Conceptual Representations of Participation in Synchronous and Asynchronous Digital Education Environments for Vocational Education and Training Students

D. Kotsifakos, E. R. Angelis, and C. Douligeris

***Abstract* — New critical educational issues arose during the implementation of distance education in the COVID-19 period. One of the most serious was the lack of non-verbal communication between students and teachers during distance education, as the physical contact of teaching was "mediated" by the digital environments of synchronous and asynchronous education. In this paper, we first describe and then take the first steps to fill this gap by designing non-mandatory descriptive methods for distance communication. To achieve this, we use conceptual representations and examine material by the real participation of Vocational Education and Training students in synchronous and asynchronous online environments. We present examples of verbal and non-verbal communication from student participation, using specific online applications, namely Mentimeter.com Hot Potatoes, and Wonder.me. Moreover, through the overall analysis of the issue, we illuminate the dynamic changes in the field of education, both due to the digital transformation of the institutional structures and to the change in attitudes and characteristics of students that result from these transformations.**

***Keywords* — digital tools for education, educational scenario, new technologies application in education, the effectiveness of digital tools.**

I. Introduction

The spread of COVid-19 and the consequent effects of the pandemic internationally has set an unprecedented stage for all organized education systems. The educational community was invited in a short time to move and take advantage of new distance learning environments to support teaching and learning [19]. Many learning stereotypes related to the students' psychological and social support had to be reconsidered and many established practices were overturned and replaced by distance learning conditions. One of the most complex issues concerns the loss of the communication mechanisms that are usually established within a physical school classroom or a laboratory. These communication mechanisms (verbal and non-verbal) form a crucial framework for the development of each student. We must, therefore, discover ways to explore non-verbal communication in distance synchronous and asynchronous learning environments.

To study on the lack of non-verbal communication between students and teachers during distance education, we focus on two directions. In the first direction, the interest is focused on conceptual representations of the communication mechanisms mainly in Vocational Education and Training (VET). Conceptual representations [14] can be very important models of the participation of the VET students in synchronous and asynchronous online environments. To fully clarify the research intention of the analysis, we utilize material from the scientific field of Conceptual Modeling [13] Conceptual representations help in the analysis of the current situation but, mainly, direct the future dimensions for the development of research. Conceptual representations contribute decisively, not only to the development of the perception of the action of language or thought [26] but in recent years they have contributed very strongly to the development and evolution of computer technology as well [8].

The second direction of the article focuses on the practical application of the communication mechanisms provided by various active digital environments. The organization of the curriculum of the specialties in VET is mainly assigned to technological educators [17]. In fact, in technical education, theoretical teaching is always combined with laboratory practice [16]. Technological educators correlate the degree of "assimilation" of the material by a student with the degree of developing, in parallel, theory and acceptable skills in an object of "laboratory nature": real system (troubleshooting), simulation, service delivery, the internet, and web technologies, and code implementation [2]. Most VET students are familiar with distance teaching and learning mechanisms due to their studies in their corresponding specialties [20]. In this paper, we follow the participation of students in distance education (synchronous and asynchronous environments) who use the online environments “Mentimeter.com”, “Hot Potatoes”, and "Wonder.me". Even though these applications had not been extensively utilized by the Greek educational community before, we expect that in the coming years the use of these tools will increase in the educational and scientific communities.

Moreover, we illuminate the dynamic changes that take place in the field of education, both due to the Digital Transformation of the institutional structures, as well due to the changes in the students’ attitudes and characteristics

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caused by these transformations. To achieve this, we examine the physical classes as well as the distance teaching of special courses in specific classes or Specialties of VET (Informatics, Electronic Engineering, etc.). We also analyze non-formal learning and teaching structures, in non-formal education activities, as described by the VET curriculum, applied to out-of-class or out-of-school student time and lifelong learning.

