Course Quality Assessment in Post-pandemic Higher Education

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***Abstract*—Changes in teaching practices due to Covid-19 pandemic have catalyzed the integration of classic in-person teaching with online strategies, such as MOOCs and Open Educational Resources. However, the resulting changes in teaching strategies raise concerns about the quality of the learning experience in the new scenarios. In this work, we tackle the problem of establishing criteria and strategies for quality assessment (QA) of in-person courses that incorporate e-learning educational resources, namely the *blended-learning* scenario. We present a Quality assessment methodology for its utilization in blended-learning and describe a case study on the utilization of the proposed methodology for QA of three undergraduate courses of an Electronics Engineering program.**

I. Introduction

In response to the Covid-19 pandemic, many institutions and educators had to adapt courses that were originally devised for in-person education to fully online formats. The need to guarantee the delivery of the learning process in scenarios of limited in-person interaction catalyzed the wider adoption of strategies that were otherwise limited to online education or blended education formats. On the one hand, the response to the pandemic has the potential to positively disrupt critical aspects of higher education, such as accessibility and the adoption of new learning strategies [1]. However, on the other hand, changes in teaching strategies and educational resources also raise concerns about the quality of the learning experience in the new scenarios [2].

In this work, we are interested in establishing criteria and a methodology for quality assessment (QA) of in-person courses that incorporate e-learning educational resources, namely the *blended-learning* scenario. *Blended learning* is a broad term used to refer to teaching strategies that involve the simultaneous utilization of e-learning resources with face-to-face interaction [3]. Recent studies have tackled different aspects of the blended-learning scenario in the postpandemic era, such as the effectiveness of the use of online resources [4], implementation strategies [5] and student's perceptions [6]. However, the literature about QA in this scope is very scarce. The aim of this work is to propose a methodology for the application of a quality assessment rubric in blended-learning courses.

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In this document, we first review current standards for QA of higher education (HE) and propose a QA methodology for its utilization in blended-learning courses. We also describe a case study on the utilization of the proposed methodology for the assessment of the quality of three undergraduate courses of an Electronics Engineering program. In order to facilitate further discussions about QA of blended-learning courses, our assessment rubric will be publicly available with guidelines for its utilization[1].

II. Background

A. Quality assessment in higher education

In the context of higher education, modern QA integrates two main perspectives: the *quality perspective*, which is concerned about the definition of standards, and evaluation and measurement strategies for systematic quality assessment, and the *higher education perspective*, that considers the aims, purpose and function of higher education [7]. A main driving force in the integration of these perspectives corresponds to the standards established by different QA agencies. In particular, regulated QA typically follows a top-bottom hierarchy in which quality guidelines are established and adapted at different implementation levels (Fig. 1). In the top level of Fig. 1, QA starts with quality standards defined by international agencies. These agencies can be of public nature, for example the European Network for Quality Assurance (ENQA), or private initiatives, such as the European Alliance for Quality Massive Open Online Courses[2], Quality Matters[3] and the Council for Higher Education Accreditation[4]. The task of these agencies is to establish commonly accepted principles, procedures, guidelines and assessment systems for their deployment at lower levels in the hierarchy [7].

Quality frameworks defined at the top level of Fig. 1 usually serve as a reference for QA systems at lower levels. At the national level, the purpose of QA agencies is usually twofold: first, they promote the adoption of common quality standards. Second, they also define the guidelines for *accreditation*. Accreditation is a quality assurance process in which higher education institutions or programs are evaluated to determine

[1]Link removed for blind review
[2]http://mooc-quality.eu/
[3]https://www.qualitymatters.org/
[4]https://www.chea.org/

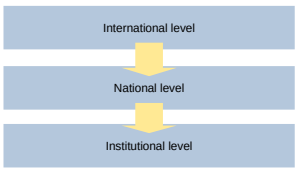

Fig. 1. Hierarchical top-bottom approach followed in the formulation and implementation of QA standards in higher education

the agreement with national standards. In this case, accreditation serves as a certificate of compliance with such standards. At the final level of the hierarchy, each institution adopts their own framework for QA in correspondence with their own needs and nature. Despite the hierarchical nature of the QA process shown in Fig. 1, in practice each level of the hierarchy has the freedom to establish their own QA framework according the their purpose. Therefore, the adoption of the guidelines from upper levels is usually not compulsory but rather a deliberate decision for strategic purposes.

