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IMPROVING WORKGROUP ASSESSMENT WITH WEBAVALIA: THE CONCEPT, FRAMEWORK AND FIRST RESULTS

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ABSTRACT

Aim/Purpose	The purpose of this study is to develop an efficient methodology that can assist the evaluators in assessing a variable number of individuals that are working in groups and guarantee that the assessment is dependent on the group members' performance and contribution to the work developed.
Background	Collaborative work has been gaining more popularity in academic settings. However, group assessment needs to be performed according to each individual's performance. The problem rests on the need to distinguish each member of the group in order to provide fair and unbiased assessments.
Methodology	Design Science Research methodology supported the design of a framework able to provide the evaluator with the means to distinguish individuals in a workgroup and deliver fair results. Hevner's DSR guidelines were fulfilled in order to describe WebAVALIA. To evaluate the framework, a quantitative study was performed and the first results are presented.
Contribution	This paper provides a methodological solution regarding a fair evaluation of collaborative work through a tool that allows its users to perform their own assessment and peer assessment. These are made accordingly to the user's perspectives on the performance of each group member throughout the work development.

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Findings	The first analysis of the results indicates that the developed method provides fairness in the assessment of group members, delivering a distinction amongst individuals. Therefore, each group member obtains a mark that corresponds to their specific contribution to the workgroup.
Recommendations for Practitioners	For those who intend to apply this workgroup assessment method, it is relevant to raise student awareness about the methodology that is going to be used. That is, all the functionalities and steps in WebAVALIA have to be thoroughly explained before beginning of the project. Then, the evaluators have to decide about the students' intermediate voting, namely if the evaluator chooses or not to publish student results throughout the project's development. If there is the decision to display these intermediate results, the evaluator must try to encourage collaboration among workgroup members, instead of competition.
Recommendations for Researchers	This study explores the design and development of an e-assessment tool – WebAVALIA. In order to assess its feasibility, its use in other institutions or contexts is recommended. The gathering of user opinions is suggested as well. It would then be interesting to compare the findings of this study with the results from other experimentations
Impact on Society	Sometimes, people develop a rejection of collaborative work because they feel exploited due to the biased evaluation results. However, the group members assessment distinction, according to each one's performance, may give each individual a sense of fairness and reward, leading to an openness/willingness towards collaborative work.
Future Research	As future work, there are plans to implement the method in other group assessment contexts – such as sports and business environments, other higher education institutions, technical training students – in other cultures and countries. From this myriad of contexts, satisfaction results would be compared. Other future plans are to further explore the mathematical formulations and the respective WebAVALIA supporting algorithms.
Keywords	WebAVALIA, software tools, evaluation tools, self and peer assessment, higher education

INTRODUCTION

According to Freeman (1995, p. 289), workgroups can "encourage deeper learning, promote student autonomy by transferring some of the responsibility for teaching and learning to students", as well as "reduce academic time in feedback and marking". One expectation for workgroups is to "make learning meaningful through active learning" (Daba et al., 2017, p. 871). For this reason, collaborative work has gained more popularity, and literature demonstrates the importance of it in the success of projects (Frank & Barzilai, 2004; Hoegl & Gemuenden, 2001; Kizkapan & Bektas, 2017).

Collaborative learning has become a common practice in academic settings since it can assist the learners with the acquisition of knowledge by sharing their experiences and work together (Rienties & Tempelaar, 2018). This learning method can be employed in different situations, being a common practice, the gathering of students in groups in order for them to complete a proposed project and thus engage in active learning (Daba et al., 2017). One approach of collaborative learning is the Problem Based Learning (PBL) method (Hmelo-Silver, 2004). When doing so, the students are able to learn what they need to know to solve the proposed problem. The purpose of PBL is to assist the student in learning content, process skills, and problem-solving skills. It provides students with

guided experience in learning through solving complex, real-world problems (Hmelo-Silver, 2004; Khoiriyah & Husamah, 2018).

With the increased usage of PBL, the lecturers at Porto Accounting and Business School (ISCAP) decided to increase the weight of these group projects in the students' final evaluation. This decision was taken after a focus group interview with the lecturers who implemented this method. Focus group interviews can provide information about ideas and feelings that individuals have, and the different perspectives between them (Babo & Suhonen, 2018; Rabiee, 2004).

Along with the increase of the projects' weight in the final grade, the need to distinguish members of a group became clear, since the assessment can be biased when evaluating the group as one. The lecturers expressed this concern and, as a result, the process of designing a framework to provide an assessment environment was started. The framework aims to assist the lecturer with the task of distinguishing the elements of a group by supporting the students' self and peer assessment.

Therefore, in order to differentiate the performance of each student in a workgroup, a first version of a framework was designed. The assessment was done using a spreadsheet and pieces of paper, which was a rudimentary way to achieve self and peer assessments from the students. By seeking to improve this first version, other approaches to reach the same goal were designed. The latest version is a web version, which was designed to provide a freeware platform available to as many people as possible – WebAVALIA.

WebAVALIA was first presented in higher education institutions (HEI), as a platform to assist the lecturers in the assessment of students in workgroups. It is fundamental to the assessment process, since it registers the self and peer assessment of group members by a voting process. The scores resulting from it can then be calculated to achieve a result with which the lecturers can base their grades. The students have a unique point of view regarding their workgroup colleagues that the lecturer does not, and since the students are involved in the assessment process, the final grades can be fairer (Tan & Keat, 2005).

While WebAVALIA can be used to assist the lecturer in the assessment process, this software tool can also be used in non-academic settings. After all, teamwork is used in organisations to achieve various goals and WebAVALIA can be helpful in providing fairer self and peer assessments in such scenarios.

BACKGROUND OF CONCEPTS

In order to discuss the design of a new assessment tool, some relevant concepts must be detailed. Therefore, this section will present a literature review on important topics, concerning e-assessment of workgroups, namely collaborative learning, self and peer assessment, and technology enhanced assessment.

COLLABORATIVE LEARNING

According to Eshuis et al. (2019), collaboration in academic settings has gained more popularity with a great amount of research on this topic. Collaborative learning is understood as the practice of bringing together a small group of students that depend on and assist each other in the development of a work where a common goal has to be achieved (Babo, 2020; Chen & Kuo, 2019). It is a "multivoiced and heterogeneous" process where interaction is the key (Hakkarainen et al., 2013, p. 71).

There are several methods for collaborative learning that provide the students with the opportunity to "discover information or look for a way to solve the problem" (Ruiz-Gallardo & Reavey, 2019, p. 76). One of these methods is problem-based learning (PBL). PBL provides students with guided experience in learning through solving complex, real-world problems. According to some authors (Bell, 2010; Hmelo-Silver, 2004; Khoiriyah & Husamah, 2018; Kizkapan & Bektas, 2017; Loyens et al.,

2015; Ruiz-Gallardo & Reavey, 2019; West, 2018), PBL can have an important role in the success of students by contributing to a better group learning, which can be very important to curricula.

Group activities can improve and develop the skills of its members. However, the majority of studies related to the effects of improving skills in workgroups were conducted in the last few years, which makes it hard to find related articles from decades ago (Pai et al., 2015). This can suggest that interest in the improvement of skills through workgroups and on searching better methods to perform them is increasing.

In fact, group learning has been practised more often in schools and tertiary institutions, since in collaborative environments, the students can learn with and from their peers (Vicente et al., 2018). Group learning promotes critical thinking skills, increases reasoning and autonomy, improves strategies to resolve problems while focusing mainly on the most important steps, and improves the knowledge. In general, students who work in collaborative groups obtain better results and are more satisfied with what they learn than those who are not in groups (Daba et al., 2017). Cooperative learning requires students to form small groups to engage in learning, and it is important to the students' "individual contribution, self-learning, peer-learning, accountability, and communication skills" (Wen, 2017, p. 127). According to Wen (2017, p. 127), "team learning is one of" the "best cooperative learning" strategies in which assessment can be done. Effective collaborative practices can offer several benefits to the students, such as "achievement, motivation, and social skills" (Chen & Kuo, 2019, p. 95). In a collaborative environment, students are able to learn with and from their peers.

There are also several studies conducted by researchers in different universities of the world which aim to prove whether workgroups are effective or not. A study done in Bule Hora University (Daba et al., 2017) concluded that most students prefer this approach because they see it as a means to get good grades and pass the course, instead of a way to learn cooperatively. However, in the Universiti Kebangsaan Malaysia, a study conducted in two degrees of Engineering Mathematics concluded that the first grade prefers individual learning while the other grade learns better by working in a group (Othman et al., 2012). Also, in an Accounting course of Emporia State University, USA, the students did not appreciate cooperative learning (Wen, 2017). Thus, in light of the findings of this last author, the evaluators have to be careful when adopting cooperative learning strategies in order for them to be effective.

The same studies revealed controversies and possible reasons for disadvantages of group working and cooperative learning. Some factors that can reflect the lack of interest by learners to work in groups can be the insufficient background knowledge of content and lack of skills related to time management, evaluating, searching, and organizing content from various sources. These difficulties may lead to having the students "develop low self-esteem, low confidence, feel of fear, and sense of depending on dominant learners" (Daba et al., 2017, p. 865). Another factor that students have expressed when working in group is the possible unfairness in groups' individual assessment. This can happen because some members are less committed than others, which leads to different contribution rates, but not always compatible assessments (Daba et al., 2017).

However, in the higher education settings, who are the learners that benefit from this type of work? The personality of the students can be one of the decisive factors on the positive (or negative) effects. A study done by Lavy (2017) said that individuals with difficulties in interpersonal relations, anxiety or attachment avoidance usually show their attachment insecurities when working in groups. At the end, this revealed to be a wrong self-perception of themselves, since their insecurities do not compromise the "students' actual performance in group projects" (Lavy, 2017, p. 175). Furthermore, attachment anxiety was associated with higher grades in group tasks. Also, one of the most commented reasons is related to the difficulties of the students to stay together outside their classes which can affect equal participation (Daba et al., 2017; Wen, 2017).

Currently, due to the pandemic outbreak, most educational institutions have temporarily closed in order to contain its spread. Therefore, in order to mitigate these impacts on the students' learning,

the Federation of the Red Cross, UNICEF and the World Health Organization (WHO) have recommended the use of online education strategies (WHO, 2020). However, this new paradigm has shifted the education system from "group learning to more individualized instruction" (Kufi et al., 2020, p. 12), since the "usual lesson-oriented group work, discussion and cooperative learning situation" is harder to be implemented when "social interaction is under control" (Kufi et al., 2020, p. 6).

