Use of ICT for Quality Management of Learning and Teaching Evaluations in Higher Education

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Abstract
Evaluation is a key process to measure student learning outcomes, improve teaching quality, and make informed educational decisions. The main objective of evaluation is to ensure quality education for students and to constantly improve educational programs and policies. Evaluation has undergone many practical and methodological evolutions in recent years. These evaluative practices have been improved with the use of Information and Communication Technologies (ICT). This article presents a study on the integration of ICT in evaluation with the aim of improving and modernizing the evaluation system in the Moroccan university. The results of an experiment, conducted in this context with an audience of 21 Master's level students, have identified the benefits and challenges of integrating ICT into evaluation practices at the university.
Keywords:
Evaluation of learning, ICT, Erasmus-CORETEV project, UCD experimentation.

1. Introduction

Evaluation in higher education is an essential practice to ensure the quality of teaching and programs offered [1]. It is carried out at different levels, including program, institutional, and instructor level. Thus, it can involve different types of methods and tools, such as written and oral assessments, student surveys, projects, group discussions, classroom observations, and peer evaluations. However, evaluation is important to improve student learning, provide feedback on their performance, and make informed educational decisions [2]. The results of evaluation are used to improve programs and educational policies, better understand the needs of students, and help teachers adapt their teaching to the individual needs of students.

Evaluation in higher education is an important issue as it plays a crucial role in the learning process and academic recognition [3]. However, there are several challenges and issues to consider when implementing evaluation in a university setting. Here are some of these challenges:

1. Diversity of students: University students come from different backgrounds and cultures, have varied learning experiences and different needs. It is therefore important to develop evaluation methods that take this diversity into account.
2. The quality of assessment: Assessment methods must be valid, reliable, and fair for all students. It is important to ensure that exam questions are clear, relevant, and accurately represent the content taught.
3. The impact of assessment on learning: Assessment should be designed to stimulate learning, rather than simply measure performance. It is important to offer constructive feedback to students to help them understand their mistakes and improve their understanding.
4. The use of technology: Using technology for assessment can make the task easier for teachers, but it can also present challenges in terms of security, fairness, and accessibility.

Indeed, assessment in the university context is a complex issue that requires particular attention to the above-mentioned issues, as well as other considerations specific to each university context. Taking into consideration these issues, this article presents an experimental study of the integration of ICT in assessment with the aim of improving the quality of the assessment system in Moroccan universities. The rest of the article is organized as follows: Section II will discuss the context of our research study and its objectives, Section III will provide an overview of assessment in a theoretical framework. Section IV will cover the experimentation and results, and Section V will serve as the conclusion of this article.

2. Context

The integration of information and communication technologies (ICT) can offer significant advantages in assessment [4], by helping to

collect, store, and analyze data more effectively and efficiently. Our study was carried out in this direction, as part of a European Erasmus CORETEV project (North-South CO-construction of a network of expertise for the use of new Technologies in Evaluation) with the aim of improving and modernizing the assessment system in Moroccan universities. This is a project that aims to modernize educational systems by using assessment as a lever to improve the quality of education. Indeed, the study in question was carried out at Chouaib Doukkali University, which is a member of the project, using the Docimo tool to design high-quality assessments with the aim of improving the assessment system.

3. Theoretical framework

The evaluation is a unique operation in education but is carried out at distinct moments in the form of multiple processes and for different objectives related to the same program [5]. Below are various research studies conducted in the field of evaluation with the aim of improving evaluative practices:

The author Deriu and his collaborators presented a review of the methods and concepts developed for the evaluation of dialogue systems [6]. These methods and concepts are related to the different requirements and functionalities of dialogue systems. Consequently, they concluded that the problem of evaluation evolves with the progress of the dialogue system technology itself.

However, traditional evaluation methods are static and based on linear functions that only take into account the learner's response. In this context, the author Chachoua proposed an approach to evaluate the learner based on learning traces, which can be used in a resource and/or pedagogical situation adaptation system [7]. For the learner evaluation, she proposed three generic evaluation models that take into account the temporal trace, the number of attempts, and their combinations. These models subsequently served as a baseline metric for her resource and/or learning situation adaptation model.

