TAEP4.0: Teacher Assistance Educational Process to Promote 21st Century Skills in the Context of Education 4.0

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Abstract: Today's professionals need to be enabled to be fit for Industry 4.0. Thus, it is the school's role to prepare the student to be a professional who has the skills and competencies required in the 21st Century. This practice redefines Education, known as Education 4.0. Based on the literature, we perceived that most studies in the context of Education 4.0 are interested in student development, but few propose teacher support in this new challenge. In this sense, this paper presents the Teacher Assistance Educational Process (TAEP4.0) to support teachers in activities related to Education 4.0. TAEP4.0 can help to prepare student-centered classes and train students for life in the 21st Century with hands-on and interactive activities. TAEP4.0 was evaluated by 6 Education professionals to check the ease of use, usefulness, and intention of future use, using the Technology Acceptance Model (TAM) indicators. After this exploratory study, quantitative and qualitative data analysis was performed. The results showed that TAEP4.0 can broaden teachers' knowledge and interaction with Education 4.0, as well as support them in preparing their classes.

1 INTRODUCTION

Society has received strong influence from the fourth Industrial Revolution. Much has been discussed about Industry 4.0. Industry 4.0 gains driving force through the digital age and can be represented as the industry's digitization and computerization process. This process focuses on data management, work systems through technology, communication, and human resource-related work efficiency improvements (Winanti et al., 2018).

With the advancement of Industry 4.0, many other sectors have received impacts on their traditional structure, such as the education sector. There was a need for an education that is more aligned with the contemporary world, which prepares young people for the challenges of the 21st Century, such as dealing with disruptive technological resources and processes such as robotics, artificial intelligence and the Internet of Things. This is a new parameter that redefines the format of education, known as Education 4.0 (Hartono et al., 2018).

In this sense, education and technology together are the primary source for addressing the challenges, barriers, and needs of Industry 4.0's workforce. Besides, Information Technology-based teaching can support this process, because it is supposed that who will succeed in Industry 4.0 is a country that has innovation, creativity, and skill in the field of technology (Winanti et al., 2018).

Thus, it is believed that traditional teaching methods are reaching their limit when it comes to vocational training to act in this new market concept. Alternatively, Education 4.0 initiatives can prepare future professionals with the necessary competencies and skills (Mourtzis, 2018).

From this perspective, it is indicated to carry out educational training still in Basic Education (kindergarten, elementary, and high school), focusing on Education 4.0. In this way, students will be able to develop the skills and competencies required in the 21st Century such as problem-solving, collaboration, communication, autonomy, mastery of technologies, creativity, and innovation. Based on the teaching of

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skills and competencies, these future professionals are expected to have a higher chance of employability in Industry 4.0 demand (Pérez-Pérez et al., 2018).

Given this, the guiding question raised for this research is: How to support teachers of Basic Education to develop skills and competencies in students in the context of Education 4.0?

Therefore, this paper aims to present an educational process to assist teachers in basic education in the elaboration of classes for the use of technological resources in context Education 4.0. The results indicate that the proposed educational process, called Teacher Assistance Educational Process (TAEP4.0), can help in the elaboration of classes with the explicit participation of the student, besides allowing the development of several 21st Century skills and competencies.

This paper is organized as follows: Section II presents some concepts and characteristics of Education 4.0 and lists some works related to the development of 21st Century skills and competencies. Section III shows the methodology of evidence-based research. Section IV presents the Educational Process of Teacher Assistance in the context of Education 4.0. Section V presents the organization of this exploratory study. Section VI presents TAEP4.0 acceptance analysis. Section VII presents qualitative data analysis. Section VIII presents the discussion of the results. Section IX presents threats to validity. Finally, Section X concludes the paper with final considerations and next steps.

2 BACKGROUND

The first mention for Education 4.0 was given in 2015 in Germany (Ciolacu et al., 2017), and is a learning model that meets the needs of Industry 4.0. Thus, there is little written literature, including empirical studies on this topic (Ayub et al., 2018). From the appearance of the term Education 4.0, seven facets were presented to configure a classroom, being: (1) Personalization, (2) Gamification, (3) Learning Manager System, (4) Adaptability, (5) Support, (6) Intelligent Question and Answer System and (7) E-Assessment. These facets can contribute to student protagonism, improvement in the teaching and learning processes, and collaborate in the development of skills necessary for life in the 21st Century (Ciolacu et al., 2017).

