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The Impact of Online Peer Assessment on the Construction of ICT Skills and Student Performance

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Online peer assessment is an evaluation tool that allows the student to make a value judgment on the work of peers. This method supports student-centered learning and aims to reinforce their knowledge through abundant comments and reflective judgment. The current study seeks to examine the impact of frequent online peer assessment on the construction of the student's skills in Information and Communication Technology and consequently on their performance in the final exam. To achieve this objective, a two-step approach was adopted. Firstly, a questionnaire that allowed a multidimensional

census of student satisfaction with this evaluation method. Secondly, Learning Analytics which made it possible to group students according to their frequent participation in scheduled peer assessments, and then compare them according to their final exam marks of the module. The results showed that the students who frequently participated in the scheduled peer assessments were satisfied with the contribution of this experience to their learning, and the comparison test demonstrated that students' grades in the final exam have been improved due to their frequent participation in peer assessments. The current findings forecast that the frequent online peer assessment could be a better support for students learning and consequently improving their results.

Keywords: online peer assessment, LMS, frequent assessment, blended learning.

Introduction

The traditional practice of assessment is focused on the summative function and the feedback of information from the teacher, resulting in a simple evaluation of learning and making the learner a passive receiver of the information [Letina, 2015].

Teaching has evolved from a unidirectional transition of knowledge towards the creation of learning communities where knowledge is generated in a collaborative manner [Loureiro, Gomes, 2023]. Increased technological development and the need for the development of 21st century skills [Saykili, 2019] have forced educational stakeholders to integrate alternative assessment methods into their educational scenarios. Online peer assessment (OPA) is one of these methods.

Learning with peers is a key skill highly required for lifelong learning, OPA improves learning of students, effectiveness and critical thinking while promoting the proliferation of professional skills, such as thinking skills, decision-making, and autonomy [Hoang et al., 2022]. Appropriating the required standards and being able to evaluate the work of peers in their light, involves students in a process of self-reflection, which improves their understanding of the course content [Amendola, Miceli, 2018], encourages them to optimize their productions, and strengthens their critical thinking [Zhang et al., 2021].

Adopting OPA as a programmatic or frequent assessment can help learners stay focused on the material being taught. It provides frequent feedback, whether from teachers or their peers, and allows the regulation of learning [I. Day et al., 2021]. On the one hand, the OPA allows learning gains compared to traditional assessments, and on the other hand, it ensures speed of delivery and portability. The learner can be informed outside of regular course hours [Carless, Boud, 2018], which will increase their contact with the material and allow them to conceptualize reflective feedback on their learning and that of their peers.

Programmatic evaluation is an evaluation design spread out along the training course, comprising several lightly weighted evaluations that inform both the student and the teacher on the evolution of learning and can be grouped together. in failure/success decisions [I.N.Z. Day et al., 2018]. A programmatic assessment designed according to a rational methodology optimizes learning because it increases the time spent by students on the task and helps them to better distribute their study effort [van der Vleuten et al., 2012].

The aforementioned advantages are proven in advanced educational systems where the learner acts in an innovative and mediated environment from a young age. In Morocco, traditional evaluation governs the evaluative practices of teachers, the use of alternative evaluative practices such as peer assessment either in class or digitally remains very rare [Abder-

rahmane, 2019]. Moreover, all of the students involved in this research do not have previous experience in peer assessment.

Through this study, we will examine the impact of a programmatic evaluation based on OPA on the development of skills of students of the first-year physical education and sports teaching license in information and communication technology in teaching (ICT) and consequently on the marks obtained in the final exam of the module.

There are two fundamental questions that arise:

- Are students satisfied with the programmatic assessment, and do they identify its effect on the development of their ICT skills?
- Does the frequency of OPA positively affect learner's results in the final exam?

For this last question, we put the following two hypotheses:

H0: Frequent OPA has no significant impact on improving student's performance in the final exam.

Ha: Frequent OPA has a significant positive impact on improving student's performance in the final exam.

Methodology

Study context

The study took place at the Higher Normal School of Tétouane, Morocco, during the first semester of the 2022–2023 academic year, it addresses students ($n = 204$) of the first year of the physical education and sports teaching license enrolled in the module Technology Information and Communication for Teaching (ICT1). This module aims at introducing students to the new digital technologies and their integrating them into the teaching field.

The ICT1 module was designed in hybrid mode (face-to-face courses, remote programmatic assessments) by adopting a project-based pedagogy. Three OPA were scheduled throughout the semester (rewarded by 10% of the continuous assessment grade for each), while the final exam of the module was organized in person.