This research can be considered as part of the general thematic area of digital tools and e-learning concepts that can be utilized in Distance Teaching and Learning environments, in synchronous and asynchronous structures for VET [15]. The broader objectives of the research include the revitalization of theoretical and practical knowledge, but also the skills that will make possible the effective integration of both fully-fledged digital technologies with the emerging technologies that dynamically penetrate the field of education under new conditions, such as COVID-19.

This paper is organized as follows: Section II presents the basic elements of the research methodology and the strategic scientific dimensions of the article. Section III presents a short introduction to the Vocational Schools' teaching theories and the non-verbal student-teacher behavior in technical school classrooms, while Section IV focuses on the conceptual representations of participation in synchronous and asynchronous digital education environments. Section V presents some examples as part of the digital environments that we have used for our teaching. Section VI provides the conclusions, the evaluation of the conceptual representations of the participation system, its added value, and likely future works.

II. RESEARCH METHODOLOGY

We use examples and patterns from real teaching circumstances for the evaluation of online services connected with specific applications in teaching scenarios of VET lessons concerning: 1) the syllabus of the course, 2) the ability to focus and increase the concentration of the apprentices, 3) the students' inclusion, and finally, 4) the students' degree of involvement as measured through their active participation in the course. This research is limited to the Greek educational reality of VET and, is, in particular, addressing the use of applications in synchronous and asynchronous Digital Education Environments which are intended for it. Serious limitations of the research are the age of the students (adolescence and early adolescence), their familiarity with technology, and the technological equipment that is available in the structures that apply in VET. We take it for granted that each student has some basic personal equipment as well as a reliable internet connection.

The conceptual models that we will use in this article are representations of parts of the educational systems and use concepts and ideas from the individual representations. Specifically, for verbal and non-verbal communication, conceptual modeling is used in many areas, from capturing specific relationships to the implicit structures of communication and their impact on students and learning. These representations contain the ideas represented by a verbal or by a non-verbal correlation or sequences of sequential effects in a learning process. Recognizing these differences between the model itself and what it represents is crucial to understanding the proper use of conceptual models and to developing our proposed strategy. This methodology is a frequent practice in many fields, special for technology and communications tools. The uses of Conceptual models apply theoretical proposals that are ontologically well-founded and psychologically documented to the novelty numerous types of smart systems, technologies, and devices for students, learners, faculty, vocational and training schools, and academic institutions [24]. Throughout this article, we will utilize the conceptual models, implement various circumstances, and apply their perspective in the field of the development of tools to be used in distance education.

As we try to formulate this strategy in terms of conceptual representations or models, we accept the relationships as we see in Fig 1. The basic idea is based on the following principle: a research team cannot develop planned proposed management or operation models for education and training if it does not have as a model extensive acquired knowledge from real-life teaching. So, if a team or an educational organism (for example Ministry of Education) plans to organize educational systems (computer or communication tools) for digital services, must «introduce or apply» in the final plan, elements of real didactic experience as metamodels.

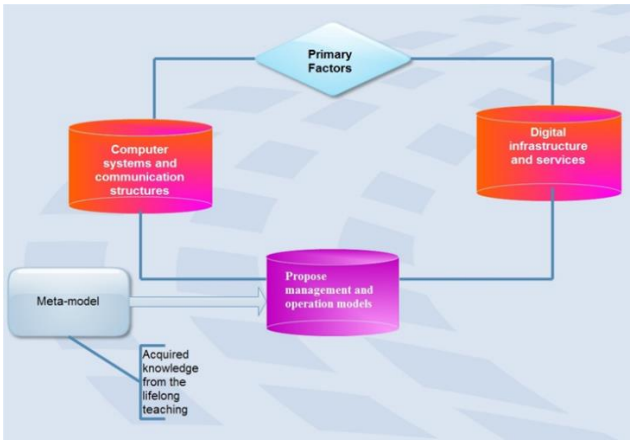

Fig. 1. Conceptual representation for a new strategy.