There are distinct classifications for skills and competencies. These can be Organizational (time management, leadership, and planning), Communicative (negotiation and communication), Behavioral (initiative, creativity, ethics, and coherence), Cognitive (problem-solving, critical thinking, decision-making agility, planning, interpretation, reflection, generalization, abstract thinking, and entrepreneurship) and Socio-emotional (interpersonal relationship, teamwork, interest management, environmental awareness, self-confidence, self-development, integrity, persuasion, self-control of emotions, empathy, flexibility, emotional stability, collaboration, patience, enthusiasm, resilience, and optimism) (Cotet et al., 2017), (Piñol et al., 2017), (Mourtzis, 2018).

In the context of Education 4.0, much has been discussed about these competencies and skills. An important consideration is about the definitions of these terminologies and how they are related. In the literature, competencies are understood as the ability to achieve the proposed goals through cognitive resources, such as knowledge, techniques, and attitudes (Perrenound, 1999). Competencies can be defined as a combination of knowledge, experience, and skills (Angrisani et al., 2018). However, competence is not limited to cognitive elements. It also covers functional aspects (technical skills), as well as interpersonal attributes (social and organizational skills), among others (Ananiadou and Claro, 2009). In general, skill is the capacity to perform tasks and solve problems, while competence is the ability to apply learning outcomes in a defined context, such as education, work, personal, or professional development (Cedefop, 2008).

The discussion about the teaching and development of competencies and skills are highlighted in the Education 4.0 scenario. Some initiatives to promote 21st Century competencies and skills are presented below:

- Teaching Factory (Mourtzis, 2018): This approach is based on knowledge triangulation (teaching, research, and technology transfer) to train professionals with useful skills that will support their future careers in manufacturing.
- Robotics Activities in Classroom (Messias et al., 2018): in this case, students followed the process suggested by LEGO Education Maker and answered a self-assessment questionnaire about their developed skills, like problem-solving, learning to learn, communication, collaboration, creativity, and innovation.
- Engineering Education Adaptation for Industry 4.0 (Coskun et al., 2016): This framework consists of 3 main steps: curriculum, lab, and student club. These steps enable you to develop skills through students' experiences in practical activities.

- International Society for Technology in Education (ISTE, 2016): ISTE has numerous online resources and publications for educators with a purpose to prepare them for challenges of the 21st century skills such as problem-solving, creativity and innovation.

Based on the literature, few studies were identified that focused on teacher education aimed at teaching or developing 21st-century skills and competencies (Ananiadou and Claro, 2009). Initiatives such as ISTE contribute to the Education 4.0 scenario, however, to develop 21st-Century skills and competencies remains a challenge, especially for teachers. Thus, this study presents an educational process to assist teachers of Basic Education in the elaboration of classes focusing on the competencies and skills pertinent to Education 4.0. The methodology used for the construction of TAEP4.0 will be presented below.

3 METHODOLOGY

We used an evidence-based methodology (Bittencourt and Isotani, 2018) to design and evaluate the TAEP4.0 educational process. The steps of the methodology are described following:

1. Preliminary Studies: At this stage, studies were conducted on: (1) Digital Storytelling and STEAM (art of storytelling and multidisciplinary methodology for working with Science, Technology, Engineering, Arts and Mathematics, respectively); (2) Scratch tool and creative learning spiral: visual programming language and educational process that supports learning by doing, respectively); (3) Unplugged Computing (teaching programming logic without computer use) and (4) Educational Robotics (projects robotics with students). These educational approaches were chosen because they fit the facets such as personalization (Ciolacu et al., 2017). Besides, these approaches enable the student to have experience and connection, some of the hallmarks of Education 4.0 (Hartono et al., 2018). In all studies, the skills and competencies of the 21st Century were worked on, and knowledge that applies to Education 4.0 was produced.
2. Systematic Mapping Study (SMS): At this stage, an SMS was conducted to collect information on educational processes and/or professional training that is being developed to further the advancement of Education 4.0 and assist in the lack of qualified human resources to work in Industry 4.0.
3. Analysis of the Studies Found: In this stage, the initiatives related to Education 4.0 and/or Industry 4.0 were verified. From the identified initiatives, those that realize activities with students or develop training with professionals were selected, besides containing a methodological process that supports the development of 21st Century skills and competencies. Subsequently, the analysis of these studies made it possible to gather reasonable practices to be incorporated into the TAEP4.0.
4. Proposal Definition: In this stage, the TAEP4.0 process was constructed. TAEP4.0 consists of three main activities: Planning (the teacher prepares his class), Execution (the teacher develops his planning with the student), Learning Verification (the teacher conducts the assessment process with the student). TAEP4.0 is presented in more details in the next section.
5. Proposal Evaluation and Evolution: In this step, TAEP4.0 was tried and evaluated by education professionals. The feedback received made it possible to verify possible improvements in the process, which allowed the evolution of this proposal. TAEP4.0 steps will be presented in the following section.