We have created a Moodle platform (*tice.gnomio.com*) to host the scheduled assessments and facilitate the extraction of learning analytics. As all of the students had no prior experience in using Moodle or in OPA, a special attention was paid to support and training.

We provided technical support in the form of a tutorial to access the platform, as well as simulations of the OPA phases in Moodle. An outsourced technical help area of the platform has also been made available to students. The evaluation grids were presented and discussed with the students during the sessions preceding the opening of each OPA workshop. The design of these workshops borrowed the typology of Adachi: [Adachi et al., 2018].

In each of the OPA, students were asked to solve a problem encountered in the teaching of physical education and sports using ICT, then submit their project on the platform for peer assessment. Each student evaluated 4 projects, and theirs was evaluated by 4 peers to ensure a good level of reliability in accordance with the literature on this subject [Falchikov, Goldfinch, 2000; Li et al., 2016]. Providing a numerical score and at least one qualitative piece of feedback for each project was mandatory to mark the assessment task as completed.

At the end of each evaluation workshop, a regulatory session was organized to discuss both, the evaluation process and the quality of the projects in light of the scores and feedback given by the peer evaluators. Samples of the highest and lowest rated projects, as well as their corrections, were presented anonymously. This phase aimed to highlight the strong

and weak points of the projects and provide instructions on the ethics of feedback provided to peers. Figure 1 summarizes the process that we followed to implement this OPA.

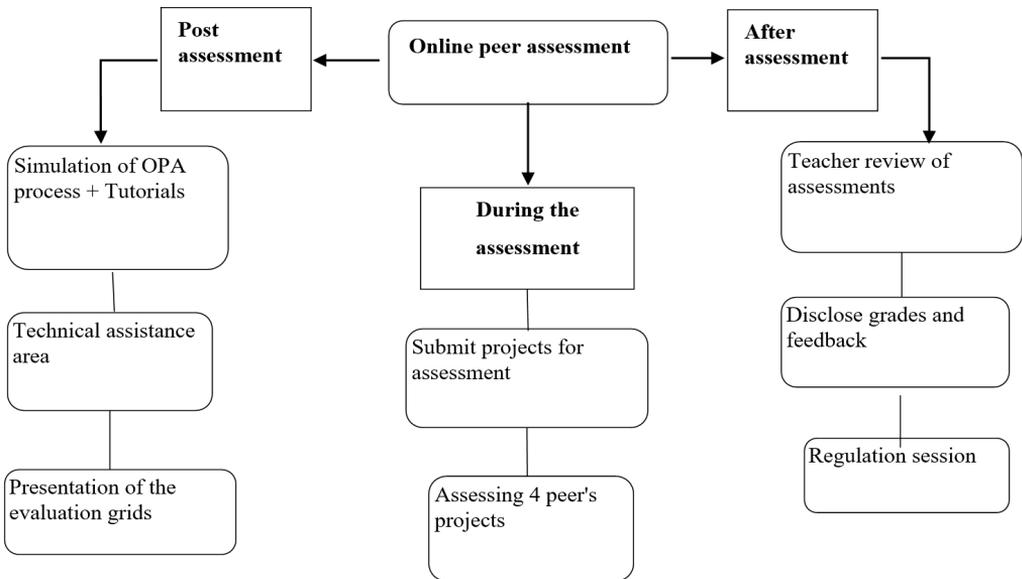


Fig. 1. Online peer assessment implementation process

Research design

A two-step approach was adopted in this study to answer the research questions. First, to measure learner satisfaction with programmatic assessments through a questionnaire, we referred to the first level of the Kirkpatrick model [Kirkpatrick, 1996] revisited by War and Bounce [Warr, Bunce, 1995], which identifies three facets of satisfaction. To achieve an in-depth understanding of learner satisfaction with OPA, we examined the data using descriptive statistics and then assessing the correlation strength between each pair of facets [Schober et al., 2018].

Secondly, to measure the impact of the frequency of the OPA on the results of the learners, we checked by crossing the results of the learners in the final exam with the number of the OPA in which they participated, through an Anova one-way test.

Data collection and analysis

To measure learner satisfaction, data were collected using an online questionnaire via Google Form addressed to students who participated in at least two scheduled OPA workshops (n = 115).

Learner satisfaction was evaluated on the spot by a questionnaire built on a 5-points Likert scale. The questionnaire focused on reported enjoyment (2 items), perceived usefulness (5 items) and perceived difficulty (1 item). The 8 items were intended for the 115 students. A good internal consistency has been achieved, Cronbach's Alpha = 0,717.