Nonetheless, the technological advances have assisted in changing the manner in which the teaching and learning processes occur. These changes allow for students to use collaborative softwares or applications to perform their group assignments online. Therefore, online learning can still encompass collaborative strategies, as long as both teachers and students are "mentally and emotionally ready" to overcome these conditions (Kufi et al., 2020, p. 9; Verawardina et al., 2020).

Self and Peer Assessment

According to McNamara and O'Hara (2008), the importance of evaluating emerged with the influences of the current political ideologies. From this study, it was also stated that the learning process has better results when there are frequent evaluations. The process of evaluation can be described as "identifying, collecting and interpreting information about learning outcomes" (Farrell & Rushby, 2015, p. 107). In the face of this popular method, some countries, like Ireland in the beginning of the decade of the 90s, had the initiative to incorporate evaluation practices at schools. Several authors consider that self-evaluation is important since it is seen as a manner for people to develop evaluation skills on themselves (McNamara & O'Hara, 2005, 2008).

Nevertheless, there was a need to prove the positive impact of self-evaluation. An analysis of the literature says that this kind of evaluation only has positive effects if every member of a group is willing to do that. Despite the implementation of these practices in schools, students tend to look at this process as an obligation, resulting in an incapability of having good effects on the process of self-evaluation. Moreover, schools' education managers and lecturers are not capable of performing self-evaluation, because they do not have this has a "standard practice" (Vanhoof et al., 2009, p. 21).

Besides, peer evaluation is critically important for workgroups, because with this approach the students have the possibility to "assess the quality of their peers' work" (Chang et al., 2020, p. 3). In a PBL approach, performing peer evaluation is a great strategy for the students to contribute to others' work, because they are not only evaluating themselves, but are also evaluating the rest of the group, and thus engage them in group learning as well. While self-evaluation can be practised in almost every individual activity, at professional, academic or even personal level, peer assessment is used more in group projects or presentations with practical means (Alias et al., 2015).

According to Kolmos and Holgaard (2007), a PBL work can be evaluated individually or in a group. Individual assessment consists of assessing a presentation where elements of the group are separated to deliver their part alone. However, in a group assessment, the presentation is evaluated like an *all-in-one*, which means all elements of the group have the same mark in the project, any element can respond to a specific question and unfairly, there is not a distintion between the members nor their actual perfomance. Notwithstanding, individual marks are synchronized with the peer assessment results allowing a distintion from the final project mark of the group, ensuring fairness and delivering a distintion amongst individuals. Therefore, peer assessment has a great significance, since it is a powerful method of education and delivers many benefits (Alias et al., 2015; Kolmos & Holgaard, 2007; Luxton-Reilly, 2009).

Despite this, a study by Alias et al. (2015) proves that generally the students' judgement on themselves, resulting from self-evaluation, is similar to the the peers' assessment and usually the combination of these assessments is higher than lecturers' assessment. Otherwise, students evaluate themselves relatively better than the rest of the group. This shows evidence of the inclusion of perspective of every member in evaluation, if these practices of self and peer evaluation are done regularly.

Summing up, evaluation frameworks have evolved, but there is still work to be done. However, with the support of previous studies, it is possible to conclude that self-assessment, as peer assessment, has great benefits. Moreover, according to some authors, like Bell (2010) and Cowan (1988), the tremendous benefits of self and peer assessment can improve the confidence of a student by making them realise the changes they can provoke in their final mark in relation to a lecturer's mark (Stefani, 1994; Tan & Keat, 2005). Since "it is far better to take the risk over the marks than to deprive students of the opportunity of developing the important skill of making objective judgments about the quality of their work and of generally enhancing their skills" (Orsmond et al., 1997, p. 357, as cited in Tan & Keat, 2005, p. 172).

Tan and Keat (2005) said that with the increase of workgroup evaluation, there will be a diffusion of the new ideology of self and peer assessment and the impact that it brings to the improvement of skills. Having said that, consideration for the respect of the students' opinions about their own final work, or the opinions of the students well involved in the workgroup, can create great doubts for academic lecturers. The exhaustive studies related to this theme support a favourable conclusion about the ponderation of self and peer assessment in the final evaluation, enabling a better workgroup distinction.

The study by Luxton-Reilly (2009, p. 210) found that peer assessment can be used in several contexts and brings benefits to its users in "cognitive, social, affective, transferable skill and systemic domains". However, despite the significant advantages of peer assessment, these practices carry an increase in administrative tasks. A manner to mitigate the increased workload is to use online tools able to support assessment management (Luxton-Reilly, 2009).

Technology Enhanced Assessment

The use of collaborative online platforms to achieve collaborative learning has been increasing. Computer-supported collaborative learning (CSCL) can generate "more complex and multifaceted cognitive, motivational, and emotional challenges in learning than individual learning" (Järvelä et al., 2019, p. 426). According to Ludvigsen and Steier (2019), CSCL is a structure of collaboration where there is the participation of two contributors, student and teacher, connected by a computational artefact. Technology can offer teachers and students the opportunity to broaden their learning outside of classrooms, by allowing the personalisation of the learning experience through these platforms, which makes the learning process more attractive (Rodríguez-Triana et al., 2019; West, 2018).

Technology enhanced assessment (TEA) covers a variety of activities where technology is used. TEA, also known as e-assessment, comprises "methodologies, tools and processes where information and communication technologies are used" (Hettiarachchi et al., 2014, p. 184). However, Cook and Jenkins (2010), define that online self and peer assessment is a different way of using computers to support assessment activities, which is distinct from e-assessment.

The use of software tools to perform self and peer assessment has been increasing. The reason being that the use of these tools for assessment can provide realistic perceptions of the actual performance of the students, as well as support the evaluator in crowded classrooms contexts. Each individual has to spend a lot of time working with their peers, which places them in a unique position to perceive and assess the performance and efforts of each other. Nonetheless, it is important to understand how this technology can be more efficient in assessment practices and at the same time, complement other assessment modes (Joint Information Systems Committee, 2007; Luxton-Reilly, 2009; Tan & Keat, 2005).

Gray and Roads (2016), affirm that the technology can be used for assessment just like any other tool to assist in the organisation of life and work. West (2018), also affirms that technology can assist in the organisation of learning processes by using and implementing several digital resources. With this

technology, it is possible to gather information to achieve a final mark, and make sure that the students are being evaluated in a suitable manner. A concern of Pereira et al. (2016) is related to assessment fairness, since there are different ideas about what is fair in a workgroup assessment process.

There are many software tools with different functionalities used in assessment activities. Luxton-Reilly (2009) made a review of some peer assessment tools, comparing them. From this comparison, it was possible to understand that most tools were either aimed towards specific courses or designed for peer reviews, for example written reports. Also, a simple search online finds several other market solutions, namely WebPA, Peergrade, iPeer, TeamMates, PeerMark, InteDashBoard, and Workshop Module, among others. When analysing these tools, it is possible to ascertain that most of them perform peer assessment only. Nonetheless, WebPA, Peergrade, and Workshop Module can perform both peer and self-assessment (Abelló Gamazo et al., 1992; Babo et al., 2020; Hettiarachchi et al., 2014; *InteDashboard™ - Empowering TBL with Technology | Peer Evaluation*, n.d.; *iPeer | Teaching with Technology*, n.d.; *Peergrade - Engaging Student Peer Review*, n.d.; *TEAMMATES - Online Peer Feedback/Evaluation System for Student Team Projects*, n.d.; *WebPA*, n.d.; *Workshop activity - MoodleDocs*, n.d.; IParadigms, 2010).

According to Babo et al. (2020), there are some key characteristics that have to be taken into account when analyzing assessment tools. One of these characteristics is the quickness to perform the needed steps in the tool by all the stakeholders (students, teachers, …), which may include quick and short questions on the different factors such as performance, anxiety, absence, motivation, knowledge, and so on. Another characteristic is the existence of a method able to restrict the scores provided by the users, which can be used to impose a comparison between members of a group. This method can be an added value to the assessment, since the individual's perceptions and viewpoints allow them to identify differences in the group members' performance. From these differences, it is possible to understand patterns and obtain a consensus on the performance of each member and distinguish them (Babo et al., 2020; Block, 1978; Sorensen & Jorgensen, 2019).

Another important characteristic to analyse in an assessment tool is its capability to perform weighted evaluations. This characteristic allows a distinction between peer and self-evaluation, and/or between different assessment criteria. Besides these characteristics, a functionality to allow the creation of workgroups or the assignment of members to workgroups is an advantage, as well as being a freeware software tool, available to "all the academic community". Luxton-Reilly (2009) also elicited the need for the development of peer assessment tools available to be used by several institutions (Babo et al., 2020; Block, 1978; Luxton-Reilly, 2009; Sorensen & Jorgensen, 2019).

Babo et al. (2020, p. 1326) made a brief analysis of the tools previously enumerated. This analysis was performed considering characteristics that the authors regarded as the key characteristics. All the enumerated assessment tools have their own technique ("rubrics, QA surveys, comments, and others") to enquire its users on their perception of the work developed. None of the tools has the possibility to restrict the scores provided by the users under evaluation, which means that the tools do not have a method to impose a comparison between group members when assigning the scores. Only the tools Peergrade and Workshop Module can "perform weighted evaluations", which allows a better distinction between self and peer assessment and/or between assessment criteria. All these tools allow an easy way to generate workgroups or assign members to groups, except Peermark. Regarding the availability of the tools, none of these tools is freeware (Babo et al., 2020, p. 1326).

RESEARCH QUESTIONS

Some few years ago, ISCAP implemented a new assessment method. This method consisted of using a Learning Management System (LMS) to conduct Multiple-Choice Questions (MCQ) quizzes. These quizzes can encompass all the practical topics, allowing the assessment of these topics in crowded classrooms while maintaining a continuous assessment setting. However, these MCQ quizzes were not considered satisfactory to be the only assessment method since they cannot assess all the skills

and competencies expected from the students. Therefore, it had to be complemented with other assessment methods, such as a PBL approach, in order to achieve the expected learning outcomes. This approach was then able to assist with the issue related to the skills and competencies acquisition that MCQ quizzes lacked, and the use of these two complementary assessment approaches improved the quality of the assessment process (Babo & Suhonen, 2018; Babo, 2020).

As this approach started to be used more frequently, the decision to increase the weight of these group projects in the students' final marks was taken. This decision was adopted after a focus group interview with the lecturers who used this method. However, with the increase of the projects' weight in the final grade, the question on how to distinguish individuals in a group, to allow a fair and unbiased evaluation arised (Babo, 2020; Babo & Suhonen, 2018).

