

# HYBRID MODEL FOR ASSESSING THE USABILITY OF A UNIVERSITY E-LEARNING PLATFORM: A CASE STUDY OF THE I-UH2C SYSTEM

MINA NKAILI<sup>1</sup>, MAJIDA LAAZIRI<sup>1,2,3</sup>, MOHAMED AZOUAZI<sup>1</sup>

<sup>1</sup> Laboratory of Information Technology and Modeling (LTIM), Faculty of Sciences Ben M'SIK Hassan II University, Casablanca, Morocco

<sup>2</sup> Higher National School of Art and Design (ENSAD), Hassan II University, Casablanca, Morocco

<sup>3</sup> DT2IA Team, M2S2I Laboratory, ENSET Mohammedia, Hassan II University, Casablanca, Morocco

E-mail : <sup>1</sup>amnkaili@gmail.com, <sup>2</sup>majidalaaziri@gmail.com, <sup>3</sup>azouazii@gmail.com

## ABSTRACT

Promoting distance learning is essential to support students fresh from high school in their transition to full autonomy, but this transition must be implemented in practice. Gradually integrating distance learning into their curriculum is an effective approach to developing their self-learning skills. This method enables them to learn how to manage their time and assess themselves, thereby strengthening their autonomy and their ability to adapt to a variety of learning situations.

This research aims to assess the usability and measurement of success and quality of learning platforms by developing a new evaluation approach based on two models and using a set of criteria developed from a quantitative and qualitative research methodology that was used at the Hassan II University in Casablanca and applied to the i-UH2C e-learning platform.

The results obtained underline the importance of implementing an evaluation model for e-learning platforms to help the university achieve these objectives and improve the performance of such distance learning platform to meet the needs of learners. These results also encourage a better understanding of the positive aspects of this approach, such as active engagement in distance learning, ease of use of the platforms, interactivity and satisfaction endorsed by the majority of students, as well as areas that could be improved, including infrastructure, socio-economic disparities, and the learner's socio-cultural environment.

**Keywords:** *Distance learning, platform, learning, evaluation, usability, quality, i-UH2C.*

## 1. INTRODUCTION

Distance learning in universities is a dynamic field that offers both opportunities and challenges. Evaluating the effectiveness of online programs is imperative to maintaining educational quality. In an age of continuous technological advances, ongoing research and evaluation play a vital role in shaping the future of distance learning [1]. This ensures that it remains a reliable and effective means of delivering higher education to a diverse and global student population.

In the twentieth century, ICT has revolutionized the field of education, and is increasingly being improved to respond appropriately to the needs of both teachers and learners. Various research studies have concluded that ICT has become an essential means of improving the quality of learning. Indeed, the advent of this mode of teaching has led to a

profound transformation, reflected in the rapid progression of technological development worldwide, which has prompted a rethink of education systems [2]. The aim of this rethink is to improve the quality of teaching and learning by encouraging the development of skills through the effective use of information and communication technologies (ICTs) [3]-[6].

Even more so, during the COVID-19 pandemic, the Moroccan Ministry of Education found itself having to take urgent measures and directives to deal with the repercussions of the Coronavirus pandemic on the country's education, training and scientific research system [7]-[9]. The main aim of these measures was to switch from face-to-face teaching to distance learning. These included the launch of a myriad of digital distance learning platforms (FOAD).

With a view to improving the engagement and involvement of learners and incorporating factors to ensure their success, Hassan II University in Casablanca has made an e-Learning platform available to its students as a response to the national digitization project in general and the acclamation of the strategic vision of the 2015-2030 education reform. However, critics of e-learning question whether technology-based modes of learning can deliver on their promise to meet the needs of non-traditional learners and offer better student learning than traditional teaching [1], [2], [10]. This is based on the fact that this platform makes it possible to relocate exchanges between teachers and students in time and space, and to diversify teaching and learning activities [11]. Whether it is to reinforce teaching programs, evaluate them or improve them, the integration of evaluation approaches that take account of the students' point of view is a crucial element in university policies aimed at guaranteeing the quality of teaching.