The questionnaire results were collected and then coded in SPSS statistics v26 to generate descriptive statistics and the potential correlations between the three facets. The five

points of the Likert scale are converted into intervals to situate the results obtained [Pimentel, 2010], table 1. The means obtained through a questionnaire are modeled on this table to define the degree of agreement.

Table 1. Scoring range of Likert scale of the survey

Likert Scale	Interval	Description
1	1–1,8	Strongly disagree
2	1,8–2,6	Disagree
3	2,6–3,4	Neither agree nor disagree
4	3,4–4,2	Agree
5	4,2–5	Strongly agree

To cross-reference the grades of students (dependent variable) with their frequency of participation in the OPA (independent variable), Learning Analytics extracted from the platform were used to form 4 groups according to the frequency of participation in the OPA:

- Group 1: those who participated in all 3 OPA;
- Group 2: those who participated in 2 OPA;
- Group 3: those who participated in just one OPA;
- Group 4: those who participated in none of the OPA.

After forming the groups, an exhaustive list of grades and numbers of participations in the OPA was established. A one-way Anova test [Howell, 2013] was conducted to determine the differences between the groups formed in terms of final exam results.

Results and Discussions

Questionnaire results

First, we evaluated the reactions of the students to the OPA workshops scheduled throughout the module, with three facets of satisfaction through a questionnaire. The descriptive statistics are presented in table 2.

Table 2. Descriptive statistics of the Likert scale questionnaire

	N	Minimum	Maximum	Mean	Std. Deviation
Reported Enjoyment	115	2,00	5,00	4,37	0,61
Perceived Usefulness	115	3,00	5,00	4,3	0,44
Perceived Difficulty	115	2,00	5,00	4,40	0,64
Valid N (listwise)	115				

For the reported enjoyment facet, we asked students whether they enjoyed this new assessment experience, the majority of them totally agreed ($M = 4.37$, $SD = 0.61$) that assessing peers and receiving feedback from them was a satisfying experience.

The perceived usefulness questions focused attention on the relationship between the improvement of students' ICT skills and participation in OPA workshops, ($M = 4.34$, $SD = 0.43$) which affirms a consensus among students towards the positive effect of OPA frequency on their skills development.

For the last facet concerning the difficulties encountered, we asked the students if the gain in competence deserves the time and cognitive investment spent ($M = 4.40$, $SD = 0.65$), indicating that the students do not regret the time and effort spent in the OPA workshops, this facet has the highest standard deviation, suggesting more variation in experiences compared to the other two facets.

Second, to examine the strength of the correlation between the three facets of satisfaction and to gain a deeper understanding of their interconnection, we opted for the correlation analysis of Spearman (table 3).

Table 3. Strength of correlation between the three facets of satisfaction

		Reported Enjoyment	Perceived usefulness	Perceived difficulty
Reported Enjoyment	Correlation Coefficient	1,000	,463**	,450**
	Sig. (2-tailed)	.	,000	,000
	N	115	115	115
Perceived Usefulness	Correlation Coefficient	,463**	1,000	,362**
	Sig. (2-tailed)	,000	.	,000
	N	115	115	115
Perceived Difficulty	Correlation Coefficient	,450**	,362**	1,000
	Sig. (2-tailed)	,000	,000	.
	N	115	115	115

** Correlation is significant at the 0.01 level (2-tailed).

All correlations were positive (0.463, 0.450, 0.362), indicating a positive linear relationship between each facet pair. These values suggest a weak to moderate correlation (rho between 0.3 and 0.69). The results also showed that all the P values were lower than 0.01 attesting that the observed correlations are statistically significant.

Strength of correlation between reported enjoyment and perceived usefulness (0.463): here we observed a moderate correlation, students who appreciated the paired evaluation process also tended to perceive it as beneficial in terms of acquisition of knowledge and ICT skills.

Strength of correlation between reported enjoyment and perceived difficulties (0.450): these two facets also correlate moderately with each other; the students appreciated this new evaluation method despite the cognitive investment and the additional workload that it requires.

Strength of correlation between reported enjoyment and perceived usefulness (0.362): We observed a positive association between these two facets, but it was slightly weaker than the previous correlations. Students perceive the OPA as beneficial to their course, despite the effort required to participate in it, which remains remarkable.

Anova test results

We first conducted a normality test (table 4). The Kolmogorov — Smirnov normality test revealed that the distribution of student's final grades was normal ($P > 0.05$) in all study groups, which allowed us keep the null hypothesis h_0 and carry out the parametric Anova test.