Considering that most students' work is developed in non-contact hours, that is, out of classes and without the consistent supervison of teachers, the teachers are not able to have an objective perception about the students who work the most in a group. Without a rigorous observation method, they cannot achieve a real insight on the actual performance of each group member. Therefore, the complexity to distinguish members in a workgroup is notable and usually leads to having every group member with the same final mark, which can be unfair. Therefore, the research questions are:

> *How to assess individuals that are working in groups, and guarantee that they are assessed according to their performance and contribution to the work developed? Is there a good methodology that can assist the evaluators with their task of assessing each individual in a workgroup?*

In order to conceptualise the research process, a theoretical framework was designed with the key concepts (Figure 1). The aim of this research it to achieve a workgroup assessment that is fair and unbiased in order to return to the individuals their sense of fairness and reward. Therefore, considering that the students are being assessed on their performance in the group project development, the methodology can be based on the self and peer assessment of each group element. These assessments allow the evaluator to have a perception of how each individual in a group perceives their own performance and of their peers. The outcomes from these assessments result on the real performance and contribution of each individual, provided that they have given their honest opinion.

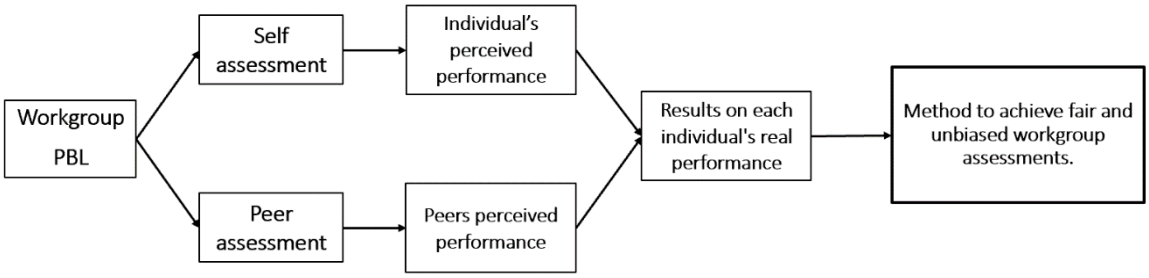

Figure 1. Theoretical framework for an unbiased workgroup assessment

METHODOLOGY APPLIED FOR DEVELOPING WEBAVALIA

This section will present the research methodology that supported the development of a framework that can assist the evaluators in assessing individuals that are working in groups and distinguish each member of the group, guaranteeing that these individuals are assessed according to their performance and contribution to the work developed.

The development of a software implies several cycles and DSR is a methodical research methodology, that has as its outcome as an artefact with practical applicability. According to Hevner et al. (2004, p. 85), this methodology is used to produce an artefact to solve a concrete problem and having

it as a relevant solution in terms of "utility, quality and efficacy". Also, the research process, the artefact development, and the consequent evaluation process need to be rigorously evaluated in order to present a "verifiable contribution" (Hevner et al., 2004; Peffers et al., 2007, p. 6).

First, a brief explanation of the Design Science Research (DSR) methodology applied to the framework will be introduced. Then WebAVALIA will be described, in terms of its features and uses, as well as the evaluation and implementation phases.

DESIGN SCIENCE RESEARCH METHODOLOGY

In recent years, Design Science Research (DSR) has received increased emphasis in the Information Systems (IS) community. This methodology addresses the creation or improvement of artefacts to provide solutions to relevant organisational problems. The Information Technology (IT) artefacts can be defined as "constructs, models, methods, and instantiations" (Hevner et al., 2004, p. 78) that demonstrate their utility for a specified problem when compared to the already existing artefacts (Deng et al., 2017; Hevner et al., 2004; March & Storey, 2008; Peffers et al. 2007).

The research process consists of a series of rigorous steps to build and design the artefact to solve an observed problem, evaluate the framework designs, and implement the alternatives, thereby making relevant contributions to the society. In order to better understand and conduct DSR, Hevner, et al. (2004) provided seven guidelines to undertake the research process. The guidelines are: design as an artefact; problem relevance; design evaluation; research contributions; research rigour; design as a search process; and communication of research, as seen in Table 1 (Hevner, et al., 2004; Peffers et al., 2007).

Table 1. Design Science Research guidelines applied to WebAVALIA framework (adapted from Hevner et al., 2004)

Guidelines	Description
Guideline 1: Design as an Artefact	A new framework was designed and developed - WebAVALIA
Guideline 2: Problem Relevance	The objective is to assist with the task of providing an environment to assess group members and achieve unbiased marks
Guideline 3: Design Evaluation	Questionnaires were applied to students since 2013/2014. In the future, the users' satisfaction obtained through questionnaire data analysis will be published
Guideline 4: Research Contributions	WebAVALIA can be used by any institution interested in performing a fair self and peer assessment
Guideline 5: Research Rigour	The framework research was based on the software development life cycle methodology
Guideline 6: Design as a Search Process	The feedback provided by the users led to the implementation and testing of alternative features in the framework. This process was repeated in an interactive loop
Guideline 7: Communication of Research	There were several (web) presentations about the tool in Portugal, Croatia, Finland, Kosovo, and India. The present paper serves as the first scientific paper on WebAVALIA

The guidelines help understand that the artefact developed must be innovative and a solution for a current problem with clear and new contributions to the field. The methodology used in its construction and evaluation must have rigour and ensure its utility. The process of the artefact development

consists of a search process to find the most effective solution, which may entail a trial and error method. After the final solution is discovered, the results have to be effectively communicated to the audiences. The guidelines do not need to be used in this order. Depending on the project, the researchers can determine how and when to apply them (Hevner et al., 2004).

The DSR process can be comprehended as an iterative three cycle research (Figure 2). On one side, there is the *Relevance Cycle* that forms a link between the research environment and the activities surrounding the project build and design. On the other side, the *Rigour Cycle* relates the actual scientific foundations necessary to build the project. In the middle, the *Design Cycle* aggregates the environment and knowledge base essential to the project development process, as well as the iterative cycle of building and evaluating the framework (Hevner, 2007). With iteration as the main aspect of the research process, *Design Cycle* expresses this quality in the "build-and-evaluate loop" (Hevner et al., 2004, p. 78). The evaluation provides important feedback about the artefact, enabling a better understanding of the problems which contributes to the re-design process (Geerts, 2011; Hevner et al., 2004).

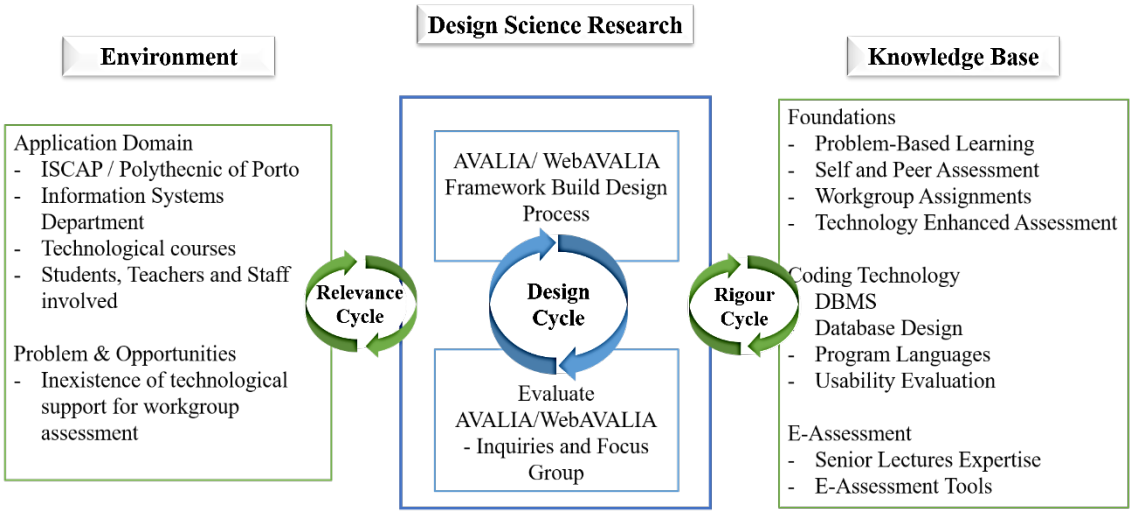

Figure 2. Design Science Research cycles of WebAVALIA (adapted from Hevner, 2007)

The research process is driven by the determination to improve the environment. The application domain consists of people, organisations, technical systems, and technology that are combined to achieve a goal. From the environment, it is possible to derive improvement opportunities and recognise problems for which the creation of innovative artefacts will be an added value. The relevance cycle emphasises the research context by providing the opportunities or problems and the criteria to evaluate the results (Hevner, 2007; Hevner & March, 2003).

The research is based on the knowledge base, which means the scientific theories and methods that will serve as a reference to the framework development. Besides the past knowledge, it must also contain experience and expertise of the stakeholders, a comparison of existing artefacts in order to guarantee actual research contributions, and the needed technology proficiencies to develop a software tool. The rigour cycle provides the foundations to design the framework (Hevner, 2007; Hevner & March, 2003).

The *Design Cycle* is at the heart of the research project. It addresses the relevance and rigour cycles by developing an artefact that fits the identified needs. This cycle is iterative since the feedback from the evaluation helps identify weaknesses and thus the development of alternatives leads to more evaluation phases. The "build and evaluate loop" continues until a final and satisfactory artefact design is achieved (Hevner, 2007; Hevner & March, 2003; Hevner et al., 2004).

WEBAVALIA RESEARCH CYCLE

WebAVALIA grew from the non-existence of technological support to differentiate the performance of each student in a workgroup assessment. It was built within ISCAP's environment and involved its staff and facilities. The knowledge base for the framework development consisted of theorical topics about the assessment process, such as PBL, self and peer assessment, workgroup assignments, knowledge of coding technology, as well as other e-assessment software tools offered in the market. Also, the expertise of the senior lectures was an important aspect.

The process of building and designing the framework was founded on the aspects above. Since WebAVALIA is a software tool, its improvement and development will require constant evaluation and redesign in an iterative cycle.

WebAVALIA context

The opportunity to improve the workgroup assessment by fulfilling the need to distinguish workgroup members led to the development of a new solution – WebAVALIA.

ISCAP is a Portuguese Polytechnic Institution which is part of the Polytechnic of Porto (P.Porto). It has a variety of undergraduate and graduate programs in the areas of Administration, Accounting, Business, and Management. ISCAP gathers around 270 teachers and 4,300 students. Its IS department is composed of about twenty lecturers who teach all degree programs at ISCAP. Concerning the large number of courses, and therefore students, there are limited resources of computers per classroom, which can be a limitation of the normal functioning of classes, since not every student has access to a computer.