Online learning and evaluation [8] have helped teachers during the COVID-19 pandemic to maintain educational continuity. Author Fauzi and colleagues presented teachers' perspectives on online learning and evaluation in a COVID-19 pandemic situation [9]. The results of this study indicated that teachers understand the context of online learning and

evaluation, but during implementation, various issues were detected, including 1) availability of facilities, 2) use of network and internet, 3) planning, implementation, and evaluation of learning, and 4) collaboration with parents.

Evaluation has existed for a long time, but what is new is the role it is beginning to play in higher education policy. Author Labouidya and colleagues addressed the issue of evaluation practices by drawing inspiration from the general model of the systemic approach [10]. The presented results showed that the organization of the teaching process, particularly the development of collaboration between students, helped students to progress as a group rather than separately.

Furthermore, authentic assessment is considered a relevant means to mitigate the pitfalls and fears associated with remote evaluation. Author Kozanitis and colleagues proposed a pedagogical reflection to evolve evaluative practices in the context of distance education in the university environment [11]. The authors mentioned that the Bloom's taxonomy model is the cornerstone that suggests the possibility of evolving evaluative practices, particularly in the context of distance education.

4. Experimentation: case of Chouaib Doukkali University

This experiment took place in the Physics Department of the Faculty of Sciences at Chouaib Doukkali University, which is responsible for implementing special and professional master's programs. The master's program involved in this study is the specialized master's degree in Instrumentation, Networks and Renewable Energies (IRER). In this context, we aim to contribute to improving evaluation practices in higher education and facilitate the achievement of this mission for the teaching unit: Digital Communications Techniques (TCN). We will present the data from the experiment we conducted.

4.1. Context of evaluation: TCN teaching module

- Content: Understanding the basics of digital communication, identifying different transmission methods, studying and comparing modulation types and multiplexing techniques used in digital transmission.

• Target audience: Future engineers - IRER Master's students.
• Format: Lecture - Tutorial - Practical work and activities in small groups.
• Trainer: Teacher-Researcher.
• Summative assessment: Online post-test (use of ICT): 25 MCQs (Multiple choice questions)+ 2 LOAQ (Questions with Open-ended Long Answers), taken on May 7, 2021.

4.2 Creation of a new exam format via the Docimo Platform

4.2.1 Creation of a Specifications Table (ST) and Trinomials (ET x PC x QM)

The Specifications Table (ST) [12] is a tool that helps teachers, on the one hand, to structure their courses, clarify their objectives for each chapter, and have a good vision of what they want to convey to the students and in what order. With this clarification of objectives, these teachers know what they should focus on during the course. On the other hand, the ST enables teachers to easily identify what they want to assess and what they expect from their students.
The specifications table includes several columns. In the first column, the general identification of the different chapters of the course is made, and then the sections of each chapter are determined in the second column. In the third column, the Elements to Test (ET) are listed.

Indeed, in this experiment, we developed our specifications table (ST) in which we structured our TCN module course into chapters (first column) and sections (second column) from which we derived the Elements to Test (ET) for each section. Then, for each of these elements, we determined the Performance Categories (PC) that we targeted and aimed for in the Bloom's Taxonomy. These are the levels at which we want to assess whether it be on analysis, comprehension, application, analysis, etc.

After that, we chose for each pair of Elements to Test and Performance Category (ET) x (PC) the Questioning Modalities (QM) that we will use in the assessment and on which we will rely to write the questions: true or false, MCQ (Multiple-Choice Questions), or LOAQ (Questions with Open-ended Long Answers). Each teacher can choose these modalities according to their specifications table. Thus, it is possible to choose several questioning modalities

for each pair of Elements to Test and Performance Category (ET) x (PC). Finally, we formed trinomials consisting of Elements to Test, Performance Category, and Questioning Modality (ET x PC x QM), as shown in Table 1 below. This specifications table was prepared and created in advance to later integrate it into the Docimo platform.

4.2.2 Creation of a questions database

This is the step of creating questions (a questions database) based on the specifications table. Each teacher must write questions in accordance with their expectations (Elements to Test), whether it be an MCQ or an LOAQ, in an appropriate trinomial (ET x PC x QM) while respecting the ITEM rules (writing rules) so that they are high-quality questions. In this section, we prepared a question bank in advance on a Word file as shown in Figure 1 below to later integrate it into Docimo.