Numerous studies have been carried out with the aim of empirically verifying the impact of student involvement on development and learning. Much of the evidence from these studies supports the assertion that involving students in the evaluation of teaching has a positive and measurable effect on their development and learning. Although some studies have found negative effects, several have shown no measurable effect, due to the use of different research methodologies [12].

It is essential to take into account certain key elements that can make distance learning as effective as traditional teaching and that favor the integration of digital technology: training, the environmental context, individual variables, the importance of a community and a human support network, and the time that people are prepared to devote to it [13]. In addition, teachers must be well equipped with the necessary methods for rational and effective use of these technologies in the teaching-learning process [14].

However, in rural areas of Morocco, the usability of learning platforms is limited by underdeveloped infrastructure and unsatisfactory network connectivity, which contributes to widening inequalities in access. Systems such as Moodle or Blackboard are often considered unsuitable for use in such resource-constrained contexts [15] and do not always provide satisfactory support solutions for users in precarious environments.

In this context, the Hassan II University of Casablanca (UH2C) has introduced a set of indicators enabling regular evaluation of its

profitability, both internally and externally, covering a variety of aspects such as governance, training and research. UH2C is committed to progress and aims to position itself on the road to excellence in education, research and innovation, while raising its profile nationally and internationally, in an approach that is both ecological and inclusive. To this end, the university has put in place a digital development strategy based on appropriate technological tools and a more coherent system of digital governance [16]. One of these strategies is the implementation of the i-UH2C distance learning platform [17].

i-UH2C aims to offer a complete digital solution to meet the needs of training, research and administrative management, while facilitating access to an interactive and flexible distance learning environment. The platform's services include distance learning, collaboration tools, pedagogical monitoring, teaching resources, administrative management, tools for scientific research and technical support services.

The objective of this study is to evaluate the usability and to measure the success and quality of the i-UH2C distance-learning platform at Hassan II University of Casablanca by proposing a hybrid model. This model is based on Nielsen's model [18], used for assessing system usability, and the DeLone and McLean model [19], designed to measure success and quality. It also incorporates a set of evaluation criteria specifically adapted to distance-learning platforms.

## 2. LITERATURE REVIEWS

In this section, we present different definitions of usability and the evaluation of the quality of a platform, identifying several attributes from various models.

### 2.1. i-UH2C platform

The i-UH2C platform is a device designed by Hassan II University in Casablanca to facilitate student access to distance learning in a flexible manner. It is characterized by its accessibility to education; i-UH2C enables students from different geographical backgrounds to access teaching materials and online courses. It offers them all types of content, including videos, PDF documents, forums [20], [21]. ...etc.

The services offered by the i-UH2C platform include (Figure 1):

- **Accessibility:** The platform allows students to access courses, learning

- resources and course materials from anywhere, at any time.
- **Interactive E-Learning:** It offers e-learning modules, including videos, interactive quizzes and discussion forums to encourage interaction between students and teachers.
  - **Course Management:** Teachers can create and manage their courses, assign homework and monitor student progress via integrated assessment tools.
  - **Technical Support:** The platform offers technical support to help users solve problems related to accessing and using resources.
  - **Learning Resources:** Access to digital libraries, academic articles and other resources to enrich learning.
  - **Communication and Collaboration:** Messaging tools, discussion forums and videoconferencing to encourage communication between peers and with teachers.

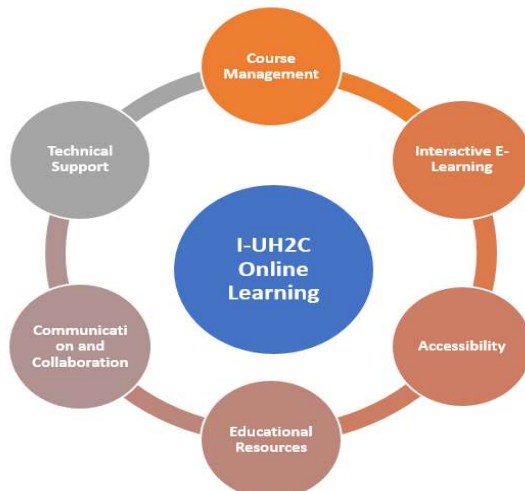


Figure 1: The different types of service on the i-UH2C platform [20], [21].