Each teacher in a semester can have up to four or more classes, where each class has about 40 students, leading to approximately 150 students in a semester. When using workgroups, it would be ideal to have groups composed of 3 to 4 members, which leads to 30 to 40 groups per semester. Due to this, the teacher might not have an objective perception of the most working students in a group, when considering that most of the work development is done outside the classroom. Although, even if there were continuous contact with the groups during all the development process, without a rigorous observation method, the teacher would still not achieve a real perception on the actual performance of each group member. The desirable approach would be to increase the size of the groups to about 6 members, to have fewer groups (around 20), therefore it would be possible to achieve a better monitoring of the groups. Nonetheless, this approach would only increase the complexity to distinguish members in a workgroup, which usually leads to having every group member with the same final mark.

According to DSR guidelines, the current problem is relevant, and a solution will be presented. Therefore, the solution to the issue previously explained is the development of a framework to assist with the task of providing an environment to assess group members and achieve fair results. Therefore, the first method to accomplish a workgroup member differentiation was implemented. It was done by using a spreadsheet, but the students had to perform their self and peer evaluation by voting on individual pieces of paper. These data were introduced by the teacher in the spreadsheet. While this approach helped in overcoming this problem to some extent, it was not efficient. It could sometimes be more laborious, since the crucial part of the process was the students' input, which was done in a rudimentary way. The papers on which the students wrote their evaluation created some problems; for example, their peers seeing their answers, thus compromising their anonymity. Although this method was a step to solve the fairness in workgroup evaluations, it was not efficient.

Although this version was not successful, it led to the development of a solution, i.e., the first version of a mathematical formulation to transform the voting results into a mark, which resulted in the design of a software tool.

WebAVALIA foundations

WebAVALIA was developed using the DSR methodology, therefore the scientific foundations used in its development have to be explained. Hence the following summary of the literature review.

Collaborative work has been more widely used, since this method can improve skills and competencies. In general, students who participate in workgroups achieve better results and are more satisfied with the learning experience (Daba et al., 2017; Frank & Barzilai, 2004; Hoegl & Gemuenden, 2001; Kizkapan & Bektas, 2017; Pai et al., 2015).

The PBL method requires students to work in collaborative groups, which can help them become active learners. It situates learning in real-world problems, by making the students responsible for their own learning (Hmelo-Silver, 2004). However, assessing workgroup members can be a difficult task, therefore self and peer assessment can be an important step to ease this concern. These assessment approaches take into consideration the students' opinions about their own work and the opinions of the students well involved in the workgroup (Alias et al., 2015; Tan & Keat, 2005).

In order to facilitate the assessment, there has been an emergence of software tools used specifically in assessment processes. But there is still the need to ensure that the assessment is fair and unbiased. To this end, it is required that the assessment tool has key characteristics (Joint Information Systems Committee, 2007; Pereira et al., 2016; Tan & Keat, 2005).

The main characteristics that should be presented in an assessment tool are the quickness to perform the needed steps in the tool, including quick and short questions on the different factors, as well as a method to impose a comparison between members of a group and the capability to perform weighted evaluations (Block, 1978; Sorensen & Jorgensen, 2019). The market offers many software tools capable of supporting the lecturer in the assessment task. Some of these tools are WebPA, Peergrade, iPeer, TeamMates, PeerMark, InteDashBoard, and Workshop Module, among others (*InteDashboard™ - Empowering TBL with Technology | Peer Evaluation*, n.d.; *iPeer | Teaching with Technology*, n.d.; *Peergrade - Engaging Student Peer Review*, n.d.; *PeerMark™ - Guides.turnitin.com*, n.d.; *TEAMMATES - Online Peer Feedback/Evaluation System for Student Team Projects*, n.d.; *WebPA*, n.d.; *Workshop activity - MoodleDocs*, n.d.). While most of these tools only perform peer assessment, WebPA, Peergrade, and Workshop Module can perform both peer and self-assessment (Abelló Gamazo et al., 1992; Babo et al., 2020; Hettiarachchi et al., 2014).

Other scientific foundations necessary to develop a software tool are the knowledge on coding technology and developers' expertise and know-how. In order to design an assessment tool, the developers need proficiency on Database Management System (DBMS) and database design, program languages, as well as usability evaluation.

Design WebAVALIA

In order to design the framework, the software development life cycle methodology was used. This methodology is used to describe the development of a software and provides a series of sequenced steps to follow, such as planning, analysis, design, implementation, evaluation and then reiteration, in order to achieve the final product (Balaji & Murugaiyan, 2012).

The following Use Case diagram (Figure 3) explains the artefact requirements and provides an outside view of the system, identifies the actors, and their interaction with the framework.

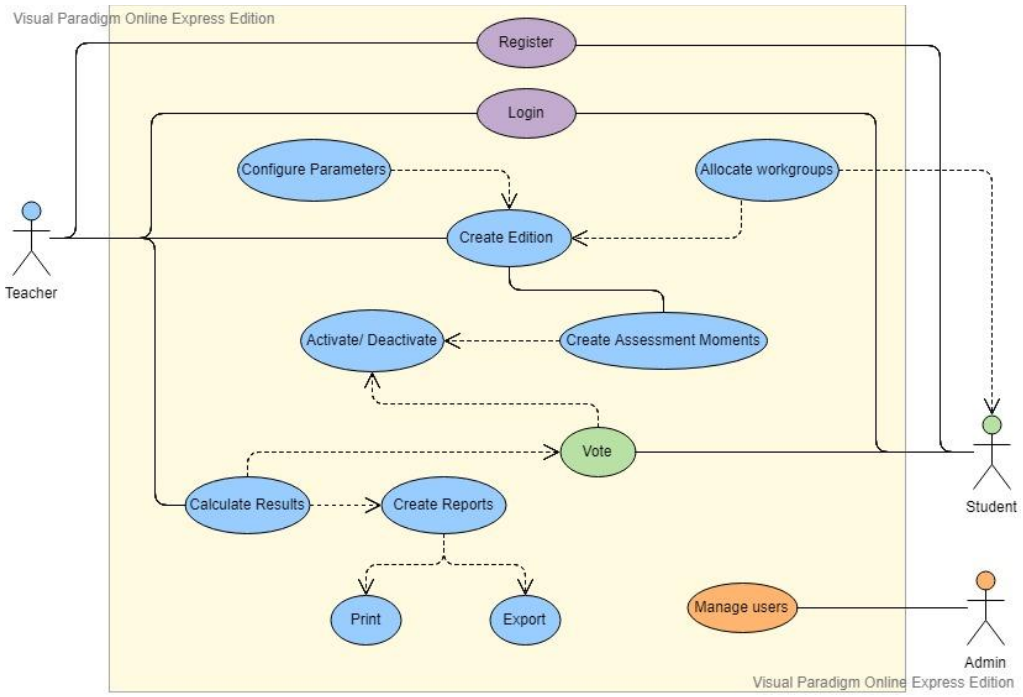

Figure 3. Use Case diagram of WebAVALIA

The first version of the software platform was implemented in 2012 and it was called AVALIA (which means Evaluate in Portuguese). The implementation was carried out in a higher education setting, where the lecturers used it to assess students. This version of the tool was basic and composed of an MS Access database in a specific, non-editable path. Nonetheless, it was the first approximation on the final software that originated WebAVALIA, which will be presented below.

WebAVALIA Presentation

WebAVALIA is a self and peer assessment tool designed to assist the evaluator with the task of distinguishing the members' performance in a workgroup. Its main goals are to provide an easy, quick, anonymous, and fair assessment. Easier and faster procedures for the members of a group to elicit their opinions about each other's performance will be more authentic, which will lead to unbiased assessments. Anonymity is also important because then the individuals can answer without the fear of reprisal. Another important aspect is to ensure the fairness of the assessments for each member to be scored according to the work developed by him/herself.

This tool has two main types of users: the evaluator, the person who is responsible for the assessment; and the member of a workgroup that is being assessed. The former has access to most features of the tool, while the latter only has access to the *voting board* and the individual profile. The evaluator can create editions in which the evaluation will occur. An *edition* is related to a specific assignment or project and can be parameterised accordingly to his/her preferences for evaluation settings. Some configurable parameters are: the amount of times the voting process should occur, the relative weight of the self and the peer evaluations, as well as the dates for the different *voting moments* (Figure 4).

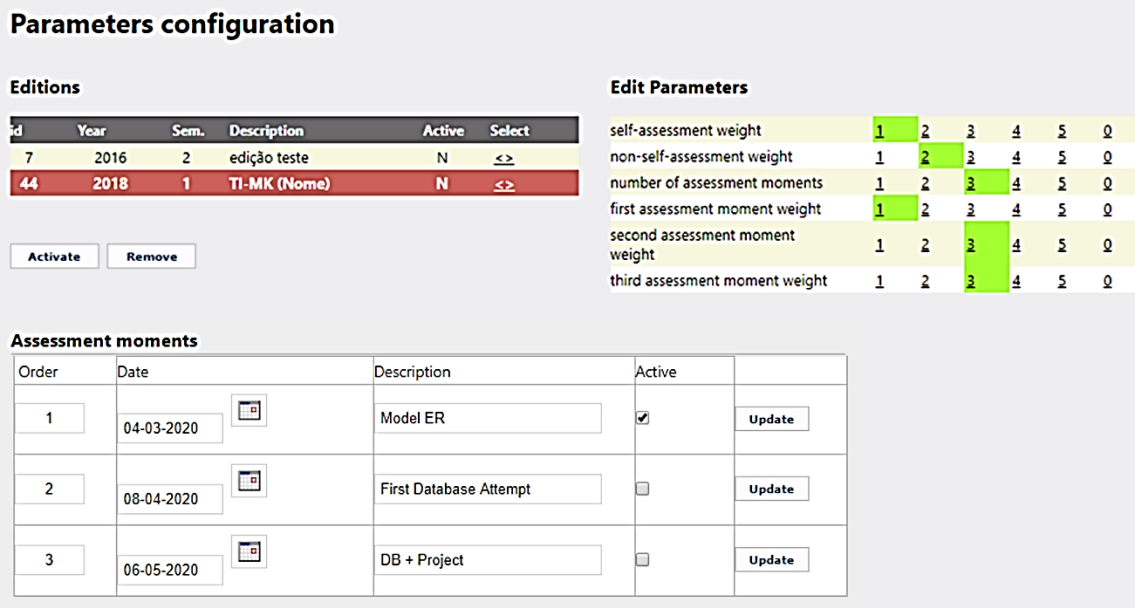

Figure 4. WebAVALIA parameters configuration

The evaluator can also form/register the groups by assigning members to workgroups and, if necessary, remove members. At the end of the project, and after the evaluator grades it, the final results can be calculated (Figure 5). These results are calculated using the several scores of the voting. The framework has evolved over time, therefore different versions were designed, which resulted in different final results. Each result is calculated through a different algorithm (A, B, C, and D), and these algorithms have been improved with time. An example of improvement was the elimination of the B algorithm, since, in some extreme cases, it delivered infeasible results. It was decided to maintain all the three marks (A, C, and D) despite the results obtained with each one being different and considering that they can be useful for the evaluator in the decision-making process about the final marks. The results can then be exported to various formats (csv, xcsx, pdf, xml, etc.) and printed (Babo et al., 2020).