Fig. 1. Question bank

4.2.3 Implementation of the Specification Table (ST) in Docimo

Once the specifications table has been prepared and created, we can move on to the step of implementing it in the Docimo platform. In this part, we have implemented our pre-prepared specifications table (Table1) in Docimo, while defining the trinomials (ET x PC x QM) that can be used as items in the questions database. By default, Docimo selects all possibilities, but each teacher can adapt the trinomials according to what they want to evaluate. Figure 2 below shows an initial

Table. 1. Specifications Table

| Chapters	Sections	1. Elements to Test (ET)	2. Performance Categories (PC) 3. Questioning Modalities (QM)			
			PC — Comprehension	Application	Analysis	
			QM — MCQ	MCQ	MCQ	LOAQ
1. In-line signal encoding	Basic notions	Flow, Speed	x	x		
		TER, RSB	x			
		Channel apacity	x			
		Spectral efficiency	x			
	Transmission modes	Baseband	x			
		Passband	x			
		Multiplexing	x	X	X	
	Common in-line codes	Code definitions	x	x	x	x
		Qualities of a code	x			
2. Reception and regeneration of a digital signal	Receiver filters	Shaping filter	x			
		Matched filter	x			
		Equalizer filter	x			
	Transmission quality	Eye diagram	x	x	X	x
		Channel coding	x			
3. Pulse Modulation	PAM Modulation	PAM principle	x			
		PAM characteristics	x			
	PWM Modulation	PWM principle	x			
		PWM characteristics	x			
	PPM Modulation	PPM principle	x			
		PPM characteristics	x			
4. Digitization of Information	Basic principle	Sampling	x	X	x	
		Quantization	x	x		
		Encoding	x		x	
	PCM Modulation	Nonlinear Quantization	x			
5. Digital Carrier Modulations	ASK Modulation	ASK Principle and Constellation	x	X		
		M-ASK Performances			X	
	FSK Modulation	FSK Principles and Variants	x	x		
		M-FSK Performances			x	
	PSK Modulation	PSK Principle and Constellation	x	x		
		M-PSK Performances				x
	QAM Modulation	QAM Principle and Constellation	x	x		
		M-QAM Performances			x	
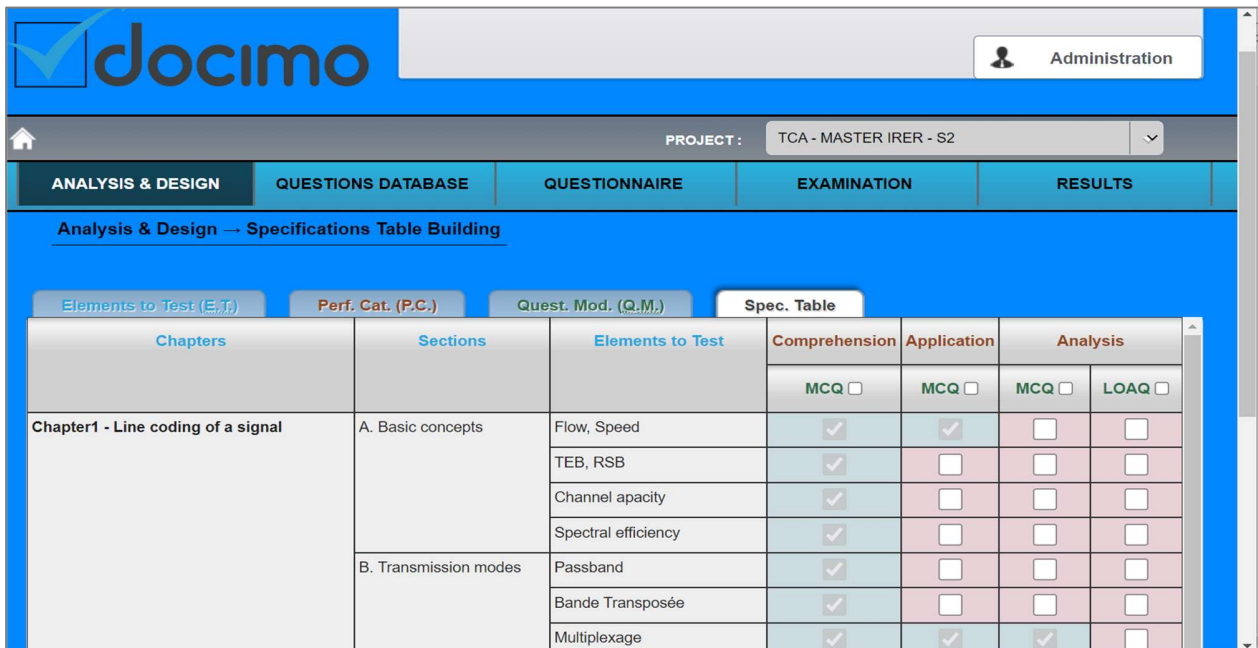
Fig. 2. Implementation of the ST in Docimo

selection of the trinomials (ET x PC x QM) after the implementation step of the specifications table.

