

EXPERT HEURISTIC COLLABORATIVE APPROACH FOR USABILITY TESTING IN A MOOC PORTAL

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Abstract. Despite the widespread use of Massive Open Online Courses (MOOCs) in online learning, the usability of MOOC portals remains a major challenge. While expert heuristic evaluation principles have been proposed as a potential solution to usability problems, there is a lack of research on the effectiveness of these principles in a real-life and big-size project context. This case study examines the usability test process derived from expert heuristic evaluation principles within a national MOOC portal context and identifies how a collaborative approach can be used to enhance the effectiveness of usability testing. Since MOOCs meet the needs of the learners by keeping the investment to a minimum and creating close links to user interaction, we, as instructional designers, experienced a continuous and sequentially usability test process from the beginning of the design stage tests of 100 MOOCs to the end-user test phases. That's why the mainly expert heuristic and collaborative approach (EHCA) is used for finding the usability problems in an iterative design process as Nielsen emphasized. Between 2015-2017, a distinctive, ongoing procedure based on immediate feedback and reliability was performed by both instructional designers (n=8), online learning experts (n=4), quality assurance testers (n=4) and end users (n=10) through Nielsen's major test components (learnability, efficiency, memorability, errors, and satisfaction). The test documents were collected, semi-structured interviews were done, testing processes were observed throughout the MOOC portal creation process, and the "collaborative approach" focusing on more expert collaboration and gradual evaluation, immediate feedback, and revised test procedure, and more prototypes and fewer problems were embraced. This approach which answers the question of "how to make a more effective evaluation of the usability of the MOOC portal" can be considered a prototype of a structure that can give new design suggestions over the years. One of the contributions of the study can be summarized as providing the relationships between the expert heuristic and collaborative approach with real-life and big-size project evidence. So, the implications made for theory and practice have the potential to make critical contributions to the usability test process. Hence, in this study, we tried to offer a flexible and collaborative usability testing process with expert team members and several methods to minimize the effort and time for testing by always dealing with the usability problems of MOOC portals during the process. Therefore, the outputs of this study can be beneficial to various MOOC portals or any kind of online learning platform in terms of sustainability and efficiency.

Keywords: MOOC usability, expert-heuristic evaluation, collaborative usability, collaborative heuristic evaluation (CHE), expert-heuristic and collaborative approach (EHCA).

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1. Introduction

In the 1980s, the first online classes were provided, and the Internet has become a medium to provide lessons at different educational levels over the last three decades. Since their conceptual inception in 2008, MOOCs have proliferated significantly after 2011 by means of a course on artificial intelligence. This course attracted 160,000 learners, and the world learned about and became familiar with the MOOC phenomenon after then (Downes, 2017). Providing learning opportunities for millions of people, MOOCs are a part of university extension, open education, and participation initiatives which aim to widen participation and extend access to education, especially higher education (Patru & Balaji, 2016). It is not quite possible to represent MOOCs adequately with only one definition (Mulder, 2015). MOOCs are online courses that “provide a structured curriculum around a given theme or topic, but learners are expected to be autonomous and manage their own learning by making their own social and conceptual connections to suit their own needs” (Tschofen & Mackness, 2012, p. 126). They differ from Open Educational Resources and other online learning materials by “offering online learning services, including learning communities, automated self-testing, peer review, and certificates of different kinds, although generally not for credit” (Mulder, 2015, p. xx). MOOCs are valuable in promoting lifelong learning and providing flexibility for learners who need training in a specific subject or simply want to gain new knowledge or broaden their knowledge in a particular area (Patru & Balaji, 2016). They are mostly based on multimedia in the form of video lectures with interaction and discussion forums (Mulder, 2015).