4 TAEP4.0

TAEP4.0 prepares students for collaborative project development, with technological resources and processes supporting teaching and learning. TAEP4.0 was developed in a clickable PDF format and enables teacher interaction with TAEP4.0 [4] (Silva et al., 2019). This format contains buttons that show usage examples, explanatory notes and tools that can help the teacher to design a lesson that aligns with the contemporary world.

TAEP4.0 consists of thirteen steps distributed in planning, execution, and verification (Figure 1). These steps will be detailed below with their respective base references. In the Planning activity, there are seven steps described following:

- **Define Scope** (Hur et al., 2018)**:** In this step, the teacher delimits the project to be developed with the students. Through scope documentation, the following are requested: to define the class to be

[4] https://drive.google.com/open?id=1Tk6TmRsCczr0fLgvRpfREy6i2uxUWwIG

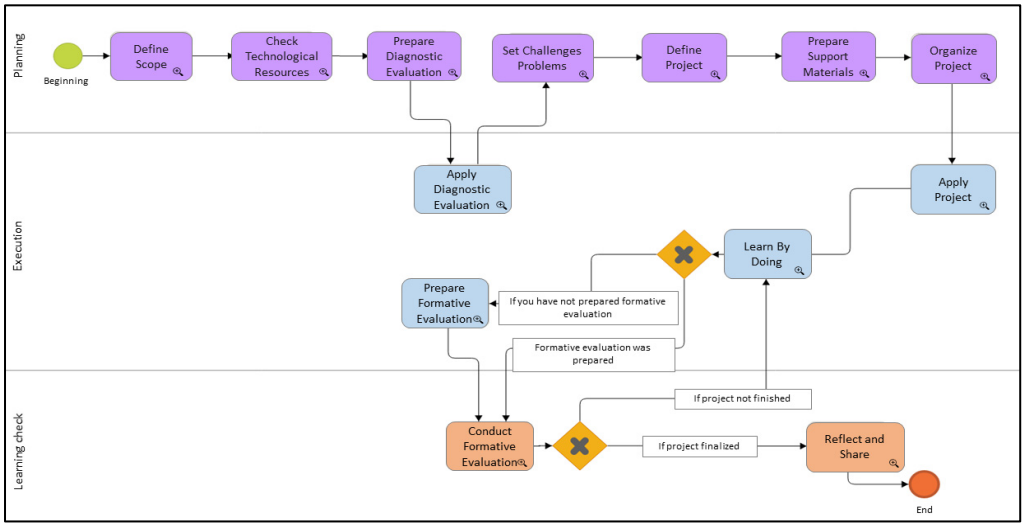

Figure 1: TAEP4.0 steps.

worked on, the discipline and content to be disseminated, the themes related to the Sustainable Development Goals (SDGs) to be worked on (in order to encourage socio-emotional skills, but not limited to them), the areas of STEAM that will be inserted (in order to enable the student to work in a multidisciplinary way) as well as the competencies and skills of the 21st Century that will be developed.

- **Check Technological Resources** (Ciolacu et al., 2017)**:** In this step, the teacher chooses the tool, according to the reality of the school. Therefore, the availability of computers with internet access to students, investments for equipment and resources, among others, should be checked. In this way, it will be possible to adapt the examples and suggestions according to the reality of the school. As support material for teachers, TAEP4.0 offers suggestions of tools for Gamification, Robotics, Programming, Augmented Reality, and Digital Storytelling.
- **Prepare the Diagnostic Evaluation** (Kin and Lee, 2017)**:** This step presents the need to conduct a diagnostic evaluation with students. Thus, it will be possible to align the scope, in addition to realizing the difficulties and needs of the class. This step can make it easier to choose the appropriate elements, such as problems, projects, tools, materials, among others. Therefore, suggestions on how to perform the diagnostic assessment in the classroom are shown.
- **Set Challenges Problems** (Nurdyansyah et al., 2017)**:** In this step, the choice of challenges to work on problem-solving is encouraged. In this activity, the construction of knowledge occurs through the discussion of the problem in groups. The students study a specific subject, they write down their doubts or difficulties and then they present the issues solved. In addition, some examples of problems that may be linked to projects are presented.
- **Define Project** (Beier, 2018)**:** In this step, the project is delimited by adjusting the previous steps. From project-based learning, students engage in a process of research, they look for resources, and practical application of information until they come to a solution or product.
- **Prepare Support Materials** (Silva et al., 2019)**:** For this step, the previous steps need to be well defined: scope, tools, problems, and design. In addition, the diagnostic evaluation must have been applied. In this way, it will be possible to know the needs of the students, and later it will be easier to produce the support materials. Support materials consist of everything students will use during the activity, including slides, worksheets, pens, manuals, among others.
- **Organize Project** (Beier, 2018)**:** In this step, it is indicated to organize the support materials, to choose the classroom configuration that allows the interaction among the participants. For this, it is taken into consideration the size of the classroom, number of chairs, and tables, computers with internet access, among others. In general, classroom logistics should be designed to reduce risk and avoid discomfort.