4.2.4 Writing and validation of questions

The creation of a test can be quite lengthy. It is not enough to write a dozen questions that will be given to the students. Generally, teachers write multiple questions and then think about which ones will allow them to test the most things, which ones are complex or simple, etc., in order to make a balanced test that is representative of what is expected of the students. DOCIMO offers a management of question banks based on the specifications tables. Each teacher can write a question, whether it is a multiple-choice question or an open-ended question, in an appropriate trinomial (ET x PC x QM). This system is interesting since we do not need to see each other to write them and we can do it asynchronously.

As soon as a teacher has an idea, they can write their question immediately and come back later while starting by selecting the trinomial for which a question should be created. Then, they must write the lead-in of the question, and then the various possible answer choices. It is possible to add typical answer choices such as "all", "none", "not enough information" or "absurd" [13]. They must also specify the correct answer, as well as any feedback for the students. It is also possible to include media such as images, videos, and sound. It should be noted that subsequently, the teacher will be able to associate the question with other trinomials.

Since the Docimo platform requires us to select a trinomial before writing the question, we must think in advance about our formulation and what we expect from the students. In addition, the platform allows us to have an overview of the number of questions already existing in each trinomial, as shown in Figure 3 below. Thus, we can quickly see what is missing in our test based on the objectives.

The teacher will then validate or not the questions. Validated questions are those that can be used when generating the test. Here, it should be noted that the teacher can perform quality controls in advance by, for example, asking colleagues to review their questions. They therefore verify that the written questions are in line with their expectations. They also have an automatic verification to see if they are complete and check the correction criteria. They can call on the platform managers to help them in the process. The

platform facilitates this type of exchange: the manager can grant access and specific roles to different stakeholders to collaborate remotely.

In this section, we have written and validated questions (Figure 3 below). The elongated green dots represent the trinomials (ET x PC x QM) for which we have written questions, and the number indicates the number of questions developed. The red dots show the trinomials that were not selected during the creation of the specification table (Table 1).

4.2.5 Questionnaire Generation

In this step, the teacher can now create their test. They will choose, from among the validated questions, those that will appear in the test (the exam), as well as their order. They can then set up the test and choose a grading scale. They also decide whether they want to administer the test online or on a paper version. The Docimo platform allows for the creation, configuration, and generation of the test in a paper or online format. The following Figure 4 shows a preview of a test generated by Docimo in paper format.
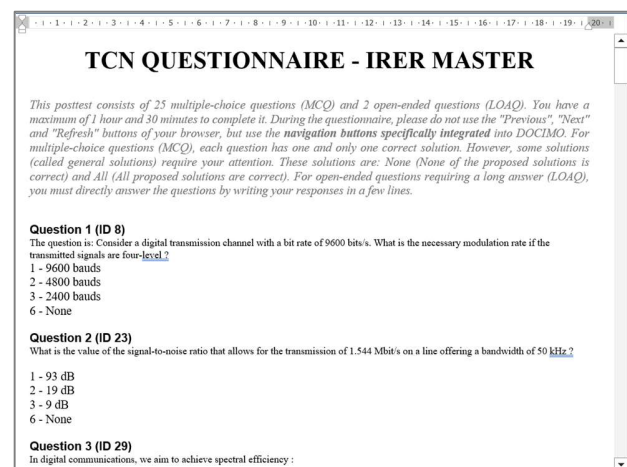

Fig. 4. Preview of the generated paper-based questionnaire.

However, caution should be exercised during this step. We should not select a validated question from each trinomial and make a test. If we reason this way, we will surely make a test that is too long, and we need to be careful not to test the same skills repeatedly. We believe that it is necessary for teachers involved in a common module to meet in a meeting to create the test. This way, they may not have the same expectations for their students.