In order to realize their potential, MOOCs should be easy to use and easy to learn (Albelbisi *et al.*, 2021; Cagiltay *et al.*, 2020). That is, usability must be given great importance throughout the design, development, and implementation of MOOCs. Usability, as the quality of use, is defined by ISO 9241-11 as “the effectiveness, efficiency, and satisfaction with which specified users achieve specified goals in particular environments” (as cited in Bevan & Macleod, 1994, p. 5). Basically, the main goal of usability evaluations is to support the development of more useful products (Lewis, 2006). Another goal of usability is to improve the design and development process of the products so that having the same problem is avoided in other products (Dumas & Redish, 1999). One of the problems MOOC faces is their low completion and high dropout rates (Jordan, 2014, 2015). High dropout rates might be the indicator of the poor usability and design of MOOCs, and these signal that MOOCs might be failing to maintain learners’ interest and provide optimal user experiences (Xiao *et al.*, 2014). MOOC continuance intention of learners is positively influenced by system quality, course quality, and service quality, and system quality is significantly related to the perceived ease of use of the system (Yang *et al.*, 2017). Moreover, the information quality, system quality, and service quality of MOOCs have significant effects on learners’ confirmation of MOOC qualities and the MOOC platform’s quality confirmation impacts learners’ perceived usefulness of the MOOC platform and satisfaction with MOOCs (Yang & Lee, 2021). Course quality and system quality are more likely to predict satisfaction toward a MOOC (Albelbisi, 2020), and system quality is significantly related to learner satisfaction toward MOOCs as well (Albelbisi *et al.*, 2021). In addition to these, MOOC success factors contain quality resources (relevant, updated, and adequate), interactivity (interactive and rich media resources), and content organization (easily finding desired information) significantly affect learners’ continuance and learning in a

MOOC (Azevedo & Marques, 2017). Also, from MOOC participants' perspectives, usability (interface design, navigation interactions, and learning environment support) and content are identified as the factors for an effective MOOC (Gamage *et al.*, 2015). As above mentioned, issues confirm, usability related dimensions have been studied as a quality factor in MOOCs. While there are research studies focusing on the usability and quality of MOOCs, there are a limited number of studies providing usability processes from the initial phases of MOOCs to the final product. Therefore, the focus of this study is to examine the EHCA usability test process of a national MOOC portal with 100 MOOCs.

2. Literature Review

Usability and Methods of Usability

Usability is affected by several factors from organizational factors to individual differences (Bevan & Macleod, 1994). The usability evaluation methods are useful for assessing the human interaction aspects of the system (Othman *et al.*, 2022). Usability itself is not a single property/entity; on the contrary, it depends on user, product, task, and environment interaction (Lewis, 2006). Usability can be approached from different perspectives as the product-centered view, the context-of-use view, and the quality-of-use view for different purposes in practice (Bevan & Macleod, 1994). There are different techniques and tools to carry out usability studies. Some of them include but are not limited to card sorting, qualitative/formative usability testing, quantitative/summative usability testing, diary study, customer journey mapping, participatory design, heuristic evaluation, and cognitive walkthrough (Barnum, 2020). Regarding the quantitative self-report measurement of usability, the System Usability Scale (SUS) has been a very popular instrument to measure perceived usability quickly (Lewis, 2018). Unlike qualitative dimensions, quantitative dimensions of usability can provide data to ensure and improve product quality, control and improve the production process, evaluate the acceptance of a software product, and pick a product from among the alternatives (Bevan & Curson, 1997). Usability tests can be performed in several environments containing varying degrees of formality, including several types of qualitative and quantitative data, and with distinct teams working with the end users (Hass, 2019). Not all techniques and tools are required in every situation as they depend on the objectives and resources available (Bevan & Macleod, 1994). As usability evaluations require resources, they can be expensive with regard to time and human resources (Ivory & Hearst, 2001). Among the different methods of usability, determining which one to use is strongly affected by the cost (Nielsen, 1995). A usability test cannot be considered successful if it is used to tick a milestone in the development process; on the contrary, it is considered successful if it helps to improve both the product and the process by which the product is developed (Dumas & Redish, 1999).

