Difficulties and Problems in the Implementation Phase of an Open Online Personalized Learning Environment for Vocational Education and Training for the Covid-19 period

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Abstract:

Purpose *- This article was formed in the context of a technical reflection on the difficulties and problems during the implementation phase of an Open Online Personalized Learning Environment for Vocational Education and Training.*

Design / methodology / approach *- The implementation phase took place in the school period 2019 - 2021, and the application development continued in the school period 2020-2021. The main focus of this paper is threefold, namely: a) the evaluation of the deviation in achieving the design objectives, b) the detailed report on the difficulties and problems in the implementation phase, and, finally, c) the possible problems of future uses as the environment operates through the Panhellenic School Network. The online designed environment works with the existing digital infrastructure as a distance learning option. The specific educational material, taken exclusively from the Analytical Curriculum, was designed, and developed based on case studies and best practices so that, after various evaluations, it could be redesigned following the suggestions of students and teachers involved.*

Findings – *The article, recording the difficulties, mediates as an assessment of the result, allows us to observe what has been achieved, and gives us the keys for similar future actions.*

Index Terms — Digital Educational Material, Learning Objects, Online Learning Environments for Technical Specialties, Internet Technologies, Software Technology

I. INTRODUCTION

Sondergeld, Stone, & Kruse **[1]** combine the development in learning with the ability to make decisions considering that the development of each student is linked to a process of gathering useful information for judging alternative decisions. That is, the development of the student acts as a continuous feedback mechanism to improve and perfect his reference system. The process of learning for engineers is essentially reduced to a process of calculating or measuring the quantities that concern them. Such a mechanism could be an Open Online Learning Environment (OOLE) for the electrical engineers of Vocational Education and Training (VET). Open Online Learning Environment appeared in 2008 as an "opening up" movement in education, which was received and implemented mainly by high and higher education institutions **[2]**. At their starting point, they introduced a culture of interconnection, and since 2011 they have gained a widespread expansion through users and supporting Institutions. The subject areas covered by Open Online Learning Environment are mainly related to educational research, but interest has also turned to other fields such as Computer Science, Business Economics, Information Science, Psychology, Engineering, etc. It, therefore, becomes understandable that these OOLE, as massive online open courses, expand to various scientific and research fields **[3]**. This breadth of reference has contributed to the fact that OOLE in the 21st century has already acquired a tradition of Internet Technology (IT) and digital technology structures, which are related to learning and significantly impact students' education. As OOLE has grown exponentially in recent years, they have been internationally at the center of educational and research interest **[4]**. Education visionaries, educational reformers, web environment designers, and web researchers throughout the meta-web 2.0 eras have cataloged the potential of online educational environments and sought to improve those **[5]**. The goals of the improvements relate to both student participation and learning analytics (Learning Analytics), and outcomes related to the expansion of teaching data (Teaching Analytics). However, creating an effective open online learning environment remains an important and complex issue as;

the simplification of user processes is inversely proportional to the complexity of programming such an environment **[6]**. The simpler the user participation processes, the more complex the programming components **[7]**. The consequences concern the even greater mixing of learning environments with the use of online resources, the integration of newer technologies and web tools, and the integration of "face-to-face" communication **[8]**.

With the passage of the 21st century in international scientific conferences, among educators, researchers, and developers-designers of IT, a trend was established worldwide, which concerned the support of personalized learning environments. This trend prominently involved student users as evaluators and advocates of online learning development **[9]**. Technological advances and the widespread development of internet applications have accelerated this trend, and web-based learning has become a primary focus of attention in the field of education **[10]**. The design of a learning environment that operates on the web can be addressed at different levels of education, from kindergarten to middle school, high school to tertiary education, and in different learning areas. Moreover, in recent years, a large proportion of national educational resources has been consumed in expenditures related to the introduction of supportive learning environments in secondary education, particularly software related to VET engineering education **[11]**. Scholars and researchers have recognized the potential of digital environments to improve student engagement in learning and learning outcomes. However, creating an effective learning environment remains a significantly challenging design issue. This happens as the technological evolution of web tools is inversely proportional to the conscious design decisions and mastered simplicity that the student user seeks. To be something simple and maximally compatible with the user, a special design effort must be invested in the modeling so that the asynchronous learning environment becomes effective **[12]**.