Fig. 3. Writing and validation of questions in Docimo

Fig. 5. Overview of the steps performed on the Docimo platform regarding the evaluation process.

Fig. 6. Online Post-Test Examination.

4.2.6 Overview of the evaluation process

The Docimo platform allows displaying global information and statistics on the evaluation process, as shown in Figure 5 above, in terms of the table of specifications (number of chapters, number of sections, number of elements to be tested, etc.), question bank (validated and total questions), and the number of generated/existing questionnaires. This figure (Figure 5) provides an overview of the steps carried out on Docimo concerning this evaluation process, from the elaboration of the test to its correction. In fact, we first started by creating the table of specifications (tab "Analysis & Design") to structure the course into chapters and sections in order to identify the trinomials: the Elements to be Tested, the Categories of Performance and the Modalities of Questioning (ET x PC x QM). Then, we wrote and validated a bank of questions (tab "Questions Database"). After that, we created, configured, and generated the questionnaire (tab "Questionnaire"). The tabs "Examination" and "Results" allow for the management of test examination and results.

4.3 Conditions of examination

- Awareness raising of the IRER (Instrumentation, Networks and Renewable Energies) Master's students at the Faculty of Sciences during the month of April.
- Thursday, May 6, 2021: Introduction session to the Docimo platform.
- Friday, May 7, 2021: Online post-test administration on the Docimo platform by IRER Master's students.

4.3.1 Creation of the user group Master IRER on Docimo

For an online administration on Docimo, we need to create a user group for our class or section. Then, we send them a link. They will log in and have a questionnaire available to them which they will complete.

4.3.2 Online Post-Test examination on the Docimo Platform

During the online assessment on Docimo, the teacher can monitor in real time what the evaluated students are doing during the test, and thus observe the test-taking process. The teacher can view the progress of each student in relation to their responses, as shown in the figure 6 above. Green indicates the answer is correct, while orange indicates there is an issue with the question. These recorded data are directly processable.

4.3.3 Correction of open-ended questions

The correction of exams via Docimo for an online test differs depending on the nature of the question. Indeed, for multiple-choice questions (MCQs), the correction is automatic and the results appear immediately. For open-ended questions, the correction is manual or it is necessary to define correction criteria (descriptive scales) with a descriptive scale, and correctors are needed. DOCIMO does not automatically manage this type of correction, but it guides evaluators in the creation and use of descriptive scales. It is also possible to leave comments on each question to share opinions among different correctors. Figure 7 below shows an overview on the Docimo platform of a manual correction of two open-ended questions, No. 10 and 15.

4.4 ANALYSIS OF RESULTS

4.4.1 Visualization of overall results per student on the Docimo platform.

Docimo allows to consult global results by student or by chapter. Indeed, for each student, Docimo allows to see their overall score out of 20 and out of 100 in relation to the entire questionnaire (test). the Docimo platform allows generating the results in the form of an Excel file, which can be rearranged and used to obtain other global descriptive statistics, such as the mean, median, standard deviation, Cronbach's alpha, etc. as shown in Figure 8 below.

	A	B	C	D	E	F
1	Descriptive statistics					
2		Global statistics				
3	Mean	10,39				
4	Median	10,74			....	
5	Standard Deviation	2,83				
6	Range	11,56				
7	Minimum	3,37				
8	Maximum	14,93				
9	Number of participants	21				
10	Number of questions	27				
11	Cronbach's alpha	0,58				
12						
13						