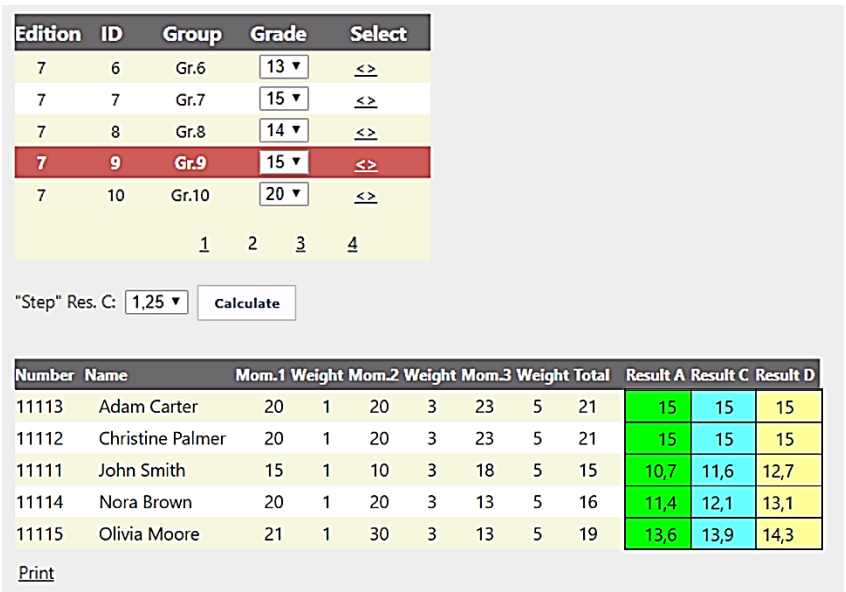

Figure 5. Results page on WebAVALIA

WebAVALIA allows an easy and simple manner for the members of a group to evaluate themselves and their peers. At the *voting date*, each member has to attribute a score to each group member, including him/herself, in the *voting board*, until the total of points sums 100 (Figure 6). After submitting the voting, the process is completed. On the next *voting date*, the same process is repeated. The voting process takes about one minute to be completed and it can occur up to three times.

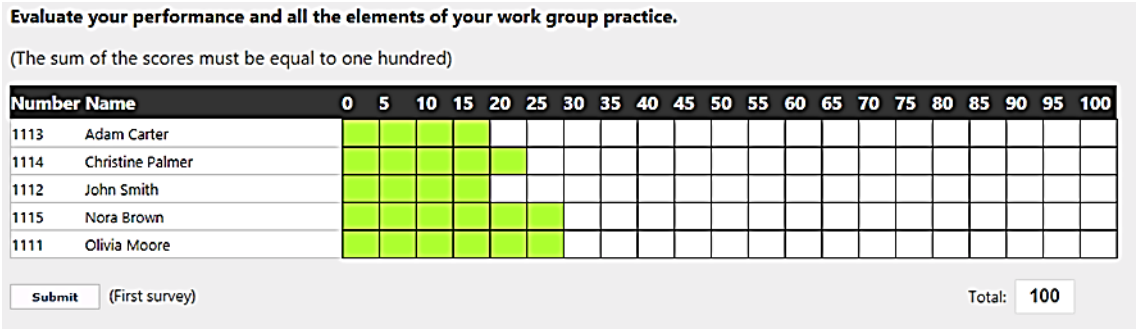

Figure 6. WebAVALIA voting board

According to the Use Case diagram (Figure 3), the first task is the registration and login of the evaluator. An *edition* is created, corresponding to a project/assignment which was previously outlined and delivered to the students. The parameters of the *edition* can be configured, namely the respective weighting of the self and peer assessment, the number of times of the voting process, and the *voting periods*. At this moment, the people that will be assessed can register themselves in the corresponding *edition*.

Close to the *voting date*, the evaluator has to activate the *voting moment,* allowing the workgroup members to vote. Before the next *voting period*, the previous *assessment moment* must be deactivated. This process ought to be done until a maximum of three *voting moments* occur.

Subsequently, the evaluator has to grade the project/assignment, autonomously, outside the platform. Then, these project/assignment grades have to be registered per workgroup in the Results page (Figure 5), which enables the calculation of the final scores for each member. Finally, the reports can be created and thereupon printed or exported.

AVALIA/ WEBAVALIA EVALUATION

The evaluation of the artefact provides important contributions to its development. This phase allows the users to provide necessary feedback to support the utility of the product and implement alternatives for the occurred problems. This process leads to a "build and evaluate loop" which contributes to the tool evolution (Hevner et al., 2004).

Feedback collection

In order to evaluate the framework and gather feedback, surveys were distributed to the students in the academic years of 2013/2014, 2014/2015, and 2016/2017. These surveys were conducted using the LimeSurvey application (*LimeSurvey: the online survey tool - open source surveys*, n.d.) and were composed of a students' characterisation page; open-answer questions where students were asked about the advantages and disadvantages of using this tool, as well as comments and suggestions; and five-point Likert scales. The statements had a variety of points important to understand the tool usability and how the respondents felt when using WebAVALIA and can be divided into five categories as stated in Table 2.

In total, more than 100 students who had used AVALIA or WebAVALIA tool to perform self and peer assessment of workgroups during the development of an assignment or a project replied to the surveys. Along the years, the statements have undergone some changes. Some of these changes were

made to the survey of 2016/2017, concerning the removal of Q6 and Q17 (as Q20 and Q21 in Table 2) and the addition of Q18 and Q19.

Table 2. Categories of the survey's five-point Likert scale statements

Categories	Statements	Explanation
Fairness	Q1 - This tool allows a fair assessment.	It provides feedback on the fairness of the tool.
	Q2 - This tool provides a greater degree of honesty in the assessment of the elements of the group.	
	Q4 - The elements who contribute less get a better grade than they deserve.	
	Q19- The use of a tool with the AVALIA's purpose is indispensable for a fair assessment of workgroups.	
Productivity	Q3 - Assessing more regularly, once a week, for example, would increase the productivity of each element of the group.	These statements allow to understand the impact of the framework on the students' performance.
	Q8 - The performance of the students increases if they have access to the score given by their group's colleagues.	
	Q11 - If the tool is used less frequently (fewer times), the performance evaluation will be more accurate.	
Complexity	Q6 - If the tool were more complex, if we could, for example, evaluate more parameters, it would be more beneficial.	These questions allow to ascertain the complexity of the tool, as well as the features the respondents deem important.
	Q9 - The simplicity of the tool allows to determine, in an easier and more accurate way, the involvement of each element of the workgroup.	
	Q13 - The "AVALIA" is an intuitive and easy-to-use tool.	
	Q15 - Having the tool available in mobile format (app for smartphone) would be an advantage and would lead to a greater use of it.	
	Q16 - The more complex the tool is, the harder it is for me to evaluate the performance of the elements of the group.	
Assessment	Q5 - I think it is wrong that the element of the group with the best evaluation has a grade equal to that assigned to the project.	This category provides feedback on the assessment process and the perception that the students have about the evaluation of the performance.
	Q7 - The student's performance is not correctly evaluated, which leads to the student having a lower mark than deserved.	
	Q10 - The "AVALIA" allows the teacher to have a more correct evaluation of the performance of each element of the group.	
	Q12 - It would be incorrect that the best element of the group had a higher score than that assigned to the project.	
	Q14 - By using this tool, the student can, in a concrete and correct way, assign a score to the work developed by each element of the workgroup.	
	Q18 - The elements who contribute less are excessively penalised by the system.	
Course's Details	Q20 - It would be better if this course's assessment consisted only in the development of the project.	Some feedback about the course and the role of the project's assessment on it.
	Q21 - The evaluation of this course should exclude the project.	
	Q17 - This tool is very useful for the evaluation of the group performance and should be adopted in all the courses, if applicable	

From the several applications of this survey, it was possible to obtain important feedback from users to improve the tool. These results and respective analysis of the surveys' answers will be presented in a future study. Nonetheless, a non-formal analysis of the results already obtained, indicate that WebAVALIA is an easy-to-use, practical, and intuitive software. The tool provides fairness in the assessment of group members, delivering a distinction between the individuals. Therefore, the elements who contribute less to the project do not get a better grade than what they deserve, and, at the same

time, they do not get too much penalty. The feedback also allowed to perceive that more frequent assessments are helpful to distinguish the group members; however, it does not increase the productivity of the students. Further perceptions and conclusions will be presented in a coming study.

Iterative development cycle

Iteration is the main aspect of the Design Cycle, since it gathers the building and evaluation processes, which allows the implementation of alternatives to the encountered problems. As explained before, this self and peer assessment framework evolved from a basic version, called AVALIA, and since then, it has been developed to achieve the current version - WebAVALIA.

AVALIA was the first version of the framework, therefore the first design cycle led to its evaluation. The first version of AVALIA was implemented in 2012, in an MS Excel spreadsheet. The following table (Table 3) compiles its respective features and problems described by the users.

Table 3. Features and problems of AVALIA's 1st version

1st version: AVALIA (2012)	
New feature(s)	**Problem(s)**
Votes were collected manually and registered in the spreadsheet	Students voted on pieces of paper that were collected by the teacher. A very time-consuming process in classroom and for teachers
Spreadsheet with a summary table with formulas	Spreadsheet insufficiency to perform self and peer assessment; The summary table had to be replicated for each group

The second version of AVALIA was implemented mid-2012 and was composed of a relational database with a simple template, designed and developed in MS Access (Table 4).

Table 4. Features and problems of AVALIA's 2nd version

2nd version: AVALIA (mid-2012)	
New feature(s)	**Problem(s)**
Allowed to manage the editions for each course and respective teacher, with up to three *assessment moments*, which occur along the semester	
Database in a specific, non-editable path	Necessity to initialise the database every time it was used, which was time consuming, because the list of students enrolled in each course and the lecturer associated with the course had to be transferred each time we ran the application.
The editions were associated to courses and respective lecturers.	Impossibility to run the AVALIA software for several teachers, since only one lecturer could run it at a time; The editions had to be activated and deactivated accordingly, because it did not allow a concurrent database access.
Data migration from ISCAP's database (with students' data - id, names, classes, and system passwords)	The database was not editable, it was not possible to add students, set their password and delete or add records of the student list.
The approach to deal with the students dropping out from the course was by having a start and end date for the duration of the *assessment moment*. Therefore, it was possible to cross reference to know which students were active (had not dropped out) in between the dates.	