In terms of learning expectations, this article focuses on implementing a VET curriculum and, more specifically, on Electrical Engineering. The specific educational material, taken exclusively from the Analytical Study Program (APS), was designed and developed based on similar typical examples, case studies of learning environments and applications of the Sectors and Specialties of Vocational High Schools (EPAL), and best practices so that, after from various evaluations to be redesigned following the suggestions of the students and teachers involved. The learning contexts and boundaries of the specific web environment **[13]** have been defined by the VET curriculum framework for the Sector (Sector of Electrical, Electronic, and Automation Engineering, 2018). The learning content of the application is related to the course on Electrotechnology **[14]**. The thematic content of the article and the type of research and analysis focuses on the context of a technical reflection on the difficulties and problems that appeared in the design, development, and first implementation phases. The implementation phase took place during the 2019 – 2021 school term, and application development continued during the 2020-2021 school term. The orientation of the research took into account the following scientific fields:

- Internet technologies,
- Human-computer interaction,
- Software Technologies,
- Online Learning Environments supported by modern technologies,
- Learning and Teaching during the pandemic.

This research is based on the metadata captured from the application results and is included in the papers that deal with practical reports on the construction of online educational environments during the pandemic. The main focus of this paper is threefold, namely: a) the evaluation of the deviation in achieving the design goals, b) the detailed report on the difficulties and problems in the implementation phase, and finally, c) the possible problems of future use as the environment operates through the Panhellenic School Network (PSN). The article, recording the difficulties, mediates as an assessment of the final result, allows us to monitor what has been achieved, and gives us the keys for similar future actions. The article's structure is divided into four parts in addition to the introduction. The parts are

a) The methodological assessment of the implementation,

b) The difficulties and problems in the implementation phase,

c) The potential problems of future uses, and finally,

d) The conclusions.

II. METHODOLOGICAL ASSESSMENT OF THE IMPLEMENTATION

The evaluation methodology of this web application (http://kotsifakos.mysch.gr/elenap/#/) follows the recognized standards of educational software evaluations **[15]**. Our application environment specifically and effectively leverages multimedia to consolidate learning and enhance teaching **[16]** of Electrical Engineering by placing it in authentic and meaningful contexts. The interfaces with the proposed videos are designed according to the principles of educational software, mostly used in classroom environments with adolescents **[17]**. Oriented instruction in a web-based personalized environment approaches and represents a pedagogical effort that hopes to help students actively and consciously engage in authentic learning by placing directions and orientation instructions for realistic problem-solving in their learning domain **[18]**.

The application interface (Figure 1) presents categories of technical problems for the calculation of real applicable quantities (e.g., voltage or resistance calculation). In addition to developing general digital literacy skills, the application helps students acquire attitudes and behaviors that contribute effectively to solving real-world problems and consolidate specific electrical engineering concepts and principles. The added educational value of the application

lies in the fact that it leaves a deep impact on the student's educational horizon which contributes to thinking effectively, consciously, and decisively about the calculation of simple or more complex quantities (e.g., Kirchhoff's Laws) **[19]**. The application tangibly demonstrates effective design principles for developing technical knowledge and exemplifies the Technological Engineers in Action with Web Educational Software Action Research.

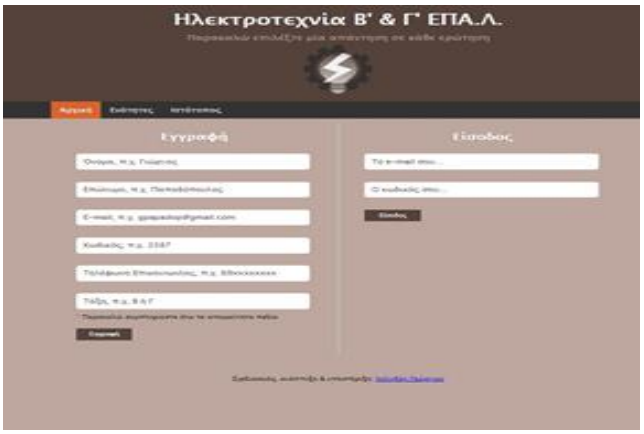

Fig. 1. The web interface of the application – Login

For the organization of this online application, we took into account the learning behavior patterns of VET students both in terms of the learning subject of Electrical Engineering **[20]** and in the orientation of solving problems related to this field **[21]**. Because of this effort, the need arose for the continuous improvement of the learning standards of technical education and the search for authentic learning and knowledge of the subject **[22]**. It is a given that due to the vertical development of Technology, Information and Communication Technology (ICT) in our days, education cannot remain unaffected. Nevertheless, scientific interest is focused on how modelling, design, and implementation adapt to learning environments and the outcomes that ultimately emerge. Often exceeding the expectations of researchers, the results not only approach the interest of the students to participate, but they perform to a greater extent than expected.