In the Execution stage, there are four steps, where the active participation of the student, mediated by the

teacher and IT professional in Education, is indicated. The execution steps are as follows:

- **Apply Diagnostic Evaluation** (Kin and Lee, 2017)**:** In this step, the use of gamification tools to improve the diagnostic assessment applied with students is indicated. Besides, other ways of performing this type of assessment are presented, such as textual production, solving problems with mathematical operations, or even looking for the performance rate and result of previous evaluations. The results obtained in the diagnostic evaluation can provide an overview of the class difficulties. This will allow us to identify which students need further guidance.
- **Apply Project** (Beier, 2018)**:** In this step, the teacher will present the proposal to the students, make sure that everyone understands the steps of the project. In addition, he will organize the groups and he will deliver the support materials. Also, it is recommended to make a checklist to check if there are enough computers in the lab with internet access, if the necessary tools for the project are installed on computers, if there is a multimedia projector available, among other. This check is essential because, at the time of class, everything should work correctly.
- **Learn by Doing** (Porvir, 2019)**:** In this step, the methodology of the invention cycle to work the project is presented. This methodology helps students learn through error and works as follows: the students imagine, build, and test if the idea works, share. Otherwise, the students identify the error, think, refine, test again and then share. Thus, error allows students to have playful experiences, discovery, and assists in rescuing students' interest in learning, especially in areas where students have little affinity.
- **Preparing Formative Evaluation** (Luckesi, 2011)**:** Formative assessment takes place from the contexts experienced by the teacher and students, which allows the regulation of learning. In this way, examples of how to prepare a formative assessment for students are presented. Formative assessment considerably demands teacher participation, such as time availability. Therefore, it is necessary to construct a record about each student and update this record whenever new data appears.

Finally, in the Verification stage, there are two steps, where the active participation of the student, mediated by the teacher, is indicated. Being them:

- **Conduct Formative Evaluation** (Vidakis, 2019)**:** In this step, the student is assessed throughout the learning process. As the teacher will accompany the students, it will be easier for this teacher to check the student's progress, the acquisition of knowledge, the improvement of some skills and competencies. However, it may be that this student is having difficulties, so the problems can already be solved.
- **Reflect and Share** (Silva et al., 2019): At the final of the process, students need to evaluate themselves, reflect, outline perceptions and experiences, comment on strengths and what could be improved in the future projects, among others. Later, the teacher is indicated to allow his students to present the developed projects.

An exploratory study was realized to verify the feasibility of the TAEP4.0 proposal. The exploratory study will be presented below.

5 EXPLORATORY STUDY

This study was organized based on the steps of the experimental process proposed by Lazar et al. (2010). This exploratory study is divided into Planning, Execution, and Analysis.

5.1 Study Planning

This exploratory study was performed with six education professionals from different levels of education. The sample was selected by convenience, consisting of four teachers of Educational Technology of the basic education, one teacher of Higher Education in Computing and one teacher of Geography of the basic education. Participants signed the Informed Consent Form (ICF) and completed a characterization form that allowed them to classify their experience about: (1) assessment of educational resources, (2) training of teachers to use technological resources (3) project monitoring in the Informatics in Education laboratory, (4) development of projects using technological resources and (5) preparation of a lesson plan.

In sequence, some artifacts were prepared to support this experiment. In addition to the characterization form and ICF, a presentation was produced with the purpose and motivation of the research, the step-by-step of study and an overview of TAEP4.0. Also, it was made available a template for participants to plan a project and a post-use questionnaire to obtain feedback from participants about TAEP4.0. Before the study was executed, the artifacts were validated by a researcher of Informatics in Education so that no problem made the study execution impossible.