Fig. 8. Global statistics.
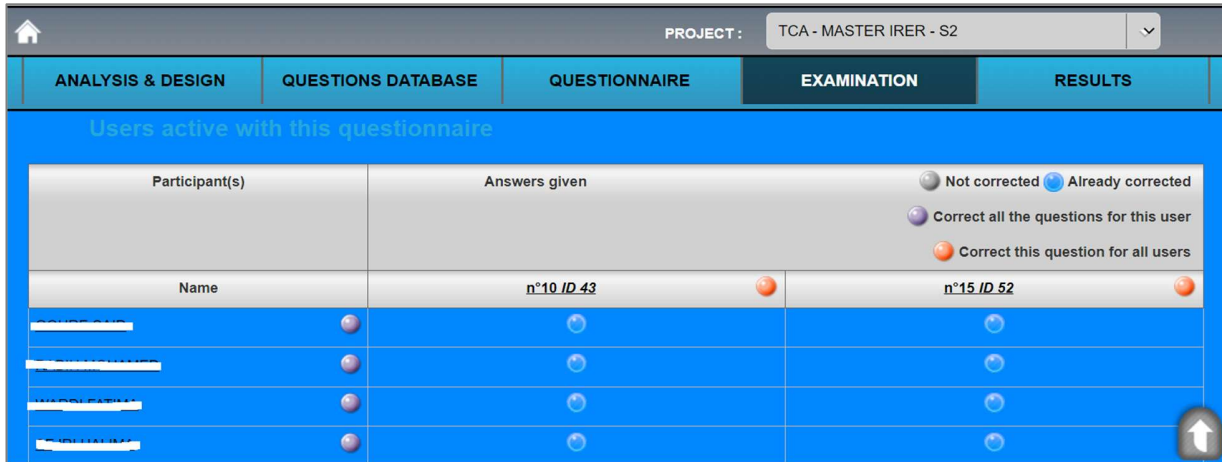
Fig. 7. Manual grading of open-ended questions #10 and #15 on the Docimo platform.

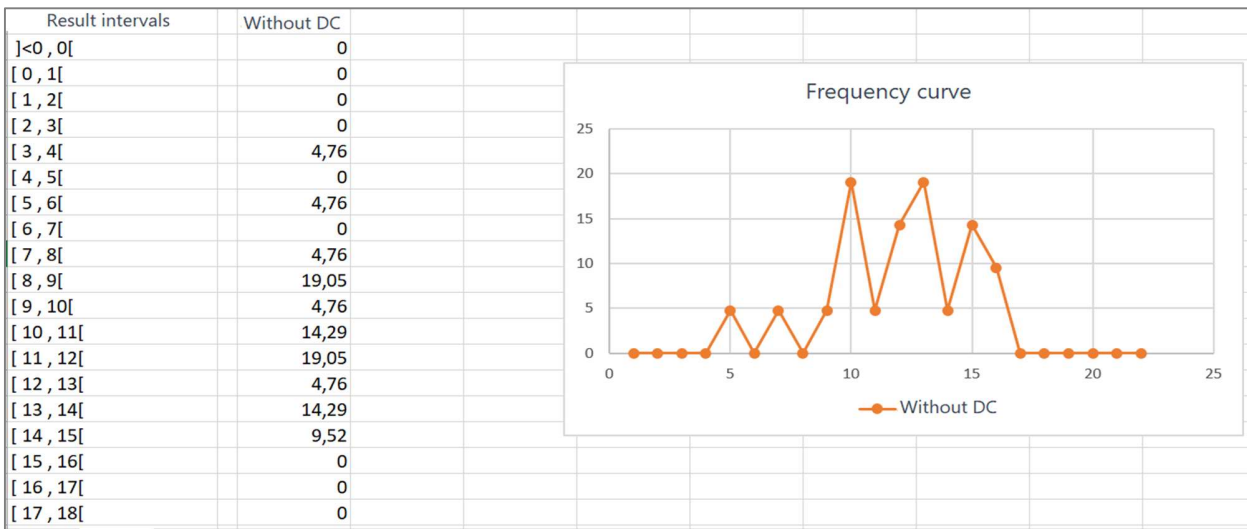| Result intervals	Without DC
]<0 , 0[	0
[0 , 1[	0
[1 , 2[	0
[2 , 3[	0
[3 , 4[	4,76
[4 , 5[	0
[5 , 6[	4,76
[6 , 7[	0
[7 , 8[	4,76
[8 , 9[	19,05
[9 , 10[	4,76
[10 , 11[	14,29
[11 , 12[	19,05
[12 , 13[	4,76
[13 , 14[	14,29
[14 , 15[	9,52
[15 , 16[	0
[16 , 17[	0
[17 , 18[	0

Fig. 9. Frequency curve.

The mean: is one of the most commonly used tools to describe a statistical series. It is calculated as the sum of the values in a series divided by the number of values in that series. According to the overall statistics shown in Figure 12, 10.39 is the average score of the online Post-Test.

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The median: However, the mean is often not very representative of the actual distribution of the data being studied. It is then useful to include the median

in the analysis. The median indicates the central point of a set of values, dividing it into two equal parts, with as many values below and above this number. The median score in our study is 10.74.