The methodology of this paper is embedded in the research strategy for the educational use of open online resources **[23]**, utilizes the tools of technology, and seeks effective learning of the curriculum of the Vocational High School (VHS) through the use of a personalized online learning environment. The interest in this research lies in the approach to knowledge about the learning subject of Electrical Engineering. Regardless of the familiarity of today's generation of students with the use of the computer, the treatment of ICT and the Internet as learning tools for extracting and disseminating knowledge should not be taken for granted. One needs to become an 'expert' in a learning environment and be oriented to be able to benefit from learning from it **[24]**. In the middle of the Learning Process (LP) is the technique of 'fenced' use of online material to enrich learning for a critical technical learning subject of the Electrical Engineering Specialty.

The presentation of the design philosophy focused on the pedagogical standards and learning models of VET as applied to the Electrical Specialties. The orientation to the Electrical Engineering course was chosen due to the criticality of its material as a learning subject for the development of Electrical Engineering in the Specialty. From the point of view of the educational use of online construction, we believe that teachers should know, on the one hand, the methods of building OOLE and, on the other hand, the difficulties and problems they will face if they try to enrich their teaching practices in similar ways and to seek the utilization of a broader "meta-web 2.0" orientation for the teaching of their subject. The environment we have designed and proposed works with existing digital infrastructures as another distance education option. This educational material, the introductory module of Electrotechnics, was designed and developed during the pilot implementation based on case studies and best practices so that after several evaluations, it could be redesigned following the students' and teachers' suggestions.

III. Difficulties and Problems in the Implementation Phase

Difficulties and problems in the implementation phase of the ongoing development of the Internet technologies and the vast range of applications in the technological field, finding reliable tools, linking them, but also the ongoing intensive study to optimize design are mandatory and are part of research and time to be devoted by the teacher, the developer or the team to implement their plans. This is to be seen as a front, as this is how we have functioned during the implementation phase. In this transition period, we have dealt with four problem areas with relative success.

- The first area concerned the responsiveness of the application to the browser. In particular, the different choices of browsers had different responses for various presentation characteristics (in colors, features, etc.).
- The second problem concerned the connection and management of the Database (DB), (Firebase).
- The third problem area was the limitation in usage time. Ensuring the extension of its usage time was considered a severe issue as the timeless operation of the application was the goal.
- The fourth problem area involved developing code in JavaScript **[25]**. The mastery of language manipulation based on adaptation to the application's needs has been and remains a severe field of research and development to this day **[26]**.

More generally, the difficulties that are analyzed and related to the implementation rate are part of the general context of web application development programming, which has been established over the last decade **[27]** and is constantly expanding. It was considered necessary for the validity of the research, the detailed presentation of the difficulty degree, and the different responses to each

problem involved.

IV. The Issue of Browser Selection (Browser)

Each browser has different features. This lies in the different specifications provided by their manufacturers. These differences are observed in terms of performance, color, and properties. For example, (Figure 2), we note that when our application runs on the Microsoft Edge browser, during the user-student data entry phase, an "X" appears in the fields at the end of the box. This signalling enables the data entry cleanup. Also, in the Chrome browser, we notice that the active field is colored blue compared to Microsoft Edge.

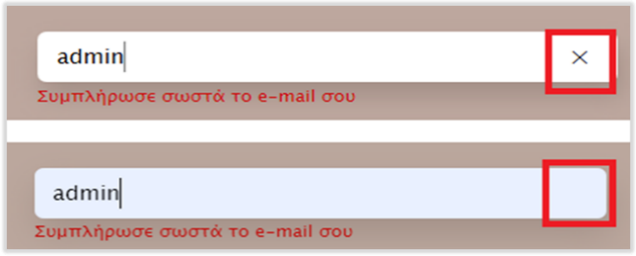

Fig. 2. Differences between Microsoft Edge (top) and Chrome (bottom)

Another difference when filling in the field concerns the user's password (Figure 3). The Microsoft Edge browser displays a unique character ("peephole") at the end of the box, allowing the user to see the digits he has typed, while Chrome does not display it in the corresponding input. Finally, Microsoft Edge, above the user's digits, does not display the field title, while these are displayed in Chrome.

Fig. 3. Differences between Microsoft Edge and Chrome

V. Connection to the Database (Firebase)

The use of advanced technologies to implement the application was a research option aimed at developing a modern personalized learning environment. One of the options that were enhanced was the Database (DB) option. The DB does not reside locally on our computer but in a single web-based centralized cloud space. In other words, instead of storing users and their data on a hard disk, USB, or laptop/PC, we store them on a server where access is only possible via the Internet. The advantages of using the cloud are:

1. more capacity on the local computer,
2. ease of data management,
3. security from the company offering the service,
4. cost minimization.