A. Vocational Schools' Classroom Communications Tools from the Students' Point of View

The VET curriculum focuses mainly on the development of mental functions and adaptive behaviors for the acquisition of conceptual, social, and practical adaptive knowledge and skills which will establish the students as future professionals [21]. The technological educators "evaluate" the effectiveness of their teaching including methods of verbal and non-verbal communication (Fig. 2). The official references for the curriculum of the technical education specialties emphasize the acquisition of technical skills and knowledge in students and the promotion of behavioral skills in the workplace for graduates or apprentices [3]. A special part of these reports focuses on the acquisition of technical skills and knowledge for promoting the ability to behave properly in the workplace.

The transformation in the spiritual and mental horizon of a student focuses on the mutation of his "professional habitus" and through this process, the largest percentage of his

education is organized. Elements such as student predispositions related to gender or family background are important but not sufficient to guarantee "effective" learning [6]. The "professional habitus" includes the development not only of a "sense" of how to be but also of the corresponding "sensitivity" to the required emotions and ethics and to the ability to behave. The transformation of the learning patterns in VET does not support the process of accumulating knowledge about a subject, as is common in general education. This type of initiation requires both verbal and non-verbal communication, and both the verbal imperatives and the descriptive non-verbal mentalities of a specialty.

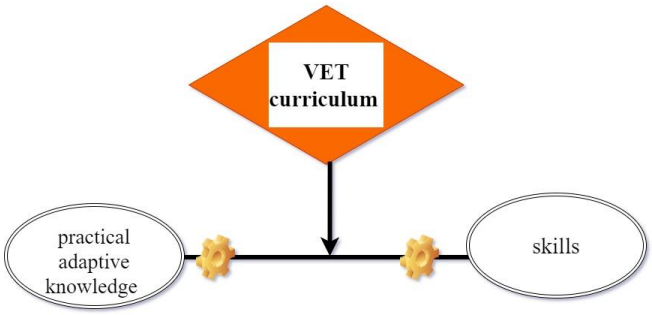

Fig. 2. Vocational schools' "tools".

B. *Verbal In-Classroom Student-Teacher Behavior*

In the daily life of teaching practice, by the term "verbal behavior" [12] we do not mean only the reproduction of content or the description of a subject, a lesson, or a theory by a student. Verbal behavior is a "method of teaching" that focuses on the idea that a meaning of a word is found in its functions [18]. By the term "student's voice" or "student's attitude", technological educators refer to a student's personality as a whole [5]. Non-verbal signals are also sent through the verbal behavior by the voice in the classroom, which is directly connected to different personal data. In the context of the student's communication with the teacher, the student's vocal behavior is determined by factors as 1) the volume of the voice, 2) the pace of speech development, 3) the student's mood and 4) the conjugation of the student's feelings towards the subject under study. The slow delivery of speech by a student may be the result of boredom, sadness, disgust, or indifference, while, on the contrary, the rapid and intense delivery of a speech, may mean a happy mood or possibly anger, fear, or stress. Overall, through the daily communication of the student to his teacher through the vocal society, several emotions and behaviors can be identified: the broken voice may show pain and despair; a trembling voice externalizes anxiety, while the loud voice conveys anger and possibly resentment. Finally, we should not forget that the vocal participation of a student in the classroom is also influenced by the presence of the other students, the impression given to them, and the comments made about his/her participation [25].

C. *No Verbal In-Classroom Student-Teacher Behavior*

The non-verbal communication of the student to his teacher and also to his classmates, within the school classroom, whether it is a theoretical lesson or a laboratory, conveys emotions together with messages. In a classroom, a series of "sensors", metaphorically, transmit to the students' brains mental processes and situations, joy, sadness, rejection, threat, disgust, and warning. This means that whether the non-verbal communication will cause positive or negative emotions depends on the form and the manner of the physical contact or the group mood. For laboratory exercises, the student's posture or tactile behaviors vary depending on the relationship he has with the object of teaching [4]. Especially for vocational students, not only age but also the degree of acquaintance and even gender affect their tactile behavior (Fig. 3). It has also been found that the organization of space and time in each laboratory affects each student differently [22].