## 2.2. Usability Evaluation of E-Learning Platforms

Usability is a central concept in the field of human-computer interaction (HCI) and is defined as “the extent to which a product can be used by specific users to achieve defined goals with effectiveness, efficient to use and satisfaction in a specified context of use [22], [23]. According to Nielsen [24], usability is based on five main dimensions: **Easy to learn, efficient to use, easy to remember, few errors and subjectively pleasing.**

The work of Shackel [25] and Nielsen [24] is one of the first significant contributions to the

formalization of usability attributes. These attributes include: efficacy, efficiency, satisfaction and Easy to learn.

Other researchers argue that usability also includes contextual and emotional dimensions, incorporating elements of user experience (UX) [25]-[27].

The usability of e-learning platforms has become a crucial research topic due to the increase in distance learning. The author [28] has developed a specific model for e-learning environments, stressing the importance of criteria such as learner motivation, navigation, interactivity and system flexibility. Studies show that the usability of an e-learning platform directly influences student success and engagement. [28].

In a more recent context, the authors [29] propose an integrated model for the evaluation of e-learning systems, which takes into account criteria such as the quality of the teaching resources, the adaptability of the user interface and the effectiveness of the technical support.

In our study of the evaluation of the i-UH2C platform, we based ourselves on the recommendations of the Nielsen model [18], which proposed an evaluation framework based on heuristics, which makes it possible to evaluate the user interface of a system through criteria such as adaptability, flexibility and user-friendliness. This framework is widely used for rapid usability testing, particularly in online platforms.

## 2.3. Jakob Nielsen's model [18]

Jakob Nielsen's model [18] is one of the most influential and widely used theoretical frameworks for assessing the usability of interactive systems. In his seminal work [18], Jakob Nielsen proposed a model centered on the evaluation of usability through a series of heuristic criteria or principles that make it possible to assess the effectiveness of an interactive system. For Nielsen [18], usability is part of a broader framework that he calls ‘system acceptability’. Acceptability has two dimensions: practical acceptability (considering the intention that the system makes it possible to achieve) and social acceptability (looking at the context in which the system is used). According to Nielsen's system acceptability model, utility and usability are two attributes derived from the system's practical acceptability.

Nielsen's model provides a clear structure for evaluating usability attributes. According to Nielsen [18], the main usability attributes are (Figure 2):

- **Easy to learn:** The interface must be intuitive so that users can quickly understand how it works without intensive training.
- **Efficient to use:** Experienced users should be able to complete their tasks quickly and efficiently.
- **Easy to remember:** After a period of non-use, users should be able to return to their normal browsing habits effortlessly.
- **Few errors:** The system must prevent user errors and enable them to be corrected quickly and easily when they occur.
- **Subjectively pleasing:** The overall experience must be pleasant, encouraging users to continue using the system.

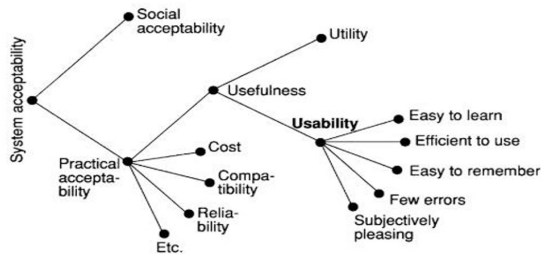


Figure 2: Usability according to Nielsen's recommendations [18].

These attributes are applicable to various types of digital platforms, and their evaluation can be carried out using a variety of methods, such as user tests, heuristic evaluations or questionnaires.