B. Digital transformation and quality assessment

In recent years, HE institutions worldwide have witnessed a surge related to the incorporation of new forms of teaching strategies in higher education, such as the incorporation of open educational resources (OERs), integration of MOOCs into traditional programs, and the emergence of digital learning environments, among others [8]. This trend has been characterized with the incorporation of information and communication technologies (ICT) in teaching practices and has been referred to as the *digital transformation* of higher education [9]. Arguably, one of the main effects of the Covid-19 pandemic has been an acceleration of the digital transformation process [10].

Innovation in teaching and learning may have important implications for quality assurance. Specifically, the digital transformation of HE could have direct implications for the supporting, developing, assessing, or reviewing educational quality [11]. Therefore QA needs to be reviewed in light of the changes and innovations that are taking place due to the digital transformation. In this work, we are interested in quality assessment for blended-learning scenarios at the *course level*. Based on a literature review, we identified an important problem in this scope: most QA frameworks have been devised to operate at the program level or higher. As a result, many of the quality criteria cannot be directly applied at the course level. The complexity of QA frameworks that have been designed to operate at the program level hinders their practical adoption at the course level. QA frameworks need thus to be specifically tailored to operate at the course level. With this goal in mind, we have adapted elements taken from three QA frameworks at the program level for the blended-learning scenario at the course level.

In the remainder of this document, we describe the rationale behind the proposed QA model, the assessment criteria for each dimension and the methodology for its utilization on the assessment of blended-learning courses in higher education. As a case study, we present the utilization of the proposed rubric to assess the quality of three courses of an undergraduate program in electronics engineering: Signals and Systems, Digital Signal Processing and Communication Systems. Finally, we discuss the case study in terms of the assessment results as well as the resources required for its implementation.

III. Proposed Quality Assessment Framework

We based our framework on the e-Learning Maturity Model (eMM) [12], the Quality Assessment of E-Learning benchmark of the European Association for Distance Teaching Universities (EADTU) [13], the Quality Reference Framework developed by the European Alliance for the Quality of Massive Open Online Courses [14], and OpenupEd quality label for MOOCs [15], [16]. Although the first three of the aforementioned frameworks were originally designed at the program level, they all work by establishing assessment criteria that are grouped into different *dimensions*. We adopted this same strategy but adapted each dimension to allow their application at the course level. The adopted quality dimensions and quality criteria are described in next section.

A. Quality dimensions

For our course quality assessment model we adopted 27 different quality criteria grouped into 6 dimensions. The rubric was designed in such a way that each criterion can be assigned a qualification between 1 and 4 according to the degree of achievement. As a result, it is possible to automatically generate an overall performance score for each dimension as a weighted sum of the scores in each criterion. The summary of the criteria and their weights per dimension is shown in Table I. For illustration, Table II shows the performance levels of an example criterion. Due to space limitations, we do not discuss each criterion individually. Each dimension is briefly described below.

1) Course introduction: the familiarity of students with the learning environment and activities as well as their role as learners is an enabling step for active learning [17]. The aim of this dimension is to assess whether proper measures have been taken so that the students are familiarized with basic aspects of the course, such as its purpose and structure, how to access course content and educational resources, pedagogical strategies and prerequisites.

2) Learning outcomes: clearly defined learning objectives and learning outcomes are instrumental for effective teaching and student engagement [12]. The process of defining and expressing learning outcomes should enable students to reflect upon their learning expectations and their relationship with learning activities [18]. Therefore, learning outcomes should be clearly stated regarding both skills and knowledge and they should be measurable and consistent with learning objectives. In addition, learning objectives should be linked explicitly throughout learning and assessment activities using consistent language.