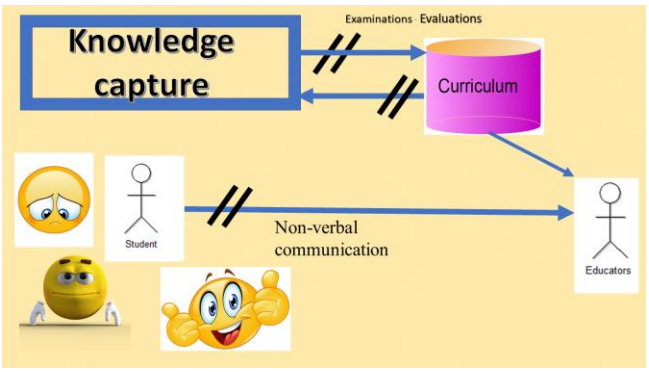

Fig. 3. No verbal in-classroom student-teacher behavior.

It is also true that the VET students express a large part of their emotions in the laboratories, as there they organize their actions either in the presence of others or together with the others who are the "important others" (classmates). A student's behavior in the school's laboratory is likely completely different from the behavior at home or in other areas of his socialization. It has also been observed that this behavior does not manifest itself in the same way at different times [9].

D. *Verbal and no Verbal Student-Teacher Behavior in Distance Teaching and Learning Environments: The Scientific Question about a New Perception*

To introduce usage models in non-verbal student-teacher behavior in distance teaching, we would like to point out some key issues that are sometimes rejected by students and teachers consciously or not. Consciously or unconsciously, teachers and students in the recent past, due to the COVID-19 pandemic, found themselves "torn" between what they had experienced and had established as learning and teaching in natural spaces, i.e., the classrooms in school laboratories, and in what they had to "do" how teaching in distance education structures (Fig. 4). Before we arrive at this conscious unconscious comparison, we must remember that educational schools as units are organized spaces and designed in such a way as to allow for interaction.

Even before the teachers or the students come to school, others (architects, designers, analysts, educators, and even economists or accountants) have precisely planned the place and time of their social interaction. At this stage, and without at all trying to defend distance education, we must acknowledge that no such plan has been made. In other words, no specific country design has been presented for the formation of virtual interaction behaviors. The important

thing for teachers and students is not the representation of the previous situation but what the students do in this new environment. It will, therefore, take time and space to capture a complete re-understanding of all these features we have described in distance learning environments. Our suggestions based on the traces we have from the digital classrooms is a modeling process. In the synchronous and contemporary processes of distance education, a second life (a new digital life for education) has begun and is evolving without us having yet taken full control of it.

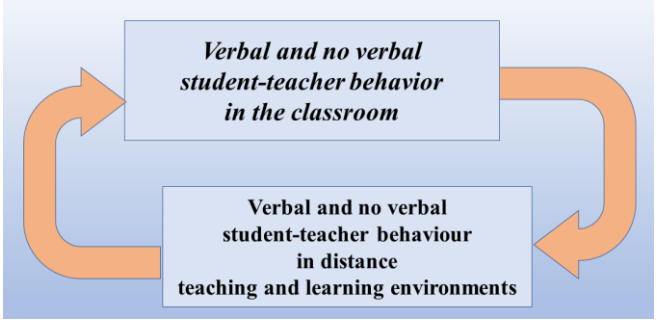

Fig. 4. Verbal and no verbal student-teacher behavior, in distance teaching and learning environments.