Usability of MOOCs

Because of their flexible structure, MOOCs create universal and inclusive learning environments for all students. Designing a MOOC to support effective teaching is very difficult (Wong, 2016) and also MOOC-related problems can be related to the Instructional design process (Meyer *et al.*, 2015). On the other hand, there is a need to elaborate Instructional Design frameworks for MOOCs (Egloffstein, 2018). In order to improve the student experience and provide quality assurance, more informed decisions

that are pedagogically successful for both MOOCs and conventional educational programs should be made in instructional design (Conole, 2015). This can be achieved by a sound usability process in every stage of MOOC design and development. Research studies on the usability of MOOCs focused on one MOOC platform or the comparison of multiple MOOC platforms. In a broader sense, the user experience of MOOC platforms was also examined. Previous research studies showed that there are several tools, methods, and approaches used for usability testing of MOOCs and MOOC portals such as surveys (İşgör & Turan, 2017; Syahid *et al.*, 2021; Tsironis *et al.*, 2016; Yousef *et al.*, 2015), think aloud (Silalahi *et al.*, 2022), SortSite software (Espada *et al.*, 2014), Emotient Analytics software (Pireva *et al.*, 2015), cognitive walkthrough method (Şahin & Durdu, 2021), and EEG device (Kelekçi, 2019). Researchers also performed usability analysis based on eye-tracking and authentic tasks in order to assess the usability of the Coursera platform (Taniş *et al.*, 2022). On the other hand, MOOC usability studies or quality evaluations are mostly performed in the form of post facto assessments/evaluations. Oh *et al.* (2020) performed a design review of 40 computer science MOOCs from two major MOOC platforms with respect to e-learning design principles. They found out that e-learning design principles were applied at a relatively low level in general apart from the principles regarding content organization and presentation.

Expert-Heuristic Collaborative Approach (EHCA)

Previous studies showed that there are several tools, methods, and approaches used for usability testing of MOOCs and MOOC portals such as eye-tracking, surveys, think-aloud, SortSite software, Emotient Analytics software, cognitive walkthrough method, EEG device, authentic tasks, and so on. Moreover, there are research studies that claim the need for conducting Collaborative Heuristic Evaluation (CHE), as an enlarged version of heuristic evaluation (Othman *et al.*, 2022) since CHE supports discussions between evaluators from the beginning to the end of the test process (Othman *et al.*, 2022; Hvannberg *et al.*, 2007; Georgsson *et al.*, 2014). Also, there is a need for inter-rater reliability in the Heuristic Evaluation process (Georgsson *et al.*, 2014). In this research context, the “collaborative approach” focusing on more expert collaboration and gradual evaluation, immediate feedback, and revised test procedure, and more prototypes and fewer problems were embraced. It is a flexible and collaborative and at the same time comprehensive usability testing process with several methods to minimize the effort and time for testing because usability testing ensures the quality of outputs and the system and the heuristics can be counted as principles used to assess usability. So, this approach which answers the question of “*how to make a more effective evaluation of the usability of the MOOC portal*” can be considered a prototype of a structure that can give new design suggestions over the years. Through collaborative usability testing, stakeholder involvement is facilitated (Fruhling & Vreede, 2006). In order to evaluate usability, a collaborative design has been used in different settings by different stakeholders. Collaboration in usability testing makes itself visible in a number of research studies. This was either in the form of collaborative teams evaluating usability or collaborative peers evaluating usability. This study exemplifies the use of a collaborative approach in a MOOC context.