TABLE I
DIMENSIONS AND CRITERIA FOR COURSE QUALITY ASSESSMENT. DIMENSIONS ARE IN BOLDFACE. NOTE: ORIGINAL RUBRIC IS IN SPANISH.

Dimensions and criteria	Weight
Course description and introduction	
• Students are provided with information on accessing course content	3
• Students are presented with the purpose and the structure of the course	2
• Pre-requisites and input competency level are clearly stated	2
• Course documentation describes the e-learning pedagogies used	1
Learning outcomes	
• Course documentation includes a clear statement of learning objectives	3
• Learning outcomes in each module refer to measurable results consistent with learning outcomes	2
• Learning objectives are linked explicitly throughout learning and assessment activities using consistent language	1
Learning activities & workload	
• Deadline and timing information provided as part of descriptions of course activities	2
• The relationship between course activities are explicit and logical	1
• The extend and timing of elearning activities is guided by student workload information	3
• Consistent use of a variety of teaching and learning activities in courses	1
• Learning activities are designed to encourage analysis and skill development	3
• Assessment rubrics include criteria reflecting the quality of student research and information use	3
• Learning activities and tasks are placed within an authentic context for student learning	3
Assessment	
• A variety of qualitative and quantitative metrics are used to assess achievement of learning objectives	2
• Assessments are consistent with course requirements and learning outcomes	3
• Assessment policies are clearly stated at the beginning of the course	2
• Assessment activities consider a variety of evidences	1
Interaction & feedback	
• The course provides learners with regular feedback through self-assessment activities, tests or peer feedback	1
• Students are provided with opportunities to describe and reflect upon their own learning	2
• Courses provide a variety of mechanisms for interaction between staff and students	2
• Students are provided with feedback beyond the marks assigned for assessed work	3
• Students are provided with opportunities for cooperative and collaborative learning tasks	1
Didactic materials & course technology	
• Consistent use of a variety of media in courses	2
• E–learning resources are packaged and stored for reuse	1
• Pedagogical issues are formally addressed in e-learning design and (re)development procedures	3
• E-learning design and development is guided by the need to ensure that learning activities are accessible	1

TABLE II
EXAMPLE OF PERFORMANCE LEVELS OF A CRITERION

Dimension: Interaction and feedback			
Criterion: The course provides learners with regular feedback through self-assessment activities, tests or peer feedback			
Performance level 1 Not satisfied	Performance level 2 Partially satisfied	Performance level 3 Largely satisfied	Performance level 4 Fully satisfied
The course offers no feedback beyond the results and grades of evaluations	Feedback is limited to the solution of evaluation activities in a generic way	The course incorporates various feedback mechanisms but they are not very regular	The course provides learners with regular feedback through different activities

3) Learning activities and workload: the planning of learning activities is a compromise between the level of attainment of learning outcomes and the required workload to reach such level. As a result, in order to increase its effectiveness, learning activities should be designed to promote analysis and skill development and should be placed within an authentic context for student learning [12], [17], [19]. At the same time, the extend and timing of such activities should be carefully guided by students' workload information [20].

4) Assessment: in direct connection with learning outcomes, the assessment is the means for determining completion of achievement and level of performance of students. However, assessment activities have an impact on the effectiveness and importance that students attribute to learning. As a result, assessment activities should be consistent with learning outcomes, they should include a variety of both qualitative and quantitative measures [15], and should constitute a tool for active learning [21].

5) Interaction and feedback: interaction is fundamental for learning [22]. Interaction and feedback are of special concern in online or remote teaching scenarios with limited or no face to face activities. This dimension assesses the existence of different communication channels, their timely and effective usage, their integration with learning activities and their suitability according to the course's learning outcomes. Because interaction is an active learning strategy, ideally the course design should also provide learners with regular feedback through self-assessment activities, tests or peer feedback.

6) Didactic materials and course technology: one of the main components of blended learning courses is constituted by the materials, resources and technologies required for the delivery of the online content. However, beyond following the proper principles for instructional design [23], e-learning design should also be guided by learning outcomes [12].