Table 4. Kolmogorov – Smirnov normality test

	OPA_participation	Kolmogorov – Smirnov		
		Statistic	df	Sig.
Student’s grades	Never participated to OPA	0,129	33	0,174
	Participated 1 time to OPA	0,110	56	0,091
	Participated 2 times to OPA	0,075	77	0,200
	Participated 3 time to OPA	0,137	38	0,069

To measure the impact of OPA frequency on student grades and compare the averages obtained by each group, we conducted a one-way Anova test (table 5) to identify the relationship between the final exam scores of students and OPA frequency.

Table 5. One-way Anova test result for student grades and participation in OPA

	Sum of Squares	df	Mean Square	F	Sig*.
Between Groups	1282,527	3	427,509	162,729	,000
Within Groups	525,426	200	2,627		
Total	1807,953	203			

* P < 0,05.

The results showed that the groups had significant differences in the grades obtained, with a Fisher index well above ($F = 162.729$). The P value ($P = 0.000$) confirms that there are at least two groups that are significantly different from each other in terms of the score obtained on the final exam. Eta squared ($\eta^2 = 0.709$), indicating a large effect of the frequency of OPA on grades of students. These results led us to retain the alternative hypothesis H_a . To compare all the groups with each other one by one, we opted for a Tamhane post-hoc test (table 6).

Table 6. Intergroup Comparison by Tamhane post-hoc test

(I) OPA_participation	(J) OPA_participation	Mean Difference (I-J)	Std. Error	Sig.
Never participated to OPA	participated 1 time to OPA	-2,71631*	,46376	,000
	participated 2 times to OPA	-5,76136*	,42256	,000
	participated 3 times to OPA	-7,40969*	,45858	,000
Participated 1 time to OPA	never participated to OPA	2,71631*	,46376	,000
	participated 2 times to OPA	-3,04505*	,27432	,000
	participated 3 times to OPA	-4,69337*	,32710	,000
Participated 2 times to OPA	never participated to OPA	5,76136*	,42256	,000
	participated 1 time to OPA	3,04505*	,27432	,000
	participated 3 times to OPA	-1,64833*	,26547	,000
Participated 3 times to OPA	never participated to OPA	7,40969*	,45858	,000
	participated 1 time to OPA	4,69337*	,32710	,000
	participated 2 times to OPA	1,64833*	,26547	,000

* The mean difference is significant at the 0.05 level.

The Tamhane test, which allows multiple comparisons to be made between groups one by one, gave P values that were well below 0.05 (sig = 0.000), this shows that the average of

the results obtained by each group differs significantly from the other groups. Inter-group comparisons showed that the differences in final exam scores between groups increased as a function of the frequency of participation in the scheduled OPA. As a result, the difference in averages obtained in the final exam of the module rose to ($I - J = 7.40$) points between group 4 and 1, then gradually decreases to a value of ($I - J = 1.64$) points if we compare the scores obtained by groups 1 and 2, but it remains significantly different.

Quantitatively speaking, the grades obtained by each group in the final exam show that the performance of learners improves with their participation in programmatic assessment, as shown in table 7.

Table 7. The obtained average score for each group

Student's grades	N	Mean	Std. Deviation	95% Confidence Interval for Mean	
				Lower Bound	Upper Bound
Never participated to OPA	33	7,1364	2,29200	6,3237	7,9491
Participated 1 time to OPA	56	9,8527	1,76907	9,3789	10,3264
Participated 2 times to OPA	77	12,8977	1,22117	12,6206	13,1749
Participated 3 times to OPA	38	14,5461	1,39358	14,0880	15,0041
Total	204	11,4369	2,98432	11,0249	11,8489

This table shows that students who never participated in the OPA had the lowest average score (7.13). A gradual increase in the average exam score was observed with a higher frequency of participation in the OPA. As a result, students who participated in all scheduled OPA obtained the highest average score (14.54). We also observe that the standard deviation generally decreased with increasing participation, suggesting a closer distribution of scores around the mean in groups with higher OPA participation.

Discussion

Previous studies have demonstrated that OPA is one of the most effective methods to motivate learners [Saeedi *et al.*, 2021], involve them in the construction of their learning, and develop their transferable skills [Tai *et al.*, 2016].

Our research reinforced these claims in Moroccan context. The study of satisfaction has been dissected into three facets; we have emphasized the usefulness facet perceived by the learner of the frequency of OPA on the development of skills in ICT. This facet of satisfaction can be associated with the development of domain-specific skills and changes in behavior in an authentic situation [Yennek, 2015]. The analysis of the questionnaire showed that the learners are completely satisfied with the contribution of this method of evaluation to the construction of their skills. They greatly appreciated the fact that they had frequent feedback and the opportunity to compare their projects with those of their peers. This may be due to the anonymity that governs the evaluation process, which improves student's perceptions of the learning value of activity [Panadero, Alqassab, 2019], but also to the frequency of OPA, which each time allows the student to conduct a reflective review of his projects in light of what he consults and the feedback he receives.