The use of Nielsen's model for evaluating e-learning platforms has been widely documented. In one study, the authors [30] applied Nielsen's model to assess user satisfaction with e-learning platforms, highlighting the importance of a consistent and intuitive interface for maximizing learner engagement and learning efficacy [30].

#### 2.4. Measuring and evaluating the quality of e-learning platforms

Evaluating the quality and success of digital platforms, particularly in the context of information systems, e-learning platforms and online services, is essential for improving the user experience and achieving organizational objectives. Various theoretical models and methodologies have been developed to evaluate these platforms across a range of criteria.

The DeLone and McLean model [19] is one of the most widely cited theoretical frameworks for measuring the success of information systems. This model was updated in 2003 to incorporate

technological developments, in particular the emergence of the Internet and digital platforms. It identifies six key dimensions for evaluating the success of information systems, including system quality, information quality, service quality and user satisfaction.

The model [31], [32] is another popular method used to assess the service quality of digital platforms. It is based on five main dimensions of service quality such as tangibility, reliability, responsiveness, assurance and empathy. These dimensions can be applied to digital platforms to measure the service quality offered, whether in terms of technical support or the overall user experience. Studies [33] have used the model [31], [32] to assess the quality of online services and concluded that improving the dimensions of reliability and responsiveness had a significant impact on user satisfaction.

E-learning platforms are complex interactive systems that require specific evaluations to ensure their success and widespread adoption [31].

Integrated models such as those in [29], [34] have also been used to assess the quality and success of digital platforms. These models highlight the factors that influence the adoption of technologies by users, such as perceived usefulness and ease of use.

In assessing the quality and success of our i-UH2C platform, we based ourselves on the DeLone and McLean model [19], which is considered to be one of the most powerful tools for assessing the systems and services quality, while Nielsen's usability criteria are essential for understanding user satisfaction.

#### 2.5. DeLone & McLean Model [19]

The information systems success model developed by DeLone and McLean [19] is a widely used conceptual framework for assessing the effectiveness and success of information systems. This model was updated in 2003 to include adjustments linked to technological advances, in particular the rise of on-line systems and digital platforms. The model is applied in a variety of contexts, including the evaluation of information management systems, e-learning platforms, and other digital systems.

DeLone and McLean have identified six interdependent dimensions, all of which influence the overall success of a system. These dimensions are (Figure 3):

- **System quality:** The system's technical performance, accessibility, reliability and efficiency.
- **Information quality:** The relevance, accuracy and timeliness of the information provided by the system.
- **Service quality:** The support offered by the service, including responsiveness, empathy and reliability of interactions with users.
- **Use:** The degree to which end-users use and adopt the system.
- **User satisfaction:** The positive perception of users after using the system.
- **Individual and organizational impact:** The effect of the system on the performance of individuals and organizations.

These six dimensions are interconnected, and an improvement in one can lead to an improvement in others.

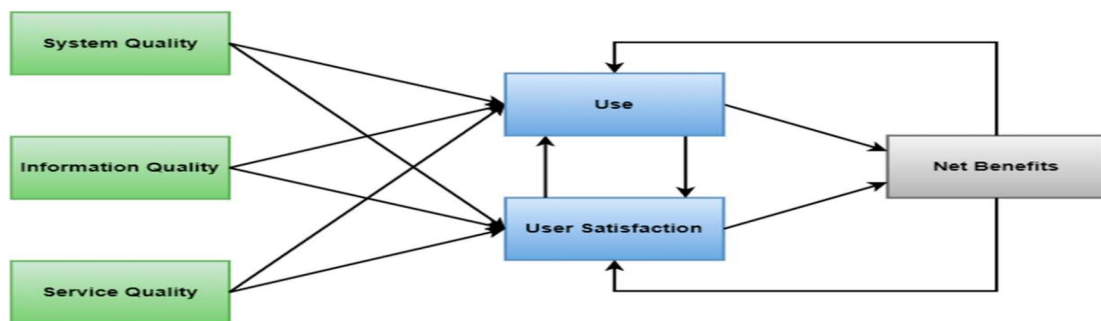


Figure 3 : The quality assessment model [19].