However, the philosophical center of our article, the "secret passage" to the next condition-state is the "recording" of the verbal and of the non-verbal behavior of the students by the teachers as a meta-model tool for new software. For us, the solution lies in translating the biophysical field into information frameworks with a complete reinterpretation of the already known representations. When this happens, either through algorithmically selected representations (big data) or through new types of computational data (quantum computers), the question for education remains the universal communication through digitalism, as a matrix of emancipated education. If the digital event ceases to be the image of the self as information and becomes an authentic technological mediation of the subjects and the objects, then we will be able to claim that we have a complete organization of his social and cultural reinterpretations. Meanwhile, now we have to stabilize conceptual representations of the student's participation.

E. Conceptual Representations of the Students' Participation

The exact nature of the conceptual representations is hotly debated as the primary problem in software production today [23]. Also, conceptual representations constant continuous development of quality, production costs, and the requirement to ensure a long-life cycle. For planning a new model, conceptual representations focus on their connection to the software requirements and determine a new phase of systems design. The documentation of conceptual processing models does not draw from reality but interferes with the reality itself and interacts with it either in part or in the whole. Fig. 5 represents the conceptual representations of the student's participation from many angles, teacher – students, digital tools, researchers.

In our attempt to introduce conceptual representations as models of participation for students of VET, we found ourselves in front of a difficult problem. From what point of view are we talking? If we want to classify the vast experience of school reality and from there to introduce it to logical representations, a researcher discovers many types of development and communication. The education of a student is a serious phase of his socialization. During a student's training in a technical school, the student of technical vocational education not only learns to speak, to redefine the way she/he thinks, the way she/he organizes her/his thoughts, feelings, and general behavior but mainly to intervene. If we want to compare the dynamic situation in which a student finds himself during his training in a technical school, we bring in mind a fire hydrant that has broken, and water is pouring from everywhere. Through the implementation of the curricula, the teachers of technical education organize practices and experiences in a verbal and non-verbal way [7]. Empirical research is always accompanied by empirical suggestions. Much of this experience, which is presented in the next section, is indirectly related to conceptual representations.

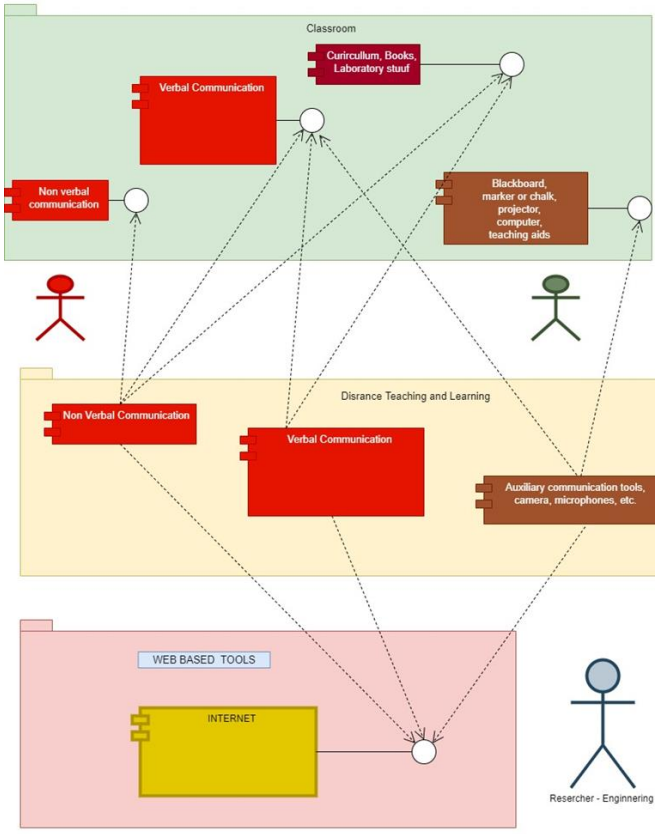

Fig. 5. Conceptual representations of the student's participation.