Heuristic Evaluation (HE) research studies started to stress effectiveness and efficiency in usability evaluation in the mid-1980s (Hvannberg *et al.*, 2007) and CHE may become a useful tool for usability evaluation among both researchers and

practitioners (Babajó, 2012). Heuristic evaluators should be experts because of the unreliable results coming from non-experts (Jeffries & Desurvire, 1992), and the advantage of combining all usability issues coming from all experts to form a set of unique issues amongst other experts (Hvannberg *et al.*, 2007; Othman *et al.*, 2022). But as one of the recent studies (Othman *et al.*, 2022) points out, while expertise plays an important role in detecting as many usability issues, still they may not be able to detect all of them, and novice testers can identify the essential ones which can not experts may not be able to detect. So, it is very important to use different tester groups. From design ideas to MOOC development, test documents were collected, and the testing processes were observed throughout the MOOC Portal creation process, and the “collaborative approach” which refers to the following features in itself was embraced: (1) More expert collaboration and gradual evaluation, (2) Immediate feedback and revised test procedure, and (3) More prototypes and fewer problems.

In Expert Heuristic Collaborative Usability Approach (EHCA), there is a small group of participants working together to evaluate the usability of a product/design and are given a set of heuristics to guide their evaluations. So it is based on the principles of heuristic evaluation, which is a method for identifying usability problems in a product by using a set of established usability guidelines, or “heuristics”. To identify as many usability problems as possible and to provide constructive feedback on how to improve the product. One of the key advantages of this approach can be allowing a more in-depth and detailed evaluation of a product/material/design usability. There are group members who are able to build on each other's observations and provide a more comprehensive evaluation by working together. Also, the collaborative nature of EHCA can help to foster a sense of teamwork and shared ownership of the evaluation process, which can lead to more engaged and dedicated participants.

3. Methodology

This study employed a case study as the research method. There are multiple definitions of case study based on its characteristics. Bromley (1990, p. 302) defines case study as “a systematic inquiry into an event or a set of related events which aims to describe and explain the phenomenon of interest”. Stake (1995, p. xi) defines case study as “the study of the particularity and complexity of a single case, coming to understand its activity within important circumstances”. According to Yin (2002), case is “a contemporary phenomenon within its real-life context, especially when the boundaries between a phenomenon and context are not clear and the researcher has little control over the phenomenon and context” (p. 13). Case studies are particularly useful when capturing the context is essential (Cavaye, 1996). The unit of the case was taken as Bilgeış pdMOOC Portal with its 100 pdMOOCs in this study. Since the main research question is “How to make a more effective evaluation of the usability of the MOOCs and MOOC portal” for this case, this study particularly focuses on how the usability process was carried out in the MOOC portal and how to make a more effective evaluation of the usability of the mentioned pdMOOC portal.

Research Context and Usability Procedure

Bilgeış MOOC Portal was developed within the scope of a project. Bilgeış Project (“Capacity Development of Employees and Employers via Information and Communication Technologies”) is a project supported by the European Union and

Turkish government (Esfer & Cagiltay, 2018; Cagiltay *et al.*, 2020; Bozkurt *et al.*, 2021). Bilgeİş MOOC Portal was one of the outputs of this project. The portal currently hosts around 120 MOOCs based on technical and soft skills. In the pdMOOC portal, between 2015-2017 years, a distinctive, ongoing procedure based on immediate feedback and reliability was ensured by both instructional designers, online learning experts, and quality assurance testers through Nielsen's (2012) major test components (learnability, efficiency, memorability, errors, and satisfaction). However, Nielsen, whose heuristics are the most renowned usability heuristics (Benaida, 2023), had no comment about the need for inter-rater reliability in the Heuristic Evaluation process a few years ago (Georgsson *et al.*, 2014).

Participants

The participants of this study included 4 main groups: *Instructional Designers (IDs)*, *Online Learning Experts (OLEs)*, *Quality Assurance Testers (QATs)*, and *End Users (EUs)*.

a. IDs (n=8) were the design and development team members (aged 25 to 45 years old) of the MOOC project and they had responsibilities for storyboard writing, video/animation/voice production, portal development, etc. They have extensive knowledge and experience in usability and human-computer interaction methods.

b. OLEs (n=4) were expert testers (aged 30 to 45 years old) who were academics with extensive knowledge and experience in online learning, MOOCs, and usability.

c. QATs (n=4) were expert testers (aged 35 to 45 years old) who were responsible for checking all the ID phases and all products in the ID process. Also, they conduct the quality assurance works of the ID process-related products and documents.

d. EUs (n=10) were end users who were final-year undergraduate students of Computer Education and Information Technology, aged 20 to 21 years old.