Much research has adopted the DeLone and McLean model for evaluating information systems [35],[36], particularly in e-learning platforms. The authors [37] have shown that this model can be used to evaluate the performance of e-learning platforms by analysing the user experience, content quality and service quality (technical and pedagogical support). Student satisfaction and the impact on their academic performance are also essential indicators in this context.

### 3. RESEARCH METHODOLOGY

Like other universities, in a drive to achieve excellence in training, education, scientific research and innovation, Hassan II University in Casablanca has introduced a set of indicators to enable ongoing assessment of its internal and external governance [21], [38]. With this in mind, the university has introduced a digital governance strategy, optimizing coherence and the use of more relevant

digital tools. In particular, the implementation of the i-UH2C platform dedicated to distance learning and various educational, learning, scientific research and messaging services [39].

Given that learners are at the heart of the educational experience and in order to measure and evaluate the use of the (i-UH2C) distance learning platform [40], it is crucial to understand their point of view. Following an approach to the evaluation of teaching by students [12], which emphasizes the importance of taking account of students' opinions, perspectives and experiences in order to evaluate and improve teaching programs and practices, a study based on quantitative and qualitative analysis was set up.

To this end, we chose as our measurement tool a questionnaire integrated into Google Forms, based on random sampling, using links distributed via email. Before proceeding with data collection, we contacted the students to verify their availability and their agreement with the purpose of the study.

Our exploratory survey was conducted among a sample of 110 graduates of different levels, genders and institutions affiliated with Hassan II University in Casablanca, of whom 97 responded. This study was approved by the ethics committee of Hassan II University. Participant data was authenticated after being anonymised to ensure confidentiality.

As part of good academic governance to improve distance learning and optimize the user experience for learners, this tool measures quality and evaluates usability of the i-platformUH2C is based on usability attributes recommended by Nielsen [41]. These attributes include ease to learn, efficient to use, easy to remember, few errors and subjectively pleasing of the platform. It is also based on the quality criteria defined by DeLone and McLean [19], Which suggest that the success of a system is measured by the quality of its operation, the information quality, the service quality, use, user satisfaction, as well as individual (learner) and organizational impact (on the university). This

study led to the proposal of a model for assessing usability and measuring success and quality of learning platforms using a set of criteria developed from the survey (questionnaire and semi-directed interviews), applied to the i-UH2C platform of Hassan II University in Casablanca (Table1).

measurement recommendations (Delone and Mclean) [42], the qualitative and quantitative results of this analysis are expressed as percentages for each response presented below (figure 4, 5 and 6).

**4.1. Usability assessment of the i-uh2c platform**

Table 1 : Proposed Hybrid Model for Usability Evaluation and Quality Measurement.

Proposed Evaluation Model for Usability, Success, and Quality in E-Learning Platforms			
Evaluation of the usability of the platform (Nielsen [2])	Easy to learn	Evaluation and measurement criteria (Survey)	- The compressibility of courses integrated in the platform - The interactivity of students with courses integrated in the platform
	Efficient to use		- Speed of down loading course documents - Fast operation / Completion of tasks
	Easy to remember		- Ease of understanding how to use the platform - Frequent and usual consultation of the platform
	Few errors		- Error messages encountered during course tracking - Technical issues with platform access resolved
	Subjectively pleasing		- Degree of appreciation of the platform - Degree of platform satisfaction with the learner's need
Evaluation of the quality of the platform (DeLone and McLean) [3]	System quality	- Availability anytime, anywhere - Variety of learning formats - Organization and modularity of content - Management of users and rights - Flexible monitoring and evaluation	
	Information quality	- Reliability and relevance of information - Ease of navigation and information retrieval - Learning measurability - Clarity and precise explanation of information	
	Service quality	- Quality of teaching resources - Platform response time - Course content update - Security of personal data and information - Interaction with the teacher	

