fault and what will you do to deal with the problem? What type of work and measurements will you do for example and why? (see the file 'Leaflet on Boiler Inspection'. Consult the relative support material.

Embedded digital material:

- Blog for instruments and accessories for petrol burners.
- Website for the function, parts of the burner and their maintenance.
- Transparency files regarding the types of combustion of petrol.
- A Sample Inspection Leaflet for boilers (pdf file).
- Illustration of a burner with the parts of the burner and the relative terminology.

Phase C

Based on the initial research design, the students of the two groups were subjected to a final post-experimental assessment test ('post-test' control), which took into consideration the following parameters: a) the topics of the test had to maintain an analogy with the topics of the pre-experimental test, so as to have a credible comparison b) due to the fact that the students are grouped into professional fields in both divisions, the linguistic exercises of the final test – in order to preserve the previous conditions of analogy – had to be connected with the technical curriculum subjects. There was, however, the risk that the students who had participated in the experiment had become familiar with the requirements on the final test from the platform exercises, and as such, had a better performance, for only that reason. In contrast, the control group ran the risk of being surprised by the content of the final test (development of a technical text type) and to be a priori in a disadvantageous position than the experimental group. To avoid this above mentioned internal risk, as the educator, I put on equal treatment the two groups by also giving the control group some texts of professional content for the requirements of the traditional lesson and thus there would exist a familiarity with analogous technical topics and

terminology. The differences between the control group and the experimental one are illustrated in the post experimental analysis in Table 7 and 8 (Average Value: A.V., Deviation Value: D.V).

The Variables

The pedagogical framework represents an essential part of the e-learning system conceptualization and development and offers sound concepts for the development of learning scenarios in order to enhance the learning experience of students in secondary schools (Granić, A., Mifsud, C., & Ćukušić, M., 2009). Accordingly, the application of an e-learning instructional program inevitably consists of technical and pedagogical features, so coming to the debate on variables in educational research, we can understand that variables aren't always 'quantitative' or numerical. For instance, in much social research and in program evaluation, we consider the treatment or program to be made up of one or more variables (i.e., the 'cause' can be considered a variable). An educational program can have varying amounts of 'time on task', 'classroom settings', 'student-teacher ratios', and so on. So, even the program can be considered a variable (which can be made up of a number of sub-variables) (Trochim M.K. William, 2006).

If we attempt to summarize the key differences between the teaching practices applied from one group to another, we could basically group them in this way: a) the students followed the TPBLL method worked entirely on an educational LMS platform, they read and wrote only utilitarian, professional technical text-genres, they dealt with technical problems from the real world by trying to solve them with guided access to electronic multimedia sources, interaction with digital-Internet resources, multimedia and hypermedia information presentation, they used language in authentic situations from the real world of work b) the students followed the conventional teaching and learning school practices worked in the traditional classroom without any technological mediation (as most school classrooms in Vocational Lyceums have no technological equipment) and dealt with photocopied articles, letters, opinions, essays and other school genres. As a result, lesson focused on vocabulary, linguistic functions, exercises, questions and answers and language use wasn't connected with the real work places' culture and discourse. These differences which shape the independent variable-method in this educational study can be found in the Appendices (Table 2). Conditions that remained unchanged are: the teacher, the use of decreasing guidance, the feedback giving, the use of genres theory pedagogy (deconstruction and reconstruction of textual items). The dependent variables were the different indicators of students' performance on writing (text size, coverage requested, communicative adjustment, vocabulary improvement etc.).