2nd version: AVALIA (mid-2012)	
New feature(s)	**Problem(s)**
The lecturers authenticated themselves through their user number and the password was saved in the database. The students' authentication was done with their student ID number and password.	The teachers could only change their own password. Students' password could not be changed and a new password could not be requested.

In 2013, the third version of AVALIA's database was placed on a network path, which solved one of the problems of the previous versions (Table 5).

Table 5. Features and problems of AVALIA's 3rd version

3nd version: AVALIA (2013)	
New feature(s)	**Problem(s)**
A database per teacher	
The students and lecturers had to choose the respective course lecturer from a combo box.	
The path was editable which enabled the restart of the application by pointing it to another location. Every lecturer had the freedom to edit the database	Not having the possibility to have several editions at the same time.
The platform could be rebooted to another location, which supported the creation of a local test version, allowing new users to experiment and use the application.	
Database allow the lecturers to have a custom authentication.	
It was possible to enable redefinition of the lecturers' passwords, add students, set their passwords, and delete or add records in the database.	
A button that allowed the removal of the student who had dropped out.	It implied more calculations to automatically provide a neutral answer in substitution of the dropped out student, in order for the remaining members not being penalised.
	Some respondents felt that there was a great discrepancy between the grades in a group

Although AVALIA could perform self and peer assessment of students and the teacher could distinguish members of workgroups, achieving individual results, the process was very laborious and lacked in usability. It also did not allow the framework to be used by other institutions outside of P. Porto.

For this reason, a new version was designed – WebAVALIA. Since it is a web version of the software, it allowed access from anywhere. This version was developed and implemented on the Visual Studio 2012 platform (C # language) and an IIS server was configured. Some of the features implemented in the first version of WebAVALIA are presented in the following figure (Figure 7).

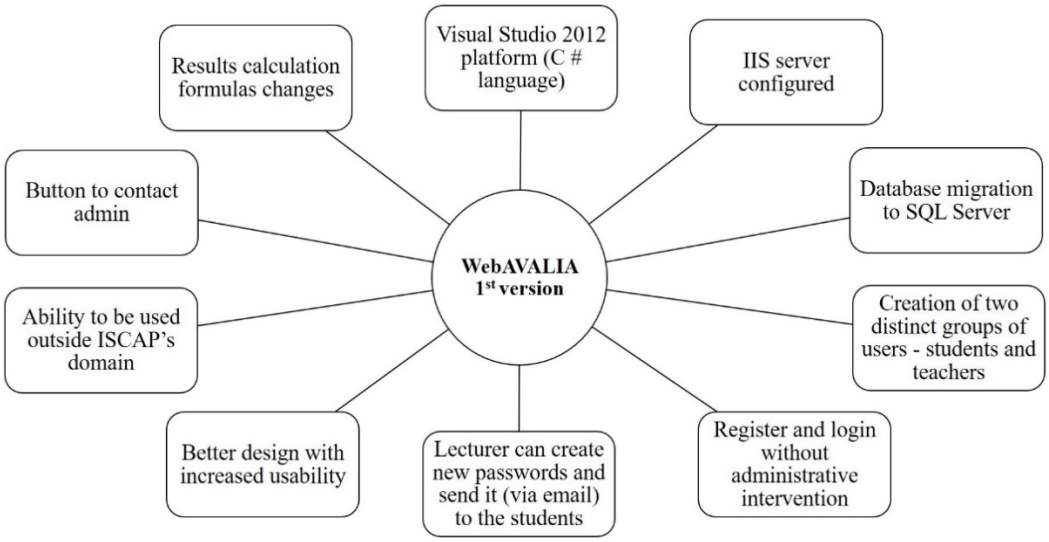

Figure 7. WebAVALIA's 1st version development and features implementation

Nevertheless, some features could still be improved, and some new problems have surfaced. It became clear that groups of bigger dimensions should be permitted. This version of WebAVALIA only allowed the lecturer to form groups of 3 to 5 members. Another problem was that when the students were to vote for the second and third time, the voting options chosen the previous times were displayed after they logged in. This situation was embarrassing for the students, if accompanied by colleagues, and could influence the way they voted the next times.

The results calculation formulas have changed since the beginning, adding new mathematical formulations. Each result expressed a more narrow or broad distinction between the students' scores, which enabled the lecturer to choose the result of their preference. However, despite the existing three new different results algorithms (A, B, and C), it could be perceived from observing the students' opinions that the ideal mathematical formulation could still be achieved.

Then in 2015, a second version of WebAVALIA was implemented to solve the problems of the 1st version and improve some of its features, as well as implement new ones. The problem of having the students' previous voting options displayed was solved by having the voting board empty every time the student would vote. An improvement of this version added the possibility to have groups of bigger dimensions (more than 7 members), which implied different layout and algorithms. This change was possible due to a new university starting to use WebAVALIA and being successful.

Concerning the results calculation, one of the existing formulas was removed (B), because in extreme cases, it did not present the correct results. Also, to provide a fairer evaluation, there was the application of a new type of results calculation (D). This new formula allows for a better distribution of scores to the group members. For this reason, the current version presents three types of results (A, C, and D), one of them being dependent on a parameter defined by the user (Babo et al., 2020).

Other features implemented in this version include an internationalisation feature, which allowed the tool to also have an English version, besides the Portuguese one. Another element applied is the possibility to send suggestions to the webmaster. It is also possible for the lecturer to verify which students did not vote and send reminders (via email) to those students.

WebAVALIA Contributions and Communication

When this tool started to be designed, its goal was to assist lecturers in the assessment of workgroups in higher education institutions. It soon became clear that several institutions use teamwork to perform their work. Thus, WebAVALIA might be used by any institution interested in performing a fair self and peer assessment.

Therefore, and according to the research contribution guidelines, WebAVALIA contributes to the area of the design artefact with clear and verifiable contributions. In comparison with the already existing software tools for workgroup assessment, WebAVALIA can be used by any institution that performs self and peer assessment. It assists the evaluator with the task of distinguish members of a workgroup in an accessible way, with simple features and an intuitive approach.

WebAVALIA is an e-assessment tool that provides an easy voting process, anonymous evaluations, a fair differentiation of members, and the simplification of the evaluator's work. It has the option to parameterise the weight of the *assessment moments* and allows them to penalise the self in relation to the peer assessment, or the opposite. It permits to calculate results, to export and print reports, and to assign members to workgroups. Also, the evaluator can choose between three types of results and the voting process is easy and intuitive.

Concerning the communication of WebAVALIA, the first idea was to protect the tool with a patent, but at the same time, there was the need to present the tool in public presentations and publications in order to allow its use for all interested. However, according to the Industrial Property Code, as soon as a tool becomes public, it can no longer be protected with a patent. Then it had to be decided: either protect the framework with a patent or to make the tool available to the public.

Therefore, the present paper serves as a presentation of WebAVALIA and its framework. The communication of the research, according to the DSR guidelines, has to be effectively presented to the "audiences" (Hevner et al., 2004). To that end, since 2016, several (web)presentations were made about the AVALIA/WebAVALIA framework:

Babo, R. (2020). Analysing and improving mathematical formulation of Webavalia: A self and peer assessment tool. *IEEE Global Engineering Education Conference (EDUCON 2020),* Porto, Portugal.

Babo, R. (2019). WEBAVALIA: Contribuem Todos Com A Mesma Intensidade? *Fórum Interno P. PORTO 2019*, Instituto Superior de Engenharia do Porto, Portugal.

Babo, R. (2019). Work group! Do all the members contribute the same? *3º Congresso Internacional de Psicologia*, Educação e Cultura, Instituto Superior Politécnico Gaya, Portugal.

Babo, R. (2018). Project Based Learning: WebAVALIA Tool. University of Pristina, Kosovo.

Babo, R. (2017). Improving group work assessment with WebAVALIA: The concept, framework and first results." *edTech & Interactive Technologies Research Seminar*, University of Eastern, Finland.

Babo, R. (2017). WebAVALIA - Distinction of individual performance in work groups. Webinar on WebAVALIA, India.

Babo, R. (2017). WebAVALIA - Distinction of individual performance in a group work Framework. University of Split, Croatia.

Babo, R. (2016). AVALIA - Distinção do desempenho individual num trabalho de grupo. *I Ciclo de Palestras em Tecnologias e Sistemas de Informação*, ISCAP, Portugal.

To promote and assist the users with their experience using WebAVALIA, a website (https://webavalia.wixsite.com/webavalia) was also developed. This website has user guides that can

be consulted, the evaluation process that helps understand the timing of the tool, and other information on the tool. Some of this information can only be accessed by registering on the website (*Tutorial WebAVALIA*, n.d.).

DISCUSSION AND FUTURE WORK

Throughout the paper, the importance of workgroups to develop skills and competencies was explained and light was shed on collaborative learning as well as the PBL methodology, since the formation of groups is an important aspect of this method. One of the disadvantages expressed about workgroups in the literature review was the difficulties in assessing the contribution of each member without it being unbiased. WebAVALIA tool was developed to assist the evaluators when distinguishing the performance of each member in a workgroup and to deliver fairer results (Daba et al., 2017; Kizkapan & Bektas, 2017; Pai et al., 2015).

In order to differentiate each individual's contribution, the literature explains the benefits of self and peer assessment. The differences between these assessments and their significance in the individuals' evaluation in workgroups was also important to state. Therefore, WebAVALIA was developed to support self and peer assessment of every group member to obtain the opinions of the people involved in the workgroup (Bell, 2010; Cowan, 1988; Schwarz & Westerheijden, 2004; Tan & Keat, 2005).

WebAVALIA is a software tool used for assessment, thus definitions of technology enhanced assessment were also an important aspect to consider, along with the different e-assessment tools already existing in the market and their main characteristics. Literature shows that the use of software tools to perform assessments can deliver realistic perceptions on the actual individual contribution. From the key characteristics, WebAVALIA is able to impose a comparison between group members, by not allowing the individuals to distribute the same score to every member. WebAVALIA also has the capacity to have different weighted assessments permitting a distinction between self and peer assessment, as well as a distinction of the different *assessment moments* (Abelló Gamazo et al., 1992; Block, 1978; Joint Information Systems Committee, 2007; Sorensen & Jorgensen, 2019; Tan & Keat, 2005).