5.2 Study Execution

At the beginning of the study, the researcher acted as a moderator and gave the participants information about the experiment. Subsequently, the structure of TAEP4.0 was presented. In this sense, participants were instructed to plan a project through TAEP4.0. For this, the template contained the seven planning steps of TAEP4.0, which are Define Scope, Verify Technology Resources, Prepare Diagnostic Evaluation, Prepare Problem Challenges, Define Project, Prepare Supporting Materials, and Organize Project. Thus, the participants were able to try TAEP4.0 partially but did the general evaluation of the 13 steps technically and pedagogically.

The study was applied to three educational institutions. Both participants took approximately two hours to use and evaluate TAEP4.0. During the study, each participant read the instructions and examples presented in TAEP4.0 to develop an educational project. All participants returned their project planning at the end of the experiment. Finally, participants answered their degree of acceptance regarding TAEP4.0 through a post-use questionnaire.

6 QUANTITATIVE ANALYSIS

The post-use questionnaire was built based on the TAM model indicators. The indicators are: (a) ease of use, (b) perceived usefulness, and (c) intended future use. Participants provided their answers on a six-point scale (Lanubile et al., 2003). Possible answers were strongly agreed, strongly agree, partially agree, partially disagree, strongly disagree, and strongly disagree. This response scale was considered adequate because there is no intermediate value. Thus, the distribution of the scale helps to avoid the bias of the central tendency in classifications, which may induce participants to judge the outcome as appropriate or inappropriate. The TAM indicators for verifying TAEP4.0 acceptance was: Ease of use, Perceived Usefulness and Intended Future Use.

6.1 Acceptance Analysis of TAEP4.0

The Ease of use indicator defines the degree to which a person believes that using a specific technology would be effortless through the following questions: (E1) My interaction with TAEP4.0 was clear and understandable, (E2) Using TAEP4.0 does not require much of my mental effort, (E3) I find TAEP4.0 easy to use and (E4) I find it easy to use TAEP4.0 to prepare a didactic 4.0 class. Figure 2 presents the participants' perception regarding the Ease of Use indicator. The vertical axis of the graph represents the affirmative of the indicator and the horizontal axis refers to the degree of acceptance of the participants. The bars were added codes that represent the participants (P1, P2, P3, P4, P5, and P6) and their respective evaluations.

In Figure 2, we identified that P6 felt more difficulties in use TAEP4.0. This issue points to the need to include the support of computer professionals in education for the use of the educational process. It is possible to notice that there is a discrepancy in the levels of agreement. We saw a large concentration of total agreement in the affirmative (E3) and a greater variation in affirmatives (E1 and E4). This indicates that TAEP4.0 is considered easy to use (E3). However, resources, methodologies, and nomenclatures for Education 4.0, maybe are unknown to the teacher. Therefore, a short time of use may not have been enough to the TAEP4.0 to be clear and understandable to prepare a class in the context of Education 4.0 (E1 and E4). Thus, we reinforce the idea that TAEP4.0 will be assisted by an Educational Technology professional.

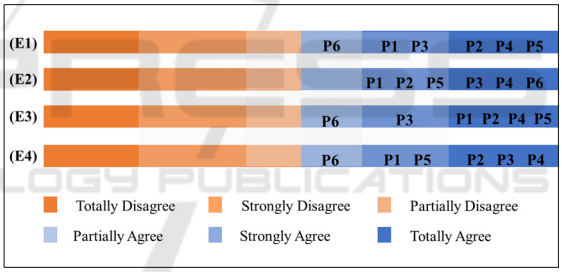

Figure 2: Degree of acceptance of participants regarding the Ease of use of TAEP4.0.

The Perceived Usefulness indicator defines the degree to which a person believes technology could improve their performance through the following questions: (U1) Using TAEP4.0 can improve my performance in preparing lessons with a didactic 4.0, (U2) Using TAEP4.0 can increase my productivity in preparing lessons with 4.0 didactic, (U3) Using TAEP4.0 can increase my effectiveness in preparing lessons with 4.0 didactic and (U4) I consider TAEP4.0 to support the preparation of lessons focusing on the development of 21st-century skills and competencies.

Figure presents the participants' perceptions regarding the Perceived Usefulness indicator. In this question, we perceived a higher level of agreement in statement U4, which indicates that TAEP4.0 can use to the development of 21st-Century skills and

competencies. Besides, we identified that P2 and P4 recognize the usefulness of TAEP4.0 for the challenges of Education 4.0. In sequence, we realized that P6 and P1 widely agree on some statements like U2 and U3, which means that the participants believe that TAEP4.0 is useful for the preparation of classes related to Education 4.0, but that it can still be improved.