FINDINGS

Phase A

The two groups were proved to be equivalent and representative: **a**) by the first personal comparison of the students' grades at the pre-test (grand totals and individual exercises), I found an equivalence between the two groups with a slight predominance of students in the control group. To verify the hypothesis of the equivalence, the measurements values were passed in the S.P.S.S. (Statistical Package for the Social Sciences) software for statistical measures of any differences in average prices between the two groups. The statistical processing showed that both groups were of low performance and linguistically equivalent (Null Hypothesis-H_0 accepted = Both groups perform equally, as 2-tailed Asymp. Sig. (=p) is >0.05 in most criteria). Although the control group predominates slightly versus the experimental group, these differences were statistically insignificant to threaten the validity and reliability of the research design. The results of these measurements are demonstrated in Appendices, Table 3. **b)** As to the economic-social comparative approach of students, a high degree of similarity of the two groups was found. **c**) in order to verify the representativeness of the sample to a larger

population(all students of the country's vocational lyceums), I compared the aforementioned profile statistics of the two groups with statistical percentages of corresponding characteristics in surveys recorded in Greek research literature. For that purpose, I sought evidence in investigations into professional-technical education in Greece, focused on the students' profile (Argiriou A., Gatsoris Th. 2012, Neophyte, Giannakidou, 2010; Pangalos, 2005, Ploumidou, P. 2002; Papaleonida P., Bechrakis Th. 2007). The current demographic, social and economic characteristics that are attributed to different sample groups of students of vocational education from different geographical regions of Greece, converge in the most recently published general classification table of students (Pangalos, St., 2005) and summarized in the following percentages: a 10-30% of total student population in Vocational Lyceum (EPA.L) come from families with low incomes, 'paved family small enterprise', do not respond to conventional teaching methods and want to quickly enter the labor market. A 10-30% come from low and middle incomes, have moderate or good performance and want to continue in Higher Technical Education, while a 50-70% come from single parent families or immigrants, show indifference to their specialization courses and wish only to get a 'paper' (degree or diploma) or to continue their studies as long as possible (until they see what they do). Furthermore, according to the aforementioned surveys, attendance rates of girls compared with boys in EPAL ranges on average by 10-30%, i.e. a very low rate.

So, I can say that the two groups in my research were largely representative of the general vocational pupil population, as we find in them, with relative percentage approach, all the social sub-categories (aliens, working students, girls boys, children of unemployed or low income parents) encountered in EPALs. Of course, because we are talking about human population and social parameters, statistical deviations of percentage relationships may change, however not statistically significantly so far, from year to year.

Phase B

The measurements and the contrast of the rates of the two groups (average value of the rates of the members of each group for each assessment criterion), as accomplished with One Way Repeated Measures, proved that the experimental group did better than the control group in the final measurements of this phase, even though in the initial measurements, it began from an inferior level in most criteria. The statistical measurements are demonstrated in the Appendices (Table 4).

Phase C

Although initially (Phase A) there were not significant statistical differences between the experimental group and the control group, however, the experimental group, as opposed to the control group at this final stage of the research (see in Appendices, Table 5), presents a better performance in the development of suitable or specialized terminology, in the responsiveness of the conventions of the text type as to the style, the responsiveness of the conventions of the text type as to the structure and the responsiveness of the conventions of the text type as to the communicative adaptation (criteria where Mann Whitney $U(=p)<0,05$, thus we do not accept the null hypothesis).

Moreover, it seems –from additional measurements conducted throughout the research - that the mediation program helped the weaker students to a significant degree, while the better students improved as much as they would have improved with the classic educational program. Observing the differences per student, I noticed that the differences between the groups of the former are tremendous and non-existent for the stronger students. Of course, up to a point this is expected as a mediation program consists of more of an adjustment for the weaker students.

Furthermore, another statistical analysis of the compared groups showed that the experimental group was improved by 87.3% between the two tests, whereas the control group was improved by 38.8%. In the measurement the Average Value is the average group performance in the school evaluation scale of 20 (20 –excellent, 10-pass, 0-9 fail), whereas students' performance was evaluated by two teachers-evaluators in the pre-test and post-test phase for more result credibility.