F. Examples of Student Participation in Synchronous and Asynchronous Digital Education Environments

During the pandemic (school years 2019-2020 and 2020-2021), many web-based environments were used to support distance learning in VET courses in Greece. Verbal and non-verbal communication between teachers and students were applied in those environments in many forms. Some of the most characteristic environments used were:

- WebEx for distance learning,
- Electronic school classroom,
- "Mentimeter" tool,
- "Wonder.me"

The main digital space for distance learning for public

schools in Greece was the environment WebEx (https://webex.sch.gr/index.php). A user support service [(Helpdesk) of the Panhellenic School Network] was provided for teachers. A teacher can ask for the help of his school support team for any problem he encounters in using WebEx (Fig.6).

Fig. 6. WebEx environment.

Each teacher could log in [10] to their account (Fig. 7). According to the official circulars of the Ministry of Education [11], the duration of the distance learning course is recommended to be 40 minutes of logging in, listening to what the teacher had to say, watching presentations or videos, and participating in the chat room or their microphones. Students were generally not required to open their cameras. Apart from WebEx, students participated through the Electronic School Classroom (e-classroom, https://eclass.sch.gr/).

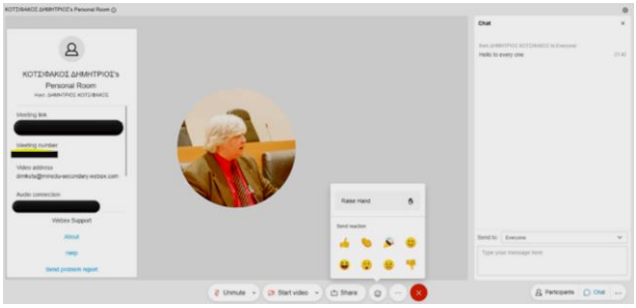

Fig. 7. A teacher's account with emoticon.

The Electronic School Classroom (e-classroom) functioned as a synchronous educational platform for students and teachers and was used daily in schools across the country (Fig. 8). The educational community utilized e-classroom as a key asynchronous digital learning tool in distance education for the development of courses. E-lessons are created and supported by the teachers themselves who interact with their students, cultivating a digital educational culture. Within each lesson, there is the possibility to activate multi-participatory tools and assessment procedures in which the student can participate in many ways.

In addition to the online classroom environment, other online tools can be integrated such as “Hot Potatoes” (Fig. 9). The Hot Potatoes application (https://hotpot.uvic.ca/) and the quiz tool that the application offers, together with other tools, can enable students to test their knowledge and make a self-assessment. The teacher can make a variety of teaching aids which can be shared with the students – trainees during, before, or after the lesson.

Fig. 8. Electronic School Classroom.

Hot Potatoes is software that enables the construction of educational material by the user in various formats (web page, text file, etc.). The characteristic of this student participation is that it takes place asynchronously and individually and is an important tool for the authentic assessment for the understanding of the learning unit by the student. From the student's reactions in this environment, we can draw critical conclusions about the degrees of comprehension of the material. This indicator is also a record of non-verbal communication between students and teachers.

1) Nonverbal student-teacher communication: the “Mentimeter” tool

The “Mentimeter” application is an online platform that offers tools that give a more interactive presentation, which may well be part of the teaching. The platform is accessible via the internet (https://www.mentimeter.com/) and it does not require the downloading of the application but only the creation of an online account. With the Q & A application of the “Mentimeter” tool, anonymous questions can be asked by the participants, which can then have a positive effect, for example, in case the students - trainees hesitate to ask their questions openly. Thus, the teacher has at his disposal a panorama of questions to understand what clarifications are needed or if something needs to be repeated, thus saving time and, at the same time, making the process more enjoyable.

Creating cloud words is a tool for group action and sharing of ideas, it allows examining the first view of students on a concept, to make a brainstorm and in this way, anonymously, to know the perception of each participant and the teacher that the department has on a topic. This application can increase participation through interactions, thus making the student part of the teaching. It can also be used to guide students - trainees to a conclusion of a lesson or a unit. The “Mentimeter” application is an important tool for student participation, and it can be used in any phase of teaching. In a lesson, it can be used either as a guidance tool for the teacher or as a tool for an intermediate unexpected assessment about what students have assimilated from the unit.