Therefore, the adoption and utilization of learning resources, learning activities and pedagogical strategies should all be integrated by means of a design and re-design process centered on the learning outcomes.

B. Assessment methodology

Most QA frameworks in HE can be understood in terms of a three-step iterative cycle that involves self-assessment, evaluation and improvement. Following the same three-step architecture, our QA assessment methodology for blended learning courses can be described as follows.

In the first step, the "interested party" performs a self-assessment based on a previously defined *quality standard*. In our proposal, the interested party is the lead instructor of the course and the quality standard is defined by the assessment rubric described in previous section. The second step, the evaluation phase, usually involves an objective third party whose role is to apply the same quality standard and corroborate the findings of the self-assessment phase. In our proposal, this third-party is conformed by different stakeholders including other instructors, students and experts in pedagogical and instructional design. The last step, *improvement*, takes place after the lead instructor is provided with feedback about the outcome of the evaluation phase in order to identify aspects for improvement in the course.

During the design of our assessment methodology, we adopted two main guiding principles: *reproducibility* and *efficiency*. Regarding reproducibility, we had to make sure that the entire assessment process could be reproduced in its entirety in a periodical manner, independently to the type of course under evaluation (i.e., fully theoretical, practical or theoretical & practical). We comply with this principle by defining a repeatable, yet comprehensive, assessment process. Regarding efficiency, the amount of resources is one of the main limitations for the application of a QA framework. QA frameworks established at the program or institutional level are usually long and involved processes that require dedicated units devoted to the collection and analysis of evidences for the correct application of quality rubrics. Unfortunately, this is not practical at the course level, where the whole process should not overburden the stakeholders involved and should still yield actionable feedback that can be used to identify flaws and improve courses in a timely manner. We tackle the efficiency problem by integrating the self-assessment and evaluation phases into a single one-session activity that can take place at the end of each teaching period. This activity is organized in three moments: preliminary activities, assessment session, and feedback. These moments are summarized in Table. III and briefly described below.

In Table III, we also identify three different roles: the instructor, who is the lead instructor of the course that will be subject to assessment; the reviewer, who is part of a reviewing panel that includes different stakeholders, such as teachers, students and pedagogy experts; and the coordinator, who organizes the assessment process. For the sake of efficiency, it is advisable that more than one course is evaluated at the same time, and course instructors can simultaneously act as coordinators and reviewers for other courses.

TABLE III
PROPOSED QUALITY ASSESSMENT METHODOLOGY FOR A SINGLE COURSE

Activity	Responsible	Duration
Preliminary activities		
Panel assembly	coordinator	1h
Session preparation	instructor	2h
Assessment session		
Course presentation	instructor	10m
Panel discussion	reviewers	30m
Assessment	reviewers	20m
Feedback		
Submission of report	coordinator	30m

In the *preliminary activities* of Table III, the coordinator assembles an evaluation panel by inviting different stakeholders to take part in the assessment session and shares the assessment rubrics so that everyone involved in the process is familiar with evaluation criteria. At the same moment, the lead instructor of each course should prepare a presentation about the self-assessment of each dimension of their own course. During the *assessment session*, each instructor will make a short presentation about their own course to facilitate the task of the reviewing panel. After the presentation, the reviewing panel is free to ask questions and discuss different aspects of the course so that they can subsequently apply the assessment rubric for the course under evaluation. Because each criterion is associated with a performance level and a relevance weight within each dimension, a report is automatically generated with a performance score by each dimension. The assessment methodology concludes through the *feedback* given to the instructors by means of a performance report compiled by the coordinator.

IV. Case study in Electronics Engineering

In this section we describe a case study on the utilization of the QA methodology presented in previous section to assess the quality of three courses of an undergraduate program of Electronics Engineering at (removed for blind review): Signals and Systems (SGN), Digital Signal Processing (DSP), and Communication Systems (COM). The generalities of each course are summarized in Table IV. In that table, the level is measured in semesters in a 10-semester (5 years) long program. As shown in that table, the three courses are different in terms of the level of the students and type of course: T is fully theoretical and T+P is theoretical & practical, which represents a rich scenario to assess the flexibility of the proposed QA methodology.