Table 1

	Experimental Group			Control Group		
	N	**Average**	**Deviation Value**	**N**	**Average**	**Deviation Value**
Pretest	22	7.1	3.1	24	8.0	3.3
Posttest22	22	13.3	2.9	24	11.1	4.0
Improvement		87.3%			38.8%	

Finally, the research showed that, especially in the production of a specific professional/technical text-genre, the students of the experimental group exhibited a much better performance in relation to the control group. They worked exclusively on readily available workplace assignments and genres such as commercial proposals, advertisement leaflets, promotion of services via professional websites, technical advice, explanation of a technical problem, demonstration of technique in an apprenticeship framework or via video etc. Their progress was recorded linguistically, on basic literacy skills (use of vocabulary/terminology, structure, grammatical – syntactical data), as to their communication performance (comprehension of communicative goal, adoption of social – professional roles, adoption of the analogous style and linguistic variety), as to their metacognitive ability (adoption of writing strategies, management and elaboration of educational material and sources, critical choice of information). Gradually, I observed a removal of the previous negative attitude towards writing, an increase in their activity concentration and goal achievement, reinforcement of autonomy and self-regulation in learning, reinforcement of internal motivation, sense of professionalism and consequent interest in technical writing and communication.

CONCLUSIONS

The students who systematically used Greek to read and study empirical electronic data of technical information, to solve technical problems and post the answer on the electronic platform of Edmodo, exhibited spectacularly greater progress in the ability to produce the written word in relation to the students in the experimental group. As a final conclusion, I could say that this e-learning project documents a successful solution for the vocational secondary students and teachers. It turned out that the technologically mediated Technical Problem Solving method was for the students an attractive, interesting method of language negotiation of technical issues, prompted them to reflect on a subject, to search for the right material, to develop language development strategies, to improve their professional language and linguistic ability in general. In closing, I believe that in a modern secondary Vocational School all subject areas can complement each other, covering different aspects and applications of learning and apprenticeship. In this light, in a holistic, cross-curricular model of language learning, mother language teaching (as physics, chemistry and mathematics) should help in vocational and technical cognitive development of the student, so as he/she strengthens his / her professional identity. In turn, of course, this raises issues of further reformation of existing vocational curricula in secondary education towards a interdisciplinary, co-operative cross-curricular teaching and learning model.

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APPENDICES

Table 2: Students' Profile

Students' Characteristics	Control Group Percentage in the Group	Experimental Group Percentage in the Group
NO personal access to the internet (via personal mobile, P.C, tablet)	50%	59%
Adequate, very good digital literacy (as ability to handle files, edit texts, upload/download files, navigate in the web)	25%	18%
Students that work alongside their schooling	43%	50%
Students with learning disabilities and mild delinquency	20%	23%
Bilingual students	4%	13%
Girls	24%	13%
Parent's employment: Mother not working outside (housekeeping only) Father employed (mostly in agricultural work, as low paid employees) Unemployed parents	 60% 82% 8%	 75% 85% 15%

Table 3: Differences in Teaching Application

Experimental Group	Control Group
TPBLL-Language Instruction and Practice by Solving Technical Problems - Area of application: e-learning training platform (educational LMS-Edmodo), computer laboratory -Pedagogical Framework: i) students read and write only utilitarian, professional technical genres ii) Problem Based Learning: students identify technical problems from the real world and try to solve them. A guided access to digital multimedia resources and the critical interaction with the educational multimodal materials help them to find the missing information and form a suitable answer iii) Situated Learning: technical problem topics make students simulate roles and situations from the real world of work/apprenticeship.	**Linguistic training through conventional teaching** - Area of application: traditional classroom without any technological mediation. - Pedagogical Framework: i) students work with printed course material, the usual school 'genres' (articles, letters, opinions, essays, news reports, announcements etc.) ii) lesson focuses on vocabulary, linguistic functions, exercises, questions and answers iii) language is not connected with the real work places' culture and discourse.