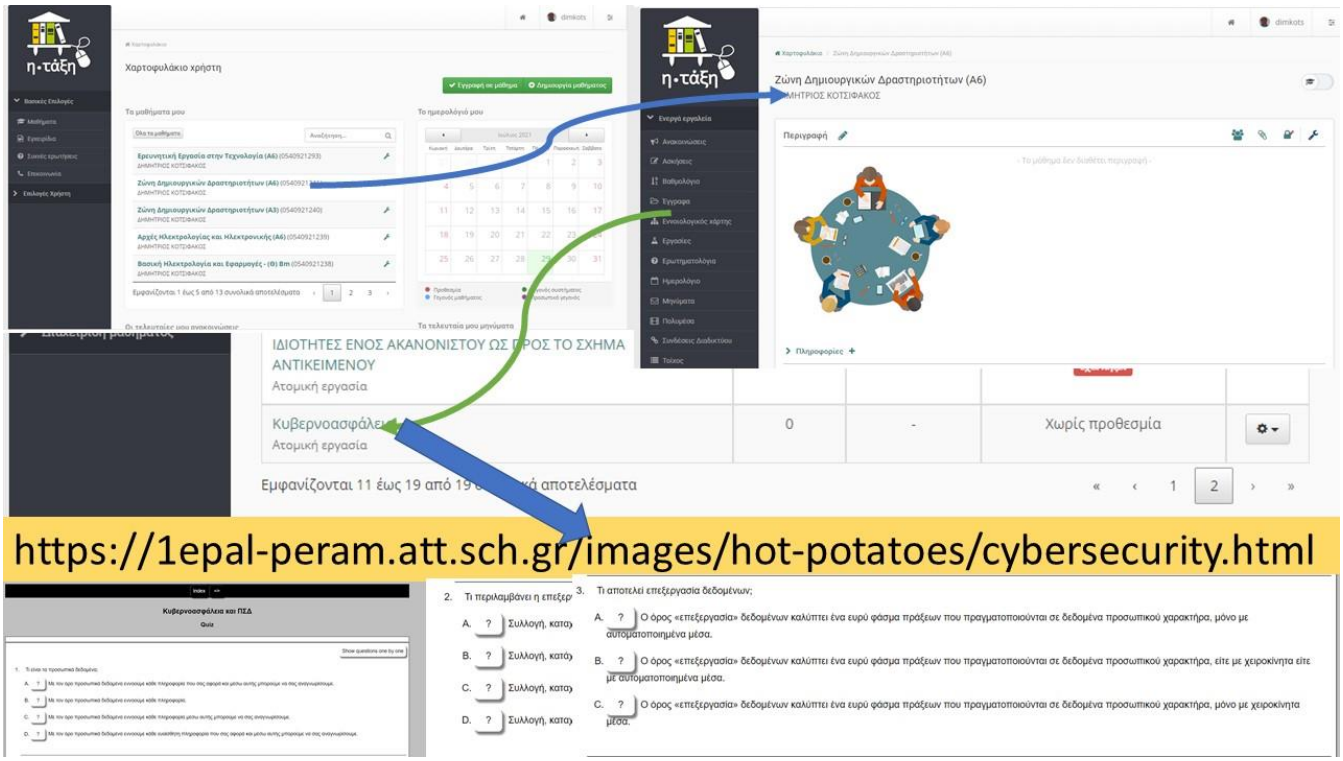

Fig. 9. E-class with Hot Potatoes.