For this application, we followed the guide of the official Google page (https://firebase.google.com/docs/web/setup), according to which you must:

5. Have a Gmail account,
6. Create an environment on the link provided,
7. Connect your base with the application.

VI. Extending the Usage Time of the Database (Firebase)

The creation of a database (DB) is a crucial point for the development of a website. The database contains a series of tables that have as their primary purpose the recording of the website's content, data, and information relevant to its operation. In the DB, data is stored and extracted to be displayed as information on the website. We chose Google's Firebase as the DB for the application's website. The initial period of operation granted by Google to users is one month from the creation of the environment. After this period, the base stops working and requires the user to log in to their account on the website to refresh it (Figure 4).

```
rules_version = '2';
service cloud.firestore {
  match /databases/{database}/documents {
    match /{document=**} {
      allow read, write: if request.time < timestamp.date(2020, 8, 16);
    }
  }
}
```

Fig. 4. Database Operating Rule

VII. The JavaScript Code Development

To complete a fully functional environment, we developed JavaScript code **[28]**. The first construction approach involved simple knowledge of "Internet Technologies", but to develop the application requirements, we needed to expand on the knowledge level (self-education, personal engagement, searching for solutions from authoritative sources, watching educational videos on the web). The first steps of implementation may seem simple, but the expansion to a larger scale was completely different quantitatively and qualitatively. We believe that working with the JavaScript language is a personal achievement for anyone involved in Internet Technologies and Web Programming **[29]**. Engagement with JavaScript is used over time and will expand the professionalism of the analyst or developer.

VIII. Potential Problems in Future Uses

The possible future problems of the application are categorized according to the choice of the web server. As the Panhellenic School Network (PSN) is constantly upgrading its digital infrastructure, there is the case that for long periods the website will remain inactive or even need to be "loaded" again. There is a constantly updatable "backup" for the application. To solve this particular problem, to keep the websites acting as if the network has "fallen", long-term expanded research is required. Another problem that may appear as a consequence of the previous ones, concerns the connection of the DB to the web server of the PSN. The result

of the response loss makes the application non-functional since, in this case, it is not associated with the tables of the DB. In this case, the administrator must do the setting and the connection to the DB again.

IX. Conclusions

This article could also be included in the context of the upgrading of the digital infrastructure of Professional Training Education if such a thing is submitted as an overall perspective for the specific level, but, at this stage, it is included in the continuous modernization of the teaching methodology for its engineers under training meta-web 2.0 era. This interest is related, on the one hand, to the continuous exploration of the possibility of using digital mechanisms in course teaching, and on the other hand, to the urgent conditions of continuing teaching during the period of pandemic and blockades. The article reflects on this particular construct and seeks to formulate and provoke positive attitudes toward research on online learning environments. In this development, we first presented the overall framework that contributed to designing an online learning environment supported by advanced web-based technologies. The additional scientific interest in this paper lies in the analytical design on the effect of the students' psychology and their tense learning orientation. Through the final web application, we aim for students to become independent, not to focus on "mechanical" learning or achieving degrees, but on understanding and enriching their knowledge through other sources.

On the other hand, the special conditions that prevailed in education due to the pandemic should be considered for the implementation and completion of our work. Particular attention should be paid to the fact that the physical distance during the pandemic period, ultimately, negatively affected the improvement of the possibilities of our construction and the feedback that we had foreseen. This observation is part of an experiential conclusion, which was recorded during the period of use of the application and related to the overall expectations of online environments during the pandemic. Without being considered an "excuse", we should accept that the general use of online environments during the pandemic registered a type of disappointment and failure to meet expectations. The expectations of replacing experiential teaching, as done in school classrooms before the pandemic, could not be transferred to online environments, no matter how well-designed they were and how well they fulfilled their specifications. It would be unfair if we took this latent and entirely legitimate tendency from teachers and students as an evaluative measure of the online tools used in the exclusion phases. The boundaries and contexts of Distance Education, whether through synchronous or asynchronous environments, have their interactivity and boundaries and produce the outcomes associated with these boundaries. The intended distance interactivity of the laboratory courses, the loss of collaborative group practice of the Professional Training workshops **[30]**, and the different types of participation in the online classes cannot be measures of comparison for the tools that were used during the exclusion phase. In this sense, and as the contemporary - asynchronous tools of Distance Education are not sufficient to fully heal the reductions to the experiences of the physical classroom, they have suffered functional obsolescence from the educational community, conscious or unconscious sometimes, and registered a devaluation and at their level, commensurate with the damages and losses of all digital learning environments. The present analysis marks a different value-added approach to online learning environments in Professional Training Education.

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