Another important characteristic that was lacking in the market was the free availability to the community, therefore WebAVALIA is free to be used by anyone who wishes to use it. Therefore if any company, team or university wants to use this tool, a manner to do so would be to contact the authors or access the WebAVALIA's website (https://webavalia.wixsite.com/webavalia), which has user guides and tutorials, as well as more information on the tool (*Tutorial WebAVALIA*, n.d.).

Surveys to gather the opinions and perceptions of WebAVALIA's users were distributed and data was collected. This data was also analysed in order to achieve general results on the validity of the tool. However, it would not be possible to present a deeper analysis of the results in this paper, since the analysis was performed during three academic years covering more than 100 students. Analysis of the results entailed a huge amount of statistical work, which would not be possible to describe and present in this paper. Therefore, in the foreseeable future, there will be the presentation of the results' analysis of the surveys carried out about the users' opinions and perceptions.

There are still some complaints about WebAVALIA, mainly from students who do not have much success on the assessment. The issue is to understand whether these students complain because the algorithm is excessively penalising the less working students or if they complain just for the sake of complaining. Sometimes when the students do not have the necessary knowledge, they may not be able to correctly assess their peers. This may happen because they may not understand the depth of the required knowledge, and thus do not comprehend the assessment/knowledge range.

However, if the complaints are due to mathematical formulations, the software's life cycle recognises room for improvement, which will enable new forms of calculation to be designed and allow for a

fairer assessment. As for future research, it would also be interesting to explore the mathematical formulations and the respective supporting algorithms in order to discuss borderline cases and other efficient forms of mathematical formulation.

When evaluating a workgroup, it is important to consider the knowledge background of the students, as well as their acquaintance with the topics. This is important because the students with less contact with the main topics will have to work harder to achieve the same learning outcomes. The student who has familiarity with the concepts does not need to endeavour much to understand and achieve the learning outcomes. All this work and effort should be considered when assessing each individual in a workgroup.

Another aspect when considering the assessment of workgroups, is the case when a group member quits the project. These cases can be complex, because there may be situations when these students do not express their decision and remain present in class. When this happens, the remaining members of the group will come off having to continue the project by themselves which implies an increase in their workload. It would be interesting to understand how to improve the mathematical formulations in order to only assess the remaining students involved in the project. An option would be to implement a different configuration in the tool's layout to permit the students or the teacher to easily remove the dropped-out student from the assessment process.

In order to understand WebAVALIA's generalizability, it would be necessary to implement the tool in other group assessment contexts. Even though it was used by different course students, ISCAP and FDMUP, an analysis of these situations is not enough to assess its generalizability. Therefore, it would be interesting to witness the future usage of this tool by other universities or by technical training students, as well as in other cultures and countries, besides Portugal. Only by implementing this tool in different contexts and obtaining the users' opinions, it will be possible to perceive the WebAVALIA's generalizability.

It would also be interesting to implement WebAVALIA in other contexts such as sports organisations or in business environments. In sports teams, there are strict and complex criteria to evaluate every athlete's actions and understand how these contribute to the team's success. However, it would be helpful to understand each athlete's perspective about the match. This way, the team members and coach could have a better understanding of each member's performance and act upon it. While in a business environment, WebAVALIA could assist in the awareness on how each member perceives their team and the work exchange within a group. This awareness can support in achieving a better coordination between team members and better assignment of tasks, improving the teams' performance, which consequently may enhance their results. By employing WebAVALIA in these teams, it can help both the team members and managers understand the importance of each member's contribution to the overall results.

Also, an experiment to understand good practices when using WebAVALIA would be to compare the students' satisfaction about the tool when some groups have access to intermediate results and the other do not. This can only be achieved by having classes where the groups are developing projects during a semester, for example. In one class, the groups are informed of the general results of each group member after each voting moment, where in the other class, this feedback is not given. By comparing the final results of both classes, it would be possible to understand if there are any differences in the groups' performance. However, there are many variables in play, which may compromise the results of this experiment. There may be students who may be discouraged and abandon the project group, others who become more hardworking, and other situations where there may be duress from the less working students on the remaining members.

CONCLUSION

The focus of this study was to present WebAVALIA. The main purpose of this e-assessment software tool is to provide the evaluator with an environment to differentiate the performance of each individual in a workgroup by having an easy, quick, anonymous, and fair assessment. The tool is capable of performing self and peer assessment and calculating a final score, taking into account the project grade.

WebAVALIA was developed using the DSR methodology. This methodology has seven guidelines that can be applied in the order that suits the project's needs in three research cycles. Firstly, the environment and the current problem were explained, as well as its relevance: the unfairness and biased workgroup assessment. A solution to it is the implementation of a framework which aims to provide the means to assist the evaluator in distinguishing the members of a workgroup and thus achieve fair and unbiased results. Secondly, the research rigour had to be demonstrated, which led to a brief explanation of WebAVALIA foundations. Then, during the Design Cycle, both these cycles were combined to develop WebAVALIA. The development process was based on the software development life cycle methodology which lead to the first version of the software.

As this cycle is iterative, after the implementation of the framework's first version, it had to be evaluated. Therefore, the users had the opportunity to express their concerns regarding the tool. From the feedback provided, it was possible to implement alternative features. This process of evaluating the tool and then implementing the changes is very important to the evolution of the software.

WebAVALIA has been used by several students at P.Porto - ISCAP since 2014. Meanwhile, numerous changes have been made to the tool. The users' input has been of great importance to improve the usability of WebAVALIA, allowing to understand that the tool is easy-to-use, practical, and intuitive. WebAVALIA has various contributions to the society, since it can return to the individuals their sense of fairness and reward. It is also clear that WebAVALIA can be used by any institution that performs assessments and intends on making this process fair and unbiased.

The last guideline is the communication of the product, which this scientific paper accomplishes by presenting WebAVALIA in a technological and management-oriented manner. Lastly, it can be said that WebAVALIA, being a software tool, has always room for improvement. For this reason, the users will continuously provide feedback to improve the tool and increase its usability, which will help the software evolve.

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REFERENCES

Abelló Gamazo, A., Burgués Illa, X., Casany Guerrero, M. J., Martín Escofet, C., Quer, C., Rodríguez González, M. E., Romero Moral, Ó., & Urpí Tubella, A. (1992). A software tool for e-assessment of relational database skills. *International Journal of Engineering Education, 32*(3A), 1289-1312. https://upcommons.upc.edu/handle/2117/89668

Alias, M., Masek, A., & Salleh, H. H. M. (2015). Self, peer and teacher assessments in problem based learning: Are they in agreements? *Procedia - Social and Behavioral Sciences*, *204*, 309–317. https://doi.org/10.1016/j.sbspro.2015.08.157

Babo, R. (2020). Group work: Does everybody contribute with the same intensity? *Sensos-E*, *6*(3), 177-183. https://doi.org/10.34630/sensos-e.v6i3.3669

Babo, R., Fitas, R., Suhonen, J., & Tukiainen, M. (2020). Analysing and improving mathematical formulation of Webavalia: A self and peer assessment tool. *IEEE Global Engineering Education Conference (EDUCON)*, 1325-1332.

Babo, R., & Suhonen, J. (2018). E-assessment with multiple choice questions: A qualitative study of teachers' opinions and experience regarding the new assessment strategy. *International Journal of Learning Technology*, *13*(3), 220-248. https://doi.org/10.1504/IJLT.2018.095964

Balaji, S., & Murugaiyan, M. S. (2012). Waterfall vs. V-Model vs. Agile: A comparative study on SDLC. *International Journal of Information Technology and Business Management*, *2*(1).

Bell, S. (2010). Project-based learning for the 21st century: Skills for the future. *The Clearing House: A Journal of Educational Strategies, Issues and Ideas*, *83*(2), 39-43. https://doi.org/10.1080/00098650903505415

Block, J. (1978). *The Q-Sort method in personality assessment and psychiatric research*. Consulting Psychologists Press. http://www.psychology.sunysb.edu/attachment/measures/content/Jack_Block_Q-sort_method_book.pdf

Chang, S.-C., Hsu, T.-C., & Jong, S.-Y. M. (2020). Integration of the peer assessment approach with a virtual reality design system for learning earth science. *Computers & Education*, *146*. https://doi.org/10.1016/j.compedu.2019.103758

Chen, C. M., & Kuo, C. H. (2019). An optimized group formation scheme to promote collaborative problem-based learning. *Computers and Education*, *133*, 94-115. https://doi.org/10.1016/j.compedu.2019.01.011

Cook, J., & Jenkins, V. (2010). *Getting started with e-assessment.* University of Bath. https://researchportal.bath.ac.uk/en/publications/getting-started-with-e-assessment

Cowan, J. (1988). Struggling with self-assessment. In D. J. Boud (Ed.), *Developing student autonomy in learning* (2nd ed., pp. 192-210). Kogan Page.

Daba, T. M., Ejersa, S. J., & Aliyi, S. (2017). Student perception on group work and group assignments in classroom teaching: The case of Bule Hora University second year biology students, South Ethiopia: An action research. *Educational Research and Reviews*, *12*(17), 860-866. https://doi.org/10.5897/ERR2016.3006

Deng, Q., Wang, Y., & Ji, S. (2017). Design science research in information systems: A systematic literature review 2001-2015. *CONF-IRM 2017 Proceedings*. https://aisel.aisnet.org/confirm2017/8

Eshuis, E. H., ter Vrugte, J., Anjewierden, A., Bollen, L., Sikken, J., & de Jong, T. (2019). Improving the quality of vocational students' collaboration and knowledge acquisition through instruction and joint reflection. *International Journal of Computer-Supported Collaborative Learning*, *14*(1), 53-76. https://doi.org/10.1007/s11412-019-09296-0

Farrell, T., & Rushby, N. (2015). Assessment and learning technologies: An overview. *British Journal of Educational Technology*, *47*(1), 106-120. https://doi.org/10.1111/bjet.12348

Frank, M., & Barzilai, A. (2004). Integrating alternative assessment in a project-based learning course for pre-service science and technology teachers. *Assessment & Evaluation in Higher Education*, *1*, 41-61. https://doi.org/10.1080/0260293042000160401

Freeman, M. (1995). Peer assessment by groups of group work. *Assessment & Evaluation in Higher Education*, *20*(3), 289-300. https://doi.org/10.1080/0260293950200305

Geerts, G. L. (2011). A design science research methodology and its application to accounting information systems research. *International Journal of Accounting Information Systems*, *12*(2), 142-151. https://doi.org/10.1016/j.accinf.2011.02.004

Gray, L., & Roads, M. (2016). Technology-enhanced assessment and feedback in further education and skills – how is the sector doing? *JISC*. https://www.jisc.ac.uk/blog/technology-enhanced-assessment-and-feedback-in-further-education-and-skills-11-may-2016

Hakkarainen, K., Paavola, S., Kangas, K., & Seitamaa-Hakkarainen, P. (2013). Sociocultural perspectives on collaborative learning. In C. E. Hmelo-Silver, C. A. Chinn, C. K. K. Chan, & A. M. O'Donnell (Eds.), *The International Handbook of Collaborative Learning*. Routledge. https://doi.org/10.4324/9780203837290.ch3

Hettiarachchi, E., Mor, E., Huertas, M. A., & Rodriguez, M. E. (2014). A technology enhanced assessment system for skill and knowledge learning. *CSEDU*, 184-191.