Data Sources

We used 2 main data sources for this study. First, opinions and suggestions of IDs, OLEs, QATs, and EUs come from semi-structured interview data. Second, the researchers' observation notes throughout the project process, all instructional design-related project reports, e-mails, all course test and development documents, meeting minutes, usability tests, and the pdMOOC development checklists were examined. Specifically, the test documents were collected and testing processes were observed throughout the MOOC portal creation process, and all of the team leaders wrote "lessons learned" and "monitoring reports" for a more efficient testing and revision process approach. Also, 10 end-user tests were done after all.

Findings

First of all, the findings about the general pdMOOC development and testing process can go approximately as follows:

Scenario writing of a pdMOOC lasts 3 to 5 days.

After storyboard approval, basically, tasks-related problems were examined in the production and initial testing phase for each course.

Production of all elements which have been planned in storyboards, voice recording, preparing and editing all audiovisuals, and combining all course content in a SCORM Package.

Development is 2-4 weeks for the first course, and for others approximately 2 weeks.

The approval process cannot be estimated at that moment.

2 – 3 courses can be developed in parallel.

Testing course screens locally + Revision requests of QAT+ Revision requests of OLEs and Ids + Testing course on the portal

Revision requests of End-user tests

Revisions-Approval of the pdMOOC-Publishing the MOOC-Beta tests -Releasing the last version of the pdMOOC.

Revision requests of End-user tests

During this process, learner evaluation, satisfaction, and experiences have been taken as the main focus. Since MOOCs meet the needs of the learners by keeping the investment to a minimum (Azami & Ibrahim, 2019), and creating close links to user interaction (Sidhawara *et al.*, 2018), we, as instructional designers, experienced a continuous and sequentially usability test process from the beginning of the design stage tests of 100 MOOCs to the end-user test phases. That is why the mainly expert heuristic method was used for finding the usability problems in an iterative design process as Nielsen (2012) emphasized. Since the instructional design (ID) process of every MOOC reflects a highly complex and gripping process, *Figure 1* below indicates the continuous test and revision process of 100 pdMOOCs.

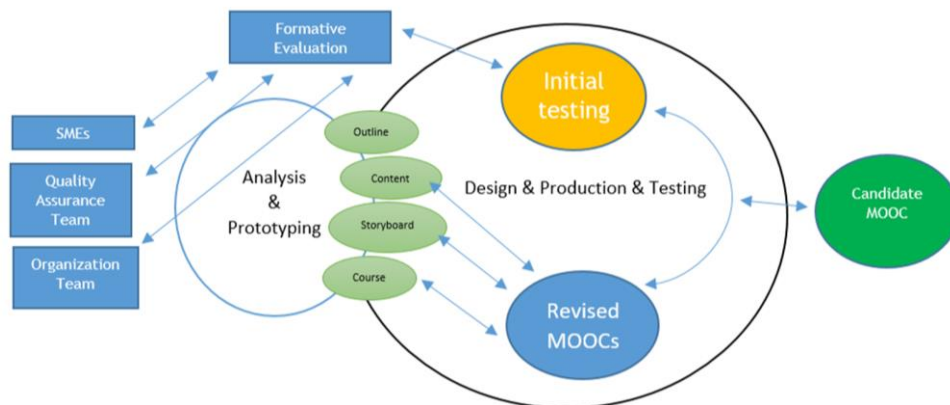


Figure 1. Expert-Heuristic and Collaborative Approach (EHCA) in continuous test and the revision process of 100 pdMOOCs