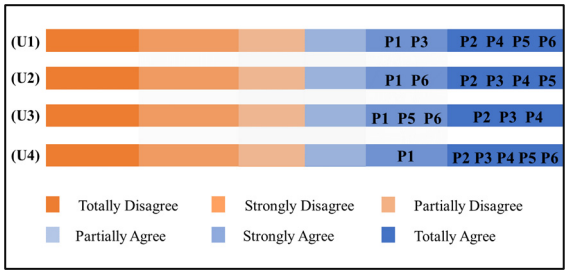

Figure 3: Degree of acceptance of participants regarding the Perceived Usefulness of TAEP4.0.

Finally, the Intended Future Use indicator defines the degree to which a person believes they would use technology in future projects through the following questions: (I1) Assuming I have access to TAEP4.0, I intend to use it and (I2) Given that I have access to TAEP4.0, I predict that I will use it at other times. Figure 4 presents participants' feedback regarding Intended Future Use. Based on the same interpretation as Figures 2 and 3, Figure 4 shows that participants are interested in using TAEP4.0. In this indicator, P1 considers TAEP4.0 appropriate for future work. Besides, the other participants state that they intend to use TAEP 4.0 at other times.

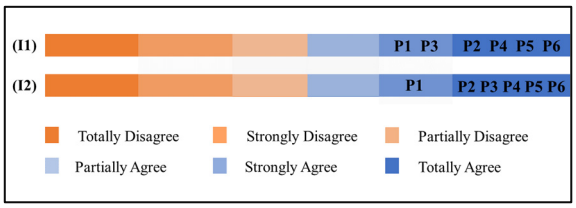

Figure 4: Degree of acceptance of participants regarding the Intention to use TAEP4.0.

Subsequently, a qualitative analysis of the data obtained from the open questions contained in the post-use questionnaire was performed.

7 QUALITATIVE ANALYSIS

For qualitative analysis, the Grounded Theory (GT) method was adopted. Therefore, participants' comments on TAEP4.0 were analyzed through a subset of the coding phases suggested by Strauss and Corbin (2008), being open (1st step) and axial (2nd step) coding. In the first step of the GT (open coding), the codes were created according to the participants' feedback. Subsequently, the codes were grouped according to their properties, forming concepts that represent categories. Finally, these codes were related to each other - axial coding (2nd step). The researcher did not use the selective coding (3rd step) because the GT rule is the circularity between the collection and analysis stages until the theoretical saturation is reached (Strauss and Corbin, 2008).

The objective of the qualitative analysis in this exploratory study was to understand how TAEP4.0 can contribute to the challenges of Education 4.0 and the development of 21st-century competencies and skills in students.

7.1 Benefits of TAEP4.0

Regarding the benefits of TAEP4.0 for students in the context of Education 4.0, one participant said that TAEP4.0 can enable the student to develop various skills (see the quotation from P1 below). Another participant noted that TAEP4.0 can rescue the importance of collaborative work (see a quotation from P2 below). Also, one participant shared that TAEP4.0 can allow classes with clear student participation (see the quotation from P6 below). Following, another participant reported that TAEP4.0 works on problem-solving (see the quotation from P3 below).

"The process gives the student the skills to develop various life skills" (P1).

"The process underscores the importance of working with students in a constructive and collaborative way" (P2).

"The process stimulates [...] dynamic classes with clear student participation" (P6).

"The process works on problem solving and interdisciplinarity" (P3).

Regarding TAEP4.0's contribution to the elaboration of projects in the context of Education 4.0, it was identified that TAEP4.0 can collaborate in the preparation of a class with didactic 4.0. In addition to preparing students for the challenges of the 21st Century. Some views were: TAEP4.0 (I) helps organize classes (see a quotation from P1 below), (II) improves project quality (see a quotation from P2 below), and (III) directs what to do in the project (see the quotation from P5 below).

"The process helps to organize and structure school classes and projects" (P1).

"Using the process can [...] improve the quality of school projects" (P2).

"The process provides guidance on how to develop and conduct classroom projects" (P5).

Regarding TAEP4.0's contribution to supporting teachers in the context of Education 4.0, one participant said that TAEP4.0 could broaden teacher contact with Education 4.0 (see the quotation from P5 below). Another participant reported that TAEP4.0 is an effective lesson design tool (see a quotation from P6 below). Subsequently, another participant shared that TAEP4.0 helps guide teachers in designing activities involving educational technologies (see the quotation from P1 below).

"The process helps guide teachers in planning [...], in addition to expanding teachers' knowledge and interaction with Education 4.0" (P5).

"The use of the process allows teachers, both those at the beginning of their teaching career and those with experience, to use an effective tool in the preparation of their classes" (P6).