Due to Covid-19 pandemic, all courses were taught in blended-learning format, but each one adopted a different strategy. In SGN, the instructor adopted a classical lecture-based approach in which synchronous sessions were mostly dedicated to lectures and guided workshops. In DSP, the instructor adopted a flipped-classroom strategy in which standard lectures were replaced by previously designed instructional materials, such as videos and readings, and synchronous

TABLE IV
SUMMARY OF COURSES. SGN: SIGNALS & SYSTEMS, DSP: DIGITAL SIGNAL PROCESSING, COM: COMMUNICATIONS

Course	SGN	DSP	COM
Course type	T	T+P	T+P
Credits	4	3	4
Level	5	6	7
Group size	25	28	20

sessions were devoted to discussions and problem solving. In COM, the instructor adopted a hybrid approach in which the class was not fully flipped but students were provided with instructional materials for class preparation. All courses took place during the first academic semester of 2020, between April 5 and October 22 of 2020. In all courses, synchronous sessions were held remotely using the Zoom teleconferencing platform[5] and online instructional materials were shared using the institutional platform: Moodle[6]. Asynchronous communication channels included Moodle, the institutional email, and alternate communications channels such as Whatsapp (for SGN), Discord[7] (for DSP) and Teams[8] (for COM).

A. Assessment methodology

We applied the QA methodology presented in section III by following the activities of Table III. For the *preliminary activities*, the main instructor of the DSP course adopted the role of the coordinator. The coordinator sent invitations to each instructor and shared the QA rubric (Table I). Each instructor was asked to prepare a presentation of his/her course based on this rubric. In addition, each instructor was asked to recruit three to four students from their courses who were willing to take part in the reviewing panel. The coordinator also invited two pedagogy experts from the *Center for Teachers Development* of the institution. As a result, the reviewing panel for the three courses was formed by 16 reviewers: 3 professors (the main instructors of each course), 11 students (3 or 4 from each course) and 2 pedagogy experts. All reviewers took part in the assessment of all courses. However, when reviewing their own courses, the instructors' assessment would be considered as a self-assessment and processed separately from the rest of reviewers. Notice that not all students in the reviewing panel had taken part in all the courses under assessment. We were hoping that this would allow us to analyze how the familiarity with a course could impact on the outcome of assessment. Ideally, the results of the assessment should not be biased by the fact that the reviewing students have been involved or participated in a course.

The assessment of the three courses took place in a single *assessment session*. At the beginning of the session, the coordinator presented the objectives of the session and proposed an order to assess the three courses. According to the suggested order, each course was reviewed following the activities in Table III: a short presentation by the instructor, an open discussion of the reviewing panel, and the assessment using the rubric in Table I. The review of each course took approximately 1 hour, thus the full assessment session took approximately 3 hours for the three courses. Based on the scores obtained in each criterion of the rubric, a performance report was automatically generated, which the coordinator shared with each instructor to provide *feedback*.

[5]https://zoom.us/
[6]https://moodle.org/
[7]https://discord.com/
[8]https://www.microsoft.com/en-us/microsoft-teams

TABLE V
PERFORMANCE SCORES OBTAINED IN EACH DIMENSION

Dimension	SGN	DSP	COM
Course description & introduction	3.75	3.96	3.89
Learning outcomes	3.67	3.11	3.59
Learning activities & workload	3.20	3.80	3.72
Assessment	3.44	3.71	3.74
Interaction & feedback	2.86	3.87	3.30
Didactic materials & course technology	3.53	3.80	3.71

TABLE VI
PERCENT AGREEMENT IN DIFFERENT GROUPS OF REVIEWERS

Group	SIG	DSP	COM
All reviewers	53	78	70
Professors	46	72	66
Non-mentees	56	82	75
Mentees	69	82	82

B. Obtained results

Based on the scored rubrics, we obtained different performance scores in each dimension for each course under evaluation. These results are summarized in Table V. According to that Table, all courses were assessed as *largely satisfying* or higher (>2.5) in all dimensions. Overall, all the three courses obtained the higher score in the dimension corresponding to "Course description & introduction". The lowest score for both the SGN and COM courses were obtained in the "Interaction & feedback dimension", whereas the lowest score for the DSP course was obtained in the "Learning outcomes" dimension. Notice that performance scores are reported independently in each dimension, since each dimension is considered to assess independent factors related to course quality.