**4. ANALYSIS AND DISCUSSION**

The objective of this study is to evaluate the usability and quality of performance of the distance learning platform of hassan ii university (i-uh2c), based on a survey conducted among 97 graduates, from different levels, gender and institutions under the Hassan II university of Casablanca. Users are invited to answer a series of related questions according to a set of criteria based on the nielsen usability recommendations [18] and quality

**4.1.1. Target audience and sampling**

The results obtained from the 97 people interviewed, 52.6% are men and 47.4% are women. We find in our sample that the gender parameter impacts the use of e-learning platforms since the number of users is lower than the number of users, which does not agree with the results of a systematic review meta-analysis, the lack of significant gender differences in e-learning outcomes, with the exception of a few countries. In the UK, women outnumber men by a considerable margin. In austria, india and mixed countries such

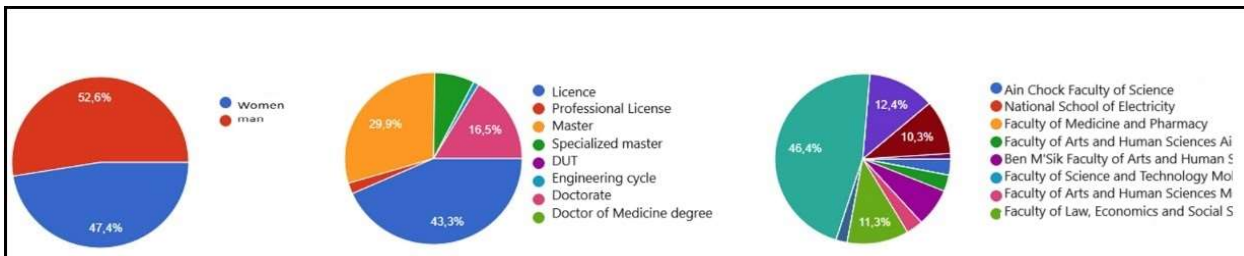


Figure 4 : Target audience results and sampling

as Chile and Spain, women have a more positive attitude to online learning than men. In the US, women have significantly higher self-efficacy than men [43]. This is strongly due to socio-cultural factors influenced by a male Moroccan mindset rather than the gender factor.

The majority of respondents are undergraduate

easy and 30.9% found it very easy. About 84% expressed, with two different degrees, the easy to learn the platform, and this can only be explained by the importance of digital skills that have increased considerably in students. So the Hassan II University of Casablanca encourages the development and evolution of this approach that has