The standard deviation is a statistical measure that applies in many areas. It is used to determine the spread or dispersion of a set of values around their mean [14]. A large standard deviation indicates that the data is dispersed around the mean. This means that there is a lot of variance in the observed data. Conversely, the smaller the standard deviation, the more the values are grouped around the mean. If the standard deviation is close to zero, the data is then very little dispersed compared to the mean. The standard deviation cannot be negative. For this study, the standard deviation is 2.83. This is a low value, which explains why the scores are not dispersed around the mean of 10.39.

Alpha Cronbach: is a statistical index ranging from 0 to 1 that allows evaluating the homogeneity (consistency or internal coherence) of a test. The internal consistency to be measured is the one that describes to what extent all the questions of a test measure the same concept and, therefore, is related to the interrelation of the test items [15]. The closer the alpha value is to 1, the more homogeneous the set of items is. According to the results (Figure 12), we can see that the Cronbach's alpha coefficient value of 0.58 is low, which explains that the scores of the online Post-Test are homogeneous.

4.4.4 Individual results of the promotion

After a first reading of Table 2 above, we can see that the students' grades were encouraging and the majority obtained grades higher than 10. Some students obtained grades lower than 10 and this can be explained by different parameters. For example, it is possible that these students are discovering this type of online evaluation for the first time, as well as the platform, and as a result, they have encountered difficulties that impacted their scores during the test.

Table. 2. Individual results.

Individual results				
Last name	First name	ID	Examination Date	Global score (/20)
A	A	Master IRER 2020/2021	07/05/2021	13,7
B	B	Master IRER 2020/2021	07/05/2021	8,52
C	C	Master IRER 2020/2021	07/05/2021	14,93
D	D	Master IRER 2020/2021	07/05/2021	8,7
E	E	Master IRER 2020/2021	07/05/2021	8,7
F	F	Master IRER 2020/2021	07/05/2021	13,52
G	G	Master IRER 2020/2021	07/05/2021	10,37
H	H	Master IRER 2020/2021	07/05/2021	3,37
I	I	Master IRER 2020/2021	07/05/2021	5,67
J	J	Master IRER 2020/2021	07/05/2021	8,52
K	K	Master IRER 2020/2021	07/05/2021	11,93
L	L	Master IRER 2020/2021	07/05/2021	13
M	M	Master IRER 2020/2021	07/05/2021	11,04
N	N	Master IRER 2020/2021	07/05/2021	10,74
O	O	Master IRER 2020/2021	07/05/2021	11,22
P	P	Master IRER 2020/2021	07/05/2021	14,44
Q	Q	Master IRER 2020/2021	07/05/2021	11
R	R	Master IRER 2020/2021	07/05/2021	12,15
S	S	Master IRER 2020/2021	07/05/2021	9,26
T	T	Master IRER 2020/2021	07/05/2021	7,04
U	U	Master IRER 2020/2021	07/05/2021	10,37

4.4.5 Frequency curve

The frequency curve is one of the indicators used to analyze the quality of evaluations. It is a curve that represents the scores of students in a test. When we look at the scores in the following Figure 9, we see that the average is around 13. Sometimes, certain questions may pose problems in an evaluation, and making a correction of the test based on these questions can lead to an improvement in students' scores.

5. Conclusion

Evaluation is omnipresent in our society, whether in companies or in education. It is therefore important that it be of quality in order to be credible in the eyes of society. DOCIMO offers different advantages for creating tests. We see that it clearly improves the quality of these tests, thanks to a quality cycle that it pushes us to perform from the very beginning, even before writing the questions. Creating a specification table to structure a given course in order to identify the elements to be tested, the questioning modalities, and the performance categories, while writing a questions database, makes it possible to generate a valid and quality test. The examination of tests is also greatly facilitated by its automatic formatting system, as well as the possibility for students to practice at home. It is also possible to provide feedback to the evaluated individuals

remotely. Even if it is a summative evaluation, it is important that they know their strengths and weaknesses and know what they need to improve. Remote and asynchronous work between teachers is also facilitated by the possibility of being able to write questions in a bank, without necessarily having them appear in the test, and to be able to leave comments on each question. In terms of perspectives: Docimo allows for the analysis of results. In this study, we see that certain questions are problematic during the administration of the test, and we plan to analyze these questions based on certain models and techniques.

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