As seen from *Figure 1* above, there are two main phases for creating a candidate pdMOOC: (1) Analysis and prototyping (small and blue circle) and (2) Design, production, and testing (big and black circle). These two phases include all activities about analysis, raw content preparation, storyboarding, production, and initial testing. However, since analysis and prototyping phase activities cover both analysis studies and the first cycle of whole course production, it is possible to see prototypes of the courses. All other iterative cycles belong to the second phase (Design, Production, and Testing). Thus, it is possible to draft and shape multiple courses simultaneously in a short time. Besides, the testing term refers to all usability and accessibility tests before the instructional designers' initial test process in this ID cycle. Since there is still no end-user evaluation in the ID process, pdMOOCs will continue to be shaped by the feedback when they are released. That is why the last product is named "a candidate pdMOOC" in this figure.

The Initial testing phase covers two main processes, which are the completed course testing process and the private mode process. Initial testing can be seen as the last step for the ID process of pdMOOCs. Before the real participants of the pdMOOC Portal evaluated the courses, the practitioners constitute a long time required part which includes

mini end-user tests like a beta test, project team members tests like alfa test with different test techniques such as black box and white box testing. Also, members of the Moodle management team run some performance tests to measure portal capacity and internet access, and some SMEs evaluate the courses regarding instructional quality. Some non-key experts of the project team made comparisons with specifications and did accessibility and usability tests in the initial evaluation part of the ID. QAT and CT contribute alfa tests, and usability tests, and evaluate the courses' instructional design quality. In the development phase, courses have not been examined in different browsers, platforms, and the portal. So, there was still an ongoing revision and feedback process among the phases. As a result of many pre-production, production, and revision problems, there were lots of errors and problematic issues on the pdMOOCs and the pdMOOC Portal. One of the least stated in the interviews, but the most desired issue was accessibility in the whole project process. Unfortunately, also the initial test results showed that there were many items including accessibility-related problems. As an example, two end-user test document parts were presented below:

"Subtitles are used to meet the standards of accessibility in the videos about lecturing but the subtitles are not given in full or at all in the applied sections or interactive sections (e.g.: Lecture-1: in the 9th, 10th, and 11th videos). The "Subtitle Options" button is not visible in the lower bar of these videos." (End User Test 9)"

"Giving the text under the screen in videos closer to the video will help the user to follow the text and the interactions that take place in the videos. As such, it is difficult to follow both the texts and the interactions in the videos using the step-by-step approach or in the interactive videos (End User Test 1)".

"There should be a concluding remark at the end of each topic to understand it is the end of the sections" (End User Test 4).

"The information transmitted as audio in the Mobile Application course's introductory video is not presented as having subtitles" (End User Test 2).

Moreover, similar problems in the other phases' test results were found again in the last version of the MOOCs and MOOC portal. Specifically, some player and portal problems were permanent, and all the teams were trying to find alternative solutions to decrease the errors.

"Problem: Workability in different browsers. Solution: User requirements statement to be add on the Moodle" (Project 1. Interim Report).

"Moreover, sometimes if there were good and quick solutions for some errors, they could not be done due to the project restrictions. For instance, the challenges of the mobile-friendly design of the portal were a trendy topic in the meetings. In the innovative Method Report, Mobile compatibility "that the training can be run on the supporting mobile device browsers".

Although there was a test form for the end user tests in the process, however, the test mainly included usability-related items. Besides the form could be still insufficient if the previous phases were not taken into consideration.

"They made a checklist for courses in hidden mode in Moodle and started looking at that checklist. It is possible but I think it should not be too limited because they are not able to see anything else this time. You know, they look at the checklist and tick each item. It is true that they check them but, in the meantime, they overlook other things. Maybe, a normal test can be applied without the checklist and, in fact, it needs to proceed according to the previous document by looking at the scenario while doing the test. At that stage, they already do that thing anyway. It is a document and they implement the test on it. It may be more meaningful to pass the checklist after doing that test. It would be more logical for everyone to follow each course from the raw to the production. Yet, a checklist will definitely help because there are things that we overlook. When you look at one course, you miss the next. It does not attract your attention. They all happen. So, they should look at the other items outside of the checklist as well (CT5)."