In order to measure the consistency of the assessments, we measured the *agreement percentage* among different groups of reviewers in each course. The agreement percentage is measured as the percentage of times the same score is assigned to a given criterion by two different reviewers. Therefore, this measure is computed by making pairwise comparisons among the scores of all reviewers. Obtained results are summarized in Table VI. In that table, the *professors* group includes both the instructors of the courses as well as the pedagogy experts. In turn, students were separated into two groups: *mentees* and *non-mentees*, depending on whether the students had participated directly in the course under review.

In Table VI, the agreement in all the reviewing groups was moderate, with percent agreements between 53% and 82%. The highest agreement among all reviewers was observed in the DSP course (78%) whereas the lowest agreement was

observed in the SGN course (53%). When comparing the agreement within different groups of reviewers, the highest agreement was always observed in the mentees (between 69% and 82% depending on the course), whereas the lowers agreement was observed in the group of professors (between 46% and 66%). This is an interesting finding since this suggests that students that had previously taken part of a course were more likely to assign similar reviews, whereas the group of professors made a more heterogeneous assessment.

V. Conclusion

In this work we tackled the problem of quality assessment (QA) of blended-learning courses in higher education (HE). In the literature, most QA frameworks for HE work at higher levels, such as at the program or institutional level. As a result, we had to adapt previously existing QA frameworks originally devised for HE programs in order to adapt them to work at the course level. We proposed an assessment rubric that considers 27 different quality criteria grouped into six different dimensions. We also proposed a methodology for the application of the quality rubric.

As a case study, we applied the proposed QA framework to a set of three courses of an undergraduate program in Electronics Engineering. The reviewing panel was formed with different stakeholders including instructors, students and pedagogy experts. The assessment of the courses took place in a single 3 hour-long session. Therefore, the proposed QA framework showed to be practical in terms of time and resources required for its utilization, yet providing useful feedback about the quality dimensions considered in the rubric.

A moderate agreement was found when comparing the percent agreement among different reviewers (between 53% and 82%). Interestingly enough, the highest agreement was observed among students that had previously taken part in the courses under review. A limitation of our analysis is that percent agreement does not account for agreements that happen by change. A more in-depth analysis of inter-rater agreement metrics is warranted in future work.

Due to increased attention an interest in the incorporation of online learning into traditional courses in post-pandemic education, we believe that quality assessment will play a pivotal role in the identification of good practices in these scenarios. We hope that this work contributes to the discussion about identifying quality criteria and QA assessment in light of the digital transformation of higher education.

References

[1] P. V. Mandke, "Higher education in the post-pandemic world," *Higher Education Digest*, Apr 2021. [Online]. Available: https://www.highereducationdigest.com/higher-education-in-the-post-pandemic-world/

[2] H. Lee, R.-S. Guo, and C. Chen, "E-learning in the postpandemic era: A case study in taiwan," *IEEE Transactions on Engineering Management*, pp. 1–13, 2021.

[3] B. Smith and C. Brame, "Blended and Online Learning," 2014. [Online]. Available: https://cft.vanderbilt.edu/guides-sub-pages/blended-and-online-learning/

[4] B. P. Legamia and Y. W. D. Akiate, "The contribution of online resources to fostering digital learning and effective teaching," *Universal Journal of Educational Research*, vol. 8, no. 11, p. 5660 – 5669, 2020.

[5] Z. Bojovic, P. D. Bojovic, D. Vujosevic, and J. Suh, "Education in times of crisis: Rapid transition to distance learning," *Computer Applications in Engineering Education*, vol. 28, no. 6, p. 1467 – 1489, 2020.