Table 4: Pre-Test Stage: Differences between the Mediation and Control Group

	B3 Experimental Group		B4 Control Group			
	Mean	Standard Deviation	Mean	Standard Deviation	Mann-Whitney U	Asymp. Sig. (2-Tailed)
Comprehension of a required problem – task:	1.7	.8	1.9	.7	231.00	.431
Critical development of auxiliary data:	1.8	.8	2.2	.9	182.50	.057
Responsiveness to the conventions of the text type as to style	1.9	.8	2.1	.9	226.00	.375
Responsiveness to the conventions of the text type as to linguistics	1.6	.7	2.0	.8	201.50	.139
Responsiveness to the conventions of the text type as to structure	1.5	.7	1.7	.9	253.00	.787
Responsiveness to the conventions of the text type as to communicative adaptation	1.7	.8	1.9	.8	222.50	.326
Morphological analysis as to frequency of syntactical errors	1.9	.8	1.9	.8	258.00	.888
Morphological analysis as to frequency of orthographical errors	1.9	.8	2.0	.9	233.00	.469
Development of suitable or specialized terminology	1.5	.6	2.0	.9	171.00	**.028**
Length of text	2.1	1.1	2.5	1.1	208.00	.199
Degree of coverage of requirements of the topic/problem	1.3	.6	1.8	.8	174.00	**.026**
GENERAL MARK (Diagnostic test – 1st Assessor)	7.1	3.1	7.6	3.2	236.50	.539

GENERAL MARK (Diagnostic test – 2nd Assessor)	7.1	3.1	7.8	3.7	241.00	.610

Table 5: Differences between the Control Group and the Experimental Group between the Two Time Intervals (Average Value: A.V., Deviation Value: D.V)

Time Interval						
			Initial Time Interval		Final Time Interval	
			A.V	D.V	A.V	D.V
Group Experimental Group (B3)		Criterion 1	1.77	.75	2.55	.60
		Criterion 2	2.23	1.11	3.18	1.01
		Criterion 3A	2.00	.93	2.73	83
		Criterion 3B	1.91	.87	2.68	.95
		Criterion 3C	1.77	.87	2.73	.94
		Criterion 3D	1.86	.77	2.64	1.05
		Criterion 4A	3.09	.53	3.18	.85
		Criterion 4B	3.14	.94	2.86	.94
		Criterion 5	1.73	.70	2.50	.91
		Criterion 6	1.45	.60	2.32	.95
		Criterion 7	2.27	1.08	3.27	.77
		Criterion 8	1.91	.87	2.68	.99
		Criterion 9	1.95	.84	2.77	.92
Control Group (B4		Criterion 1	1.96	.75	2.42	.58
		Criterion 2	2.21	.83	2.92	.78
		Criterion 3A	2.42	.65	2.38	.71
		Criterion 3B	1.71	.62	2.08	.88
		Criterion 3C	2.08	.78	2.00	.78
		Criterion 3D	2.29	.75	2.42	.83
		Criterion 4A	1.87	.74	2.50	.72
		Criterion 4B	2.00	.83	2.54	.66
		Criterion 5	1.58	.65	2.08	.93
		Criterion 6	1.46	.66	2.21	.93
		Criterion 7	2.63	1.13	2.96	.81
		Criterion 8	1.92	.83	2.25	.85
		Criterion 9	1.96	.75	2.17	.82

Table 5: The Post Experimental Comparison of the 2 Groups

	Experimental Group (B3)				Control Group (B4)	
					Mann	Asymp.
	M.T	T.A	M.T	T.A	U	Whitney Sig.(2Tailed
Comprehension of a required problem – work	2.42	.77	2.36	.66	193,000	643
Critical development of auxiliary data	2.74	.99	1.82	1.01	109,500	**.007**
Responsiveness to the conventions of the texttype as to style	2.47	.84	2.00	.98	157,000	149
Responsiveness to the conventions of the text type as to the communicative adaptation	2.63	1.01	1.95	1.05	135,500	**.046**
Morphological analysis as to Frequency of syntactical errors	2.79	.63	2.64	.85	182,500	.453
"Morphological analysis as to Frequency of orthographical errors	2.58	.69	2.41	.85	183,000	.462
Development of suitable or specialized terminology	2.53	1.02	1.86	.94	133,500	**.040**
Length of Text	3.00	.88	2.27	1.24	138,500	056

Degree of coverage of requirements of the topic/problem	2.42	.90	1.86	1.04	143,500	.071
GENERAL MARK (Diagnostic test – 1st Assessor)	13.16	3.50	10.95	4.60	161,000	.206
GENERAL MARK (Diagnostic test – 2nd Assessor)	13.26	3.80	10.95	4.81	159,000	189