Some of the most stated testing-related suggestions were: 1. Reference points should be approved storyboards for testing (n=7), 2. Testers should test the same course in the whole course creation process (n=5), and 3. Different tester groups which include independent and experienced experts should be created (n=6). 4. Progress in the testing process can be

defined and also measured by the team's acceptance in each cycle before proceeding to the following step for the courses ($n=8$).

This study highlighted the testing process of MOOCs from instructional designers' perspective and provided a practical approach for creating usable and qualified MOOCs. This approach is a collaborative and expert heuristic approach focusing on *more expert collaboration* and *gradual evaluation, immediate feedback, and revised test procedure, and more prototypes* and fewer problems were embraced. The key takeaways from this study can be summarized as the following:

- The usability process must be iterative during the instructional design process. So EHCA is an experienced, continuous, and sequentially usability test process from the beginning of the design stage tests of 100 MOOCs to the end-user test phases.
- Each item in the courses should be tested in order to ensure “no error”.
- Multiple experts should retest each process over and over and a collaborative approach should be followed. In this way, it might feel longer timewise, yet it can contribute to a more effective usability process.
- Testing courses on the portal lastly is not the same as testing by instructional designers at every stage. We have seen many details before the candidate MOOC and beta tests by testing at each stage. Even in such a comprehensive portal with 100 pdMOOCs, an effective process can be realized if the learning scenario on the portal is tested at every stage if it is constantly revised if at least 2 experts perform the tests if the standard document is followed, and if there is a general QA control at the end.
- The quality of organizational communication of all instructional design team and Quality Assurance team members can be counted as an “enabler” for testing. For instance, each person on the team can be aware of the distribution and sequence of the testing.
- The agility and adaptation of each expert tester to these situations are essential, as test documents and approaches to testing can be updated quickly. For the coordination of this cooperative work, involved all the members should follow a mutual formal plan for the completion of a test item or task.
- EHCA requires ongoing feedback and support mechanisms from the beginning of the analysis stage to the end user test stage. Also, providing constructive feedback on how to improve the product is the key factor for ongoing success.
- Progress in the testing process can be defined and also measured by the team's acceptance in each cycle before proceeding to the following step for the courses.
- EHCA leads the experts through a series of tasks, and discussions based on their observations and sharing feedback with each other. Moreover, each tester's observations and experience provide a more comprehensive evaluation if they discuss the products and share ideas by working collaboratively.

4. Discussion

Firstly, this study's findings have similarities with several studies claiming experts' evaluation importance (i.e., Babajo, 2012; Zhang *et al.*, 2020; de Souza Filho *et al.*, 2019; Othman *et al.*, 2022). If the testers have the expertise and comprehensive knowledge of usability issues, they can find and identify more issues (Othman *et al.*, 2022; Zhang *et al.*, 2020; de Souza Filho *et al.*, 2019). Besides, CHE-related studies (i.e., Babajo, 2012; Othman *et al.*, 2022) point out that expert testers detect more issues/problems in terms of

usability when compared to novice ones (i.e., Babajo, 2012). On the other hand, if there is a lack of interaction between experts, they may come up with different problems (Othman *et al.*, 2022), and merging all the different evaluators' usability test results is challenging (Baker *et al.*, 2001; Hvannberg *et al.*, 2007; Molich & Dumas, 2008; Othman *et al.*, 2022). The collaborative nature of EHCA can create teamwork, so it will be possible to create more engaged and dedicated members and continuous cooperation seems to be a must among evaluators.