"The process helps guide teachers in designing activities with technology resources" (P1).

Reports show that TAEP4.0 can support students in the development of 21st Century skills and competencies through technical support to the teacher. It is believed that in this way, the teacher will be able to prepare student-centered classes and conduct training for life in the 21st Century with practical, interactive and diverse activities. Therefore, TAEP4.0 will be able to work on the student's integral development, such as cognitive, socio-emotional and cultural aspects based on educational technology.

7.2 Content of TAEP4.0

Regarding the content presented in TAEP4.0, one participant said that the examples available in TAEP4.0 help the teacher structure his proposal (see the quotation from P4 below). Another participant said that the examples presented in TAEP4.0 might subsidize the classroom teacher (see the quotation from P6 below).

"I consider it to be quite complete, with several examples for the educator to take as an example to structure his proposal" (P4).

"The process provides examples that allow teachers to subsidize their classroom work" (P6).

TAEP4.0 is not limited to presenting structure, online resources, publications and examples of best practices. The TAEP4.0 allows teachers to select the resources available on the internet, according to the discipline and needs of their students. Thus, following the steps of TAEP4.0, the teacher finds directions to prepare a class/project with the characteristics of Education 4.0 based on 21st-century skills and competencies.

7.3 Improvements in TAEP4.0

In the aesthetics and ease of use of TAEP4.0, through feedback from participants, it was possible to identify which visual features of TAEP4.0 are being used. In addition, TAEP4.0 has a good use. Some views were: TAEP4.0 (I) is visually beautiful (see the quotation from P4 below), (II) has easy-to-understand navigation (see a quotation from P2 below), and (III) has good visuals (see a quotation from P1 below).

"The process is very clear, visually beautiful" (P4)

"The educational process has a clear reading, easy navigation" (P2).

"Fonts, pictures, and colors are good" (P1).

Comments show that TAEP4.0 has different tools and examples that support student-centered lesson preparation. Features that, when combined with appropriate fonts, colors, and pictures, can provide clear reading and easy understanding. Therefore, participants provided feedback on suggestions for improvements, as seen in the following section.

One of the improvement suggestions for TAEP4.0 that deserves attention is the types of evaluations worked on in the proposal. For some participants, summative assessment should be avoided, especially in the context of Education 4.0 (see a quotation from P4 and P1 below). Summative assessment, also known as classificatory, is done through evidence (Luckesi, 2011). Therefore, in the evolved version of TAEP4.0 presented in section 4, we prioritize formative assessment, with emphasis on teacher coaching throughout the student learning process.

"I would like you to pay attention to the types of evaluation [...]. Today we are looking for formative evaluation and not summative, be careful with that" (P4).

"Depending on the outcome of the project, there would be no need for a summative assessment. The result itself would already be evaluated, without the need for another evaluation" (P1).

Other suggestions for improvements were: (I) having less text explaining project organization (see P2 the quotation below) and (II) changing the color of the navigation buttons for easier viewing (see P5 the quotation below). In future work, we intend to add more examples of team and project organization. The idea is that these examples give a guide on how to organize projects from different perspectives.

"At the point of "Defining the project," I thought that the explanation of team organization could be reduced, which would allow room for more examples" (P2).

"I suggest changing the color of the navigation buttons because they match the main color of the process because it is tiring for those with vision problems" (P5).

From the exploratory study, it was possible to evolve TAEP4.0 to a second version (v2), which we present in this study (Figure 4). This release follows the Business Process Model and Notation (BPMN) model used to create processes, including those of an educational nature (Pereira, 2011). In v2, the "Learning by Doing" step stands out, as this is where there is greater student participation. According to the conditional defined in TAEP4.0, while the student is producing, the teacher must perform formative assessment throughout the activity. Finally, when the student finishes his activity, the teacher directs him to the "Reflect and Share" step. In this way, the process is terminated.

In TAEP4.0 V2, most of the changes made were internal, such as reducing the amount of text in some parts, increasing the font size, changing the colors of navigation icons, inserting more illustrations, among others, as mentioned before. From the comments of the participants, the suggestions were attributed to improving the teachers' experience with TAEP4.0 for future use with their students.

8 DISCUSSIONS

TAEP4.0 was considered a useful process to help teachers in the Education 4.0 scenario. This educational process allows the teacher to prepare practical, diversified and interactive classes with a focus on 21st-century skills and competencies.

Based on qualitative analysis, we identifiers that TAEP4.0 can provide support for the teacher in planning and execution of the classes, including the assessment of 21st-century skills. Following the steps of TAEP4.0, the teacher selects the information and the appropriate technology to work in the classroom, according to discipline and the needs of the students. For this, TAEP4.0 gathers several materials available on the web with the intention of the teacher to have access to the greatest number of possibilities and news.