[6] R.-A. Salas-Rueda, R. Castañeda-Martínez, A.-L. Eslava-Cervantes, and C. Alvarado-Zamorano, "Teachers' perception about MOOCs and ICT during the COVID-19 pandemic," *Contemporary Educational Technology*, vol. 14, no. 1, 2022.

[7] D. Vlachopoulos, "Assuring quality in e-learning course design: The roadmap," *International Review of Research in Open and Distance Learning*, vol. 17, no. 6, pp. 183–205, dec 2016.

[8] D. Kabugo, "Utilizing open education resources to enhance students' learning outcomes during the covid-19 schools lockdown: A case of using kolibri by selected government schools in uganda," *Journal of Learning for Development*, vol. 7, no. 3, pp. 447–458, 2020.

[9] C. Brooks and M. McCormack, "Driving digital transformation in higher education," EDUCASE, Lousville, Tech. Rep., jun 2020.

[10] C. Li and F. Lalani, "The COVID-19 has changed education forever. this is how," *World Economic Forum*, Apr 2020. [Online]. Available: https://www.weforum.org/agenda/2020/04/coronavirus-education-global-covid19-online-digital-learning/

[11] A. Greere, A. Martens, R. Moreg, and M. J. Robert, "Innovation in teaching and learning as part of external quality assurance approaches," European Association for Quality Assurance in Higher Education, Brussels, Tech. Rep., 2019.

[12] S. Marshall, "Improving the quality of e-learning: Lessons from the eMM," *Journal of Computer Assisted Learning*, vol. 28, no. 1, pp. 65–78, feb 2012.

[13] K. Williams, K. Kear, and J. Rosewell, "Quality assessment for e-learning a benchmarking approach," European Association of Distance Teaching Universities, Tech. Rep., 2012. [Online]. Available: https://eadtu.eu/home/policy-areas/quality-assurance/publications/118-quality-assessment-for-e-learning-eadtu

[14] C. M. Stracke, E. Tan, A. Texeira, M. Pinto, B. Vassiliadis, A. Kameas, C. Sgouropoulou, and G. Vidal, "Quality reference framework (QRF) for the quality of massive open online courses (MOOCs)," European Alliance for the Quality of Massive Open Online Courses, Tech. Rep., 2018. [Online]. Available: http://www.mooc-quality.eu/QRF

[15] J. Rosewell and D. Jansen, "The openuped quality label: benchmarks for moocs," *The International Journal for Innovation and Quality in Learning*, no. 3, pp. 88–100, 2014.

[16] J. Rosewell, "Benchmarks for MOOCs: the OpenupEd quality label," in *International Conference on Enhancement and Innovation in Higher Education*, 2015, pp. 9–11.

[17] R. S. Grabinger and J. C. Dunlap, "Rich environments for active learning," in *The changing face of learning technology*, D. Squires, G. Conole, and G. Jacobs, Eds. Cardiff: University of Wales, 2000, ch. 1, pp. 8–38.

[18] J. Allan, "Learning outcomes in higher education," *Studies in Higher Education*, vol. 21, no. 1, pp. 93–108, 1996.

[19] S. Vonderwell and S. Turner, "Active learning and preservice teachers' experiences in an online course: A case study," *Journal of Technology and Teacher Education*, vol. 13, no. 1, pp. 65–84, January 2005.

[20] G. Salmon, *E-moderating: the key to online teaching and learning*. New York: Routledge, 2011.

[21] J. K. Adkins, "Active learning and formative assessment in a user-centered design course," *Information Systems Education Journal*, vol. 16, no. 4, pp. 34–40, 2018.

[22] T. Anderson, "Getting the mix right again: An updated and theoretical rationale for interaction," *The International Review of Research in Open and Distributed Learning*, vol. 4, no. 2, 2003.

[23] R. E. M. Ruth Colvin Clark, *e-Learning and the Science of Instruction: Proven Guidelines for Consumers and Designers of Multimedia Learning*. New Jersey: John Wiley & Sons, 2016.