Secondly, it is possible to assert that we have reached very similar principles in this EHCA approach with the following CHE studies:

- The usefulness of CHE can be explained by the collaboration of a small group of testers (Othman *et al.*, 2022).
- CHE is much better at finding usability issues than individual HE in terms of its cost-effectiveness (Broin, 2011).
- At the beginning of the process, CHE allows all discussions which could address issues between evaluators (Othman *et al.*, 2022).
- Also, Othman. *et al.* (2022) suggest if novice testers have usability knowledge but no experience in CHE, they can still perform evaluations. In this study, we used EHCA to test the usability features of MOOCs without involving end users, like expert evaluation developed by Molich and Nielsen (1990). However, OLEs, QATs, and IDs also collected several data from the experts' friends, students, and friends informally since they are novices and more objective. The usability evaluation members examined and cared about the EUs test results.
- CHE allows participants to actively collaborate with each other throughout the process (Othman *et al.*, 2022).

Thirdly, current literature knowledge includes the number of evaluators' importance in the HE process. We knew that there are different suggestions about the number of evaluators before the project. For instance, 4 evaluators (Nielsen, 1992), 5 evaluators (Nielsen & Landauer, 1993), and 8 evaluators (Hwang & Salvendy, 2010) were suggested. On the other hand, Tan *et al.* (2009) claimed that 5 evaluators are not satisfactory. Specifically for CHE, 6 evaluators can be seen as a satisfactory number (Othman *et al.*, 2022). However, for this study, there are 16 experts, and all of them have an active role in the whole project process, not just in the evaluation phase. So, the project required more evaluators due to the number of MOOCs. Moreover, we can assume the process of evaluating the usefulness of a cyberlearning environment in supporting the instructional design process and user satisfaction as success criteria (Alomari *et al.*, 2020).

Fourthly, this study strongly confirmed the usability premise "test early and often-not just once at the end of the development process" (Dumas & Redish, 1999, p. 22). Additionally, while summative usability is related to measures and metrics, formative usability is related to identifying and solving usability problems (de Lima Salgado *et al.*, 2018). So, like the CHE method, the HE method can be seen as a formative method (Lewis, 2014; de Lima Salgado *et al.*, 2018). On the other hand, the context of the MOOC project may also be a factor for experts' collaboration and iterative evaluation process because OLEs, QATs, and IDs aim to do their best to design 100 MOOCs throughout 2 years. Further MOOC quality is notably related to the perceived ease of use of the system (Gamage *et al.*, 2015; Azevedo & Marques, 2017; Yang *et al.*, 2017; Albelbisi *et al.*, 2021). That's why one of the key advantages of this approach can be allowing a more in-depth and detailed evaluation of MOOCs' usability.

5. Conclusion

The principal output of this case study is to set forth a holistic and collaborative usability testing approach which is named by Expert-Heuristic and Collaborative Approach (EHCA). While this approach can answer how the test studies of 100 MOOCs were completed in a short time like 2 years, it requires the intensity of cooperation and communication dynamics. Another critical contribution of this study is the usability evaluation approach suggestions based on a comprehensive MOOC project so that they can be reexamined and reusable by experts and researchers. EHCA treats the ID process as a collaborative and cumulative effort with quad-communication dimensions among designers, testers, QAs, and a distinctive, ongoing procedure based on immediate feedback and reliability. The “collaborative approach” which refers to the following features in itself was embraced: (1) More expert collaboration and gradual evaluation, (2) Immediate feedback and revised test procedure, and (3) More prototypes and fewer problems. So, this study can be a starting point for agile enthusiasts looking for a usability testing approach that is both comprehensive and rapid. It is possible that the usability approach and process strategies in the current study can potentially be beneficial for future MOOC testers and MOOC instructional design teams. Also, this usability test process will be possible to meet the need to elaborate Instructional Design Frameworks for MOOCs (Egloffstein, 2018). Although this study followed a systematic approach in order to evaluate the usability of pdMOOCs, more comprehensive processes might be used in future research studies. In this study, quality assurance members and instructional designers used MOOCs from the perspectives of end users. Future studies can recruit end learners during this process by engaging them in real tasks and obtaining their perspectives via quantitative measurements and qualitative techniques as well.

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