Based on the quantitative analysis, we realized the importance of the Educational Technologies professional to support the teachers to use the new educational technologies in the classroom. In this way, TAEP4.0 can be a useful resource for teacher training. Thus, the teacher can feel more secure in using TAEP4.0 to streamline and improve their activities. Besides, students will be increasingly updated and under a didactic aligned to the 21st century.

However, we recognize that one of the biggest challenges for TAEP4.0 is the participation and encouragement of the pedagogical coordinators of the schools. In one of the educational institutions that we carried out the exploratory study, we realized that the more frequent teachers in the computer lab are those who are charged for their coordination. On the other hand, those who are not encouraged end up following the traditional teaching model. In this way, no matter how interesting the technology is, it is not used. This attitude ends up affecting students' learning. In the next studies, this limitation should be reduced.

In general, in this exploratory study, we identified that TAEP4.0 can contribute to active learning, where the protagonism by the student and learn by doing can be worked. In addition to cultivating 21st-century skills and competences, instead of using a set of predefined data.

9 THREATS TO VALIDITY

In this sense, as in all studies, some threats may affect the validity of the results. In this exploratory study, threats were categorized according to the approach of Wohlin et al. (2000). Thus, threats of the internal, external, conclusion and construct type were identified. We sought to soften them while conducting the exploratory study to reduce the possible risks.

For Internal Validity: (a) training effects: to avoid this type of risk, the activities were carried out with education professionals, following the same scope. (b) experience in classification: it was not necessary to classify participants according to knowledge and experience, as it was a heterogeneous sample to evaluate TAEP4.0 from different perspectives: Computing, Education and Informatics in Education, (c) : time: participants had the same time to use and evaluate the proposal, and (d) mediator influence: to reduce the mediator's relative influence on the analysis of the experiment result, the data were reviewed in pairs.

For external validity: (a) participants who were not specialists in Informatics in Education: under these conditions, the experiment sought feedback from educators in general, but prioritizing participants' experience in using technologies to

support teaching and learning processes; (b) the study was not conducted with students: in this first moment, the study focused on validating the process with educators to improve it and remove possible flaws and inconsistencies. So, later, you can apply it to a class of students and analyze their results.

For the validity of the conclusion: the main problem is the sample size because they are 6 educators. This number of participants is not statistically ideal, although this problem is recurrent in studies of Informatics in Education. However, the sample has heterogeneity, as the participants are educators from 3 different institutions. Even so, there was a limitation of the results, which are considered indicative and not conclusive.

For construct validity: there may be an influence of the indicators that were applied in the quantitative analysis, such as ease of use, perceived utility and intended use. These indicators have been defined and evaluated by other researchers in various studies and represent important aspects to verify the acceptance of a technology (Nakamura et al., 2017).

10 CONCLUSIONS AND FUTURE WORK

This paper presented an educational process to provide technical support to the basic education teacher in the development of activities in the context of Education 4.0. Therefore, TAEP4.0 was proposed to support the development of student-centered classes. To achieve the objectives defined in this paper and to reach the current version of TAEP4.0, an evidence-based methodology was used.

From the analysis of the preliminary studies and studies identified in the MSL, the TAEP4.0 was created and presented. This process is made up of 13 steps, each step containing examples, explanatory notes, tools, among other elements, to facilitate its handling.

An exploratory study was conducted to validate this technology with six education professionals from 3 different educational institutions. Therefore, through the acceptance analysis of TAEP4.0 and qualitative analysis of the data, it was possible to realize that TAEP4.0 can help in the elaboration of classes with the clear participation of the student, besides enabling the development of 21st-Century Skills. Following the steps of TAEP4.0, the teacher will find instructions needed to prepare activities for an Education 4.0, based on cognitive, socio-emotional and cultural aspects. One of the limitations identified in this exploratory study is that the pedagogical coordination and the school management itself need to encourage the teacher to use TAEP4.0 and its possibilities.

As future works, it is intended to add more examples of project organization in order to guide teachers in the preparation of educational proposals under the context of Education 4.0. Besides, studies will be conducted to verify how the use of TAEP4.0 can benefit student learning. From the next student studies, we intend to update and transform TAEP4.0 into a web application. Thus, it is expected to facilitate the insertion and access to new resources and enable teachers to share classes and experiences on the TAEP4.0 platform. Besides, make an integration between teacher, education technology professional and pedagogical coordination to see how TAEP4.0 works under the school.

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