G. Multitask Student-Teacher Communication Tools: The "Wonder.me" Application

The "wonder.me" application (https://www.wonder.me/) is an alternative tool for formal and non-formal communication. It can offer a greater sense of naturalness and a different experience through its graphical interface (Fig. 10). With the wonder.me application the teacher can increase the participation of students by offering the opportunity to interact in an online "school" in which they can go virtually (moving their avatar) from class to class and, thus, give a greater sense of naturalness in the educational process.

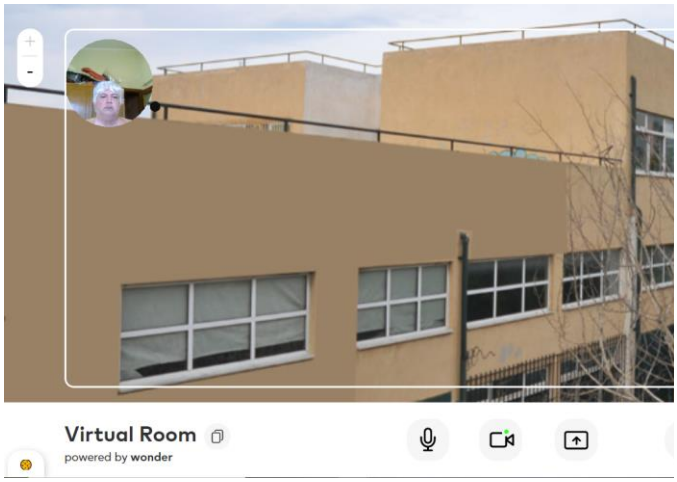

Fig. 10. "Wonder.me" application with the background of the yard of α technical high school (https://www.wonder.me/r?id=9718f43d-1bfe-4247-b517-81883a491161).

This does not mean that the students are transferred to a digital school that somehow replaces the physical. It could be seen as a digital space of interaction with its privileges and features.

III. Conclusions and Future Work

The established lifelong teaching has systematized pedagogical principles and norms of communication. The existing well-established didactics in VET are built on strong reference standards with specific perceptions and interpretive elements, based on the verbal and non-verbal communication between students and teachers. Distance education introduces a new way of thinking, judging, and interpreting, in addition to the existing established communication. This article posits the tendency to go beyond and expand the existing pedagogical boundaries. What is being implemented is a first approach on how to do this. We offer a fundamental first approach and the opening of the discussion on non-verbal communication in digital environments. We connect the different types of non-verbal communication and the impressions from the participation of students in various applications with the emerging new possibilities of the new digital age.

The utilization and results from the impact of digital tools in education are considered as an important element for future research, as the comparison of the results from the evaluation of these pedagogical educational scenarios will settle for different environments (physical-mixed-digital class–a hybrid or "phygital"). The revitalization of the theoretical and the practical knowledge of teaching skills for vocational education and training, if implemented, will enable the effective integration of new digital technologies and emerging technologies that are dynamically penetrating the field of education.

Beyond the fundamental step, in this article, we introduce conceptual representations as models of participation for VET students in Synchronous and Asynchronous Online Environments [1]. We correlate these representations with the actual participation of students as it was organized in real

conditions through existing and reliable web applications ("mentimeter.com", "Hot Potatoes", "Wonder.me" etc.). Even though the article focuses on the distance learning conditions that emerged following the implementation of restrictive measures due to the spread of COVID-19, it also extends to the added value of the transition to a new reality, that of the new digital culture imposed by the development of the rapid telecommunications. To fully define the perspective rules for non-verbal communication in a school classroom, we must resort to descriptive ways of the school reality. To resort to descriptive ways of rendering this reality requires a constant effort to understand the prototypes and the standards of non-verbal communication between students and teachers. To conquer, to re-thing and reorganize in terms of design, new online tools with advanced technologies, for covering the complexity of non-verbal communication of student participation. With those plans, we can approach the regulatory standards that will be integrated into the digital environments of distance education. The plans that may emerge will require tools or conversions to unify the specialized non-verbal communication. On the other hand, these plans need to be constantly compared with the already existing repositories of the existing incomplete communication.

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