The Spearman correlation test demonstrated that the three facets of satisfaction are well correlated. The students appreciated the fact of evaluating the work of their peers and receiving feedback from them; they also perceived the frequency of the OPA as beneficial

to the development of their ICT skills, despite the intellectual investment required for complete peer assessment workshops.

However, the correlation between reported enjoyment and perceived usefulness was the weakest. This implies that gaining ICT skills through the OPA required a remarkable effort from students. This finding was expected because we were looking to increase student contact with the course through programmatic assessment.

To consolidate the positive findings detected by the questionnaire, we cross-referenced the results obtained by the learners in the final exam of the module with the number of participants in the OPA. The ANOVA test leaves no doubt about the positive effects of OPA frequency on learner performance. The statistical results showed significant differences between the groups in terms of performance in the final exam, bearing in mind that all the students had the same starting point regarding the use of ICT in teaching.

The group that had high averages is the one that participated in all the OPA scheduled along the module; this can be attributed to the large number of projects consulted (4 projects per evaluation, i. e., 12 in total) and also to the amount of feedback received from peers, which undoubtedly provided considerable support for their learning. We also found that the averages obtained in the final exam decreased with the decrease in participation in the programmatic assessments, which may be due to the nature of the pedagogical system based on the construction of learning by the learners. However, when learners avoided the OPA activity or only participated in it to a limited extent, they had less chance to identify their strengths, their weaknesses and then regulate them.

Conclusion

This study aimed to determine the contribution of a programmatic OPA to learning of the students in ICT. We explored this contribution by taking two paths. The first was the measurement of student satisfaction with this evaluation strategy, while the second made it possible to detect the existence of significant differences in scores obtained by the students, depending on their frequency participation in OPA.

Generally, numerous studies have mentioned the role of the OPA as a learning facilitator for students engaged in this process [Hodgson *et al.*, 2014], it allows the reception of diversified information on the quality of the work submitted and consequently guarantees the opportunity to improve learning [Iglesias Pérez *et al.*, 2022]. We mention that the majority of these studies come from developed countries where students are accustomed to new evaluation strategies such as OPA and to the uses of ICT in teaching.

In our study, the results of the questionnaire or the ANOVA test made it possible to prove a positive contribution of this evaluation strategy to the learning of the students who participated permanently, knowing that all of the students involved in this study are novices in ICT and have no previous experience with traditional or online peer assessment.

However, the reproduction of such results requires careful design of the evaluation system while ensuring permanent support for students during the various OPA phases. The post-assessment regulatory sessions also play an important role, because, alongside the regulatory function, it encourages students to take the process seriously, knowing that their artifacts and their evaluations are controlled by the teachers.

In conclusion, this study reinforced the findings of previous studies that validated the importance of OPA in building skills, promoting learning, and demonstrating its positive

impact on student outcomes. However, the transfer of the skills acquired in ICT to the professional environment thanks to this experience requires a more in-depth study and a follow-up of the students in their professional situation.

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Влияние взаимного онлайн-оценивания на успеваемость студентов и на формирование у них навыков в области информационно-компьютерных технологий

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Взаимное онлайн-оценивание — это инструмент, который позволяет студенту выносить оценочные суждения о работе своих коллег. Этот метод поддерживает обучение, ориентированное на студентов, и направлен на закрепление их знаний посредством обширных комментариев и рефлексивного суждения. Данное исследование направлено на изучение влияния регулярной взаимной онлайн-оценки на формирование у студентов навыков в области информационно-коммуникационных технологий и, следовательно, на их результаты на итоговом экзамене. Для достижения этой цели был использован двухэтапный подход. Во-первых, анкетирование позволило собрать многоаспектные сведения об удовлетворенности студентов этим методом оценки. Во-вторых, аналитика обучения позволила сгруппировать студентов по частоте их участия в запланированных взаимных оценках, а затем сравнить их по итоговым баллам за модуль. Результаты показали, что студенты, часто участвовавшие в запланированных взаимных оценках, были удовлетворены вкладом этого опыта в свое обучение, а сравнительный тест продемонстрировал, что оценки студентов на итоговом экзамене улучшились благодаря их частому участию в взаимных оценках. Текущие результаты прогнозируют, что частая взаимная онлайн-оценка может стать более эффективной поддержкой для обучения студентов и, следовательно, для улучшения их результатов.

Ключевые слова: взаимное онлайн-оценивание, система управления обучением, частая оценка, смешанное обучение.