Hevner, A. (2007). A three cycle view of design science research. *Scandinavian Journal of Information Systems*, *19*(2). https://aisel.aisnet.org/sjis/vol19/iss2/4

Hevner, A. R., & March, S. T. (2003). IT systems perspectives - the information systems research cycle. *Computer*, *36*(11), 111–113. https://doi.org/10.1109/MC.2003.1244541

Hevner, A., March, S., Park, J., & Ram, S. (2004). Design science in information systems research. *MIS Quarterly, 28*(1), 75-105. https://doi.org/10.2307/25148625

Hmelo-Silver, C. E. (2004). Problem-based learning: What and how do students learn? *Educational Psychology Review*, *16*(3), 235-266. https://doi.org/10.1023/B:EDPR.0000034022.16470.f3

Hoegl, M., & Gemuenden, H. G. (2001). Teamwork quality and the success of innovative projects: A theoretical concept and empirical evidence. *Organization Science*, *12*(4), 435-449. https://doi.org/10.1287/orsc.12.4.435.10635

InteDashboard™. Empowering TBL with Technology | Peer Evaluation. (n.d.). https://www.intedashboard.com/

IParadigms (2010). *PeerMark™ Manual.* Turnitin Instructor Handbook.

iPeer | Teaching with Technology. (n.d.). https://lthub.ubc.ca/guides/ipeer/

Järvelä, S., Järvenoja, H., & Malmberg, J. (2019). Capturing the dynamic and cyclical nature of regulation: Methodological progress in understanding socially shared regulation in learning. *International Journal of Computer-Supported Collaborative Learning*, *14*(4), 425-441. https://doi.org/10.1007/s11412-019-09313-2

Joint Information Systems Committee. (2007). *Effective practice with e-assessment: Overview of technologies, policies and practice in further and higher education.* http://www.jisc.ac.uk/media/documents/themes/elearning/effpraceassess.pdf

Khoiriyah, A. J., & Husamah, H. (2018). Problem-based learning: Creative thinking skills, problem-solving skills, and learning outcome of seventh grade students. *Jurnal Pendidikan Biologi Indonesia*, *4*(2), 151-160. https://doi.org/10.22219/jpbi.v4i2.5804

Kizkapan, O., & Bektas, O. (2017). The effect of project based learning on seventh grade students' academic achievement. *International Journal of Instruction*, *10*, 37-54. https://doi.org/10.12973/iji.2017.1013a

Kolmos, A., & Holgaard, J. E. (2007). Alignment of PBL and assessment. *Journal of Engineering Education - Washington*, *96*(4), 1-9. https://core.ac.uk/download/pdf/60395088.pdf

Kufi, E. F., Negassa, T., Melaku, R., & Mergo, R. (2020). Impact of corona pandemic on educational undertakings and possible breakthrough mechanisms. *BizEcons Quarterly*, *11*, 3–14. https://ideas.repec.org/a/ris/buecqu/0022.html

Lavy, S. (2017). Who benefits from group work in higher education? An attachment theory perspective. *Higher Education*, *73*(2), 175-187. https://doi.org/10.1007/s10734-016-0006-z

LimeSurvey: The online survey tool - open source surveys. (n.d.). https://www.limesurvey.org/

Loyens, S. M. M., Jones, S. H., Mikkers, J., & van Gog, T. (2015). Problem-based learning as a facilitator of conceptual change. *Learning and Instruction*, *38*, 34-42. https://doi.org/10.1016/j.learninstruc.2015.03.002

Ludvigsen, S., & Steier, R. (2019). Reflections and looking ahead for CSCL: Digital infrastructures, digital tools, and collaborative learning. *International Journal of Computer-Supported Collaborative Learning*, *14*(4), 415-423. Springer. https://doi.org/10.1007/s11412-019-09312-3

Luxton-Reilly, A. (2009). A systematic review of tools that support peer assessment. *Computer Science Education*, *19*(4), 209-232. https://doi.org/10.1080/08993400903384844

March, S., & Storey, V. (2008). Design science in the information systems discipline: An introduction to the special issue on Design Science Research. *Management Information Systems Quarterly*, *32*(4). https://doi.org/10.2307/25148869

McNamara, G., & O'Hara, J. (2005). Internal review and self-evaluation: The chosen route to school improvement in Ireland? *Studies in Educational Evaluation*, *31*(4), 267-282. https://doi.org/10.1016/j.stueduc.2005.11.003

McNamara, G., & O'Hara, J. (2008). The importance of the concept of self-evaluation in the changing landscape of education policy. *Studies in Educational Evaluation*, *34*(3), 173-179. https://doi.org/10.1016/j.stueduc.2008.08.001

Othman, H., Asshaari, I., Bahaludin, H., Tawil, N. M., & Ismail, N. A. (2012). Student's perceptions on benefits gained from cooperative learning experiences in engineering mathematics courses. *Procedia - Social and Behavioral Sciences*, *60*, 500-506. https://doi.org/10.1016/j.sbspro.2012.09.414

Pai, H.-H., Sears, D. A., & Maeda, Y. (2015). Effects of small-group learning on transfer: A meta-analysis. *Educational Psychology Review*, *27*(1), 79-102. https://doi.org/10.1007/s10648-014-9260-8

Peergrade - Engaging Student Peer Review. (n.d.). https://www.peergrade.io/?nab=1&utm_referrer=https%3A%2F%2Fwww.google.pt%2F

PeerMark™ - Guides.turnitin.com. (n.d.). https://guides.turnitin.com/01_Manuals_and_Guides/Instructor_Guides/Turnitin_Classic_(Deprecated)/23_PeerMark

Peffers, K., Tuunanen, T., Rothenberger, M. A., & Chatterjee, S. (2007). A design science research methodology for information systems research. *Journal of Management Information Systems*, *24*(3), 45-77. https://doi.org/10.2753/MIS0742-1222240302

Pereira, D., Flores, M. A., & Niklasson, L. (2016). Assessment revisited: A review of research in assessment and evaluation in higher education. *Assessment & Evaluation in Higher Education*, *41*(7), 1008-1032. https://doi.org/10.1080/02602938.2015.1055233

Rabiee, F. (2004). Focus-group interview and data analysis. *Proceedings of the Nutrition Society*, *63*(04), 655-660. https://doi.org/10.1079/PNS2004399

Rienties, B., & Tempelaar, D. (2018). Turning groups inside out: A Social network perspective. *Journal of the Learning Sciences*, *27*(4), 550-579. https://doi.org/10.1080/10508406.2017.1398652

Rodríguez-Triana, M. J., Prieto, L. P., Ley, T., de Jong, T., & Gillet, D. (2019). Tracing teacher collaborative learning and innovation adoption: A case study in an inquiry learning platform. In K. Lund, G. P. Niccolai, E. Lavoué, C. H. Gweon, & M. Baker (Eds.), *13th International Conference on Computer Supported Collaborative Learning (CSCL) 2019* (Vol. 1, pp. 432-439). International Society of the Learning Sciences.

Ruiz-Gallardo, J.-R., & Reavey, D. (2019). Learning science concepts by teaching peers in a cooperative environment: A longitudinal study of preservice teachers. *Journal of the Learning Sciences*, *28*(1), 73-107. https://doi.org/10.1080/10508406.2018.1506988

Schwarz, S., & Westerheijden, D. F. (Eds.). (2004). *Accreditation in the framework of evaluation activities: A comparative study in the European higher education area*. Springer. https://doi.org/10.1007/978-1-4020-2797-0_1

Sorensen, K., & Jorgensen, J. J. (2019). Millennial perceptions of fast fashion and second-hand clothing: An exploration of clothing preferences using Q methodology. *Social Sciences*, *8*(9), 244. https://doi.org/10.3390/socsci8090244

Stefani, L. A. J. (1994). Peer, self and tutor assessment: Relative reliabilities. *Studies in Higher Education*, *19*(1), 69-75. https://doi.org/10.1080/03075079412331382153

Tan, K., & Keat, L. (2005). Self and peer assessment as an assessment tool in problem-based learning. In K. Tan (Ed.). *Problem-based learning: New directions and approaches* (pp. 162-175). Learning Academy.

TEAMMATES - Online Peer Feedback/Evaluation System for Student Team Projects. (n.d.). http://teammatesv4.appspot.com/

Tutorial WebAVALIA. (n.d.). https://webavalia.wixsite.com/webavalia

Vanhoof, J., Van Petegem, P., & De Maeyer, S. (2009). Attitudes towards school self-evaluation. *Studies in Educational Evaluation*, *35*(1), 21-28. https://doi.org/10.1016/j.stueduc.2009.01.004

Verawardina, U., Asnur, L., Lubis, A. L., Hendriyani, Y., Ramadhani, D., Dewi, I. P., Darni, R., Betri, T. J., Susanti, W., & Sriwahyuni, T. (2020). Reviewing online learning facing the Covid-19 outbreak. *Journal of Talent Development and Excellence*, *12*(3s). http://www.iratde.com/index.php/jtde/article/view/281

Vicente, A. J., Tan, T. A., & Yu, A. R. (2018). Collaborative approach in software engineering education: An interdisciplinary case. *Journal of Information Technology Education: Innovations in Practice*, *17*, 127-152. https://doi.org/10.28945/4062

WebPA. (n.d.). http://webpaproject.lboro.ac.uk/

Wen, L. (2017). The perceptions of students on cooperative learning at intermediate accounting II course. *Business Education Innovation Journal*, *9*(2), 127-133.

West, R. E. (2018). *Foundations of learning and instructional design technology*. Taylor and Francis.

WHO. (2020, March 10). *COVID-19: IFRC, UNICEF and WHO issue guidance to protect children and support safe school operations*. https://www.who.int/news-room/detail/10-03-2020-covid-19-ifrc-unicef-and-who-issue-guidance-to-protect-children-and-support-safe-school-operations

Workshop Activity - MoodleDocs. (n.d.). https://docs.moodle.org/35/en/Workshop_activity

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