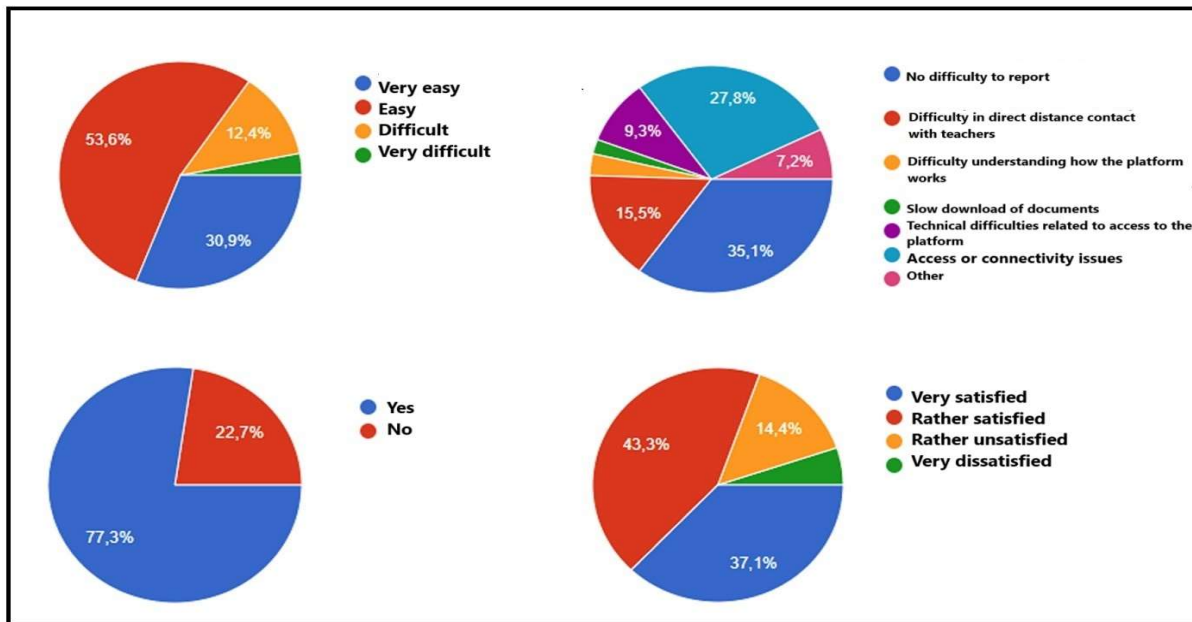


Figure 5 : Usability assessment results for the i-uh2c platform

students (43.3%), 29.9% are master's students and 16.5% are phd students. For this question, it is clear that the platform is more used among undergraduate students and used with moderation among those of master's and doctoral. This can be explained by the fact that during the master's cycle students are really engaged in the construction of learning while the bachelor's students consult the courses prepared by the teachers on the platforms.

At the level of the various institutions of the Hassan II University of Casablanca. 46.6% are students of the FSBM, while 12.4% belong to the FSJESA. The study also highlighted the representation of different faculties, with 46.6% of students from FSBM and 12.4%, 11.3% and 10.3% are successively from FSJESAS, FSJES ac and ENSEM.

#### 4.1.2. Usability assessment of the i-uh2c platform

Based on the results of the i-uh2c platform usability based on Nielsen's recommendations, the study explored students' perceptions of the easy to learn of the platform. In particular, 53.6% found it

become an essential aspect of students' daily lives. However, the existence of the 12.4% who found this use difficult can be attributed to sociocultural factors.

The results also show that the learning process is essentially based on interaction between the learner and tutor and the learner with peers. The content of courses requires, first, an understanding and assimilation by the learner who must review and restructure his individual understandings " [44].

The interactivity between student and teacher in distance learning is considered a crucial factor for student satisfaction and quality of learning [45].

The majority of students (77.3%) in this study consider that courses are interactive and understandable, which testifies to the progress and quality of distance learning at our university.

For the efficiency to use and errors of the i-uh2c platform, 35.1% reported no difficulties. 27.8% had problems with internet access or connectivity. The difficulties encountered during distance learning were also documented. While 35.1% reported no difficulties, 27.8% had problems with internet

access or connectivity. This shows that despite the various initiatives taken by Moroccan universities to integrate ICT into higher education, some students still have obstacles and difficulties in using these new technologies. This can be analyzed by the fact that teachers now transmit knowledge traditionally and face-to-face, and that not all students have evolved in terms of ICT exploitation [46], [47]. In addition, parallel to these actions, obstacles can be identified related to the reluctance to adopt new teaching methods, probably due to a lack of external motivation, as well as the lack of skills in the educational use of information and communication technologies (ICT). In addition, infrastructure constraints such as availability of equipment, software and internet connection are also to be taken into account [48].

The study also highlighted the platform memorability, with results showing that 77.3% of students found it memorable, and 22.7% considered it difficult to memorize.

For the evaluation and satisfaction of the i-uh2c platform, 37.1% of students are very satisfied, 43.3% rather satisfied, 14.4% rather dissatisfied.

When assessing overall satisfaction, the study showed that 37.1% of respondents were very satisfied, 43.3% rather satisfied and 14.4% dissatisfied. This suggests that there are areas for improvement to further increase student

physical facilities and a good quality psychosocial environment [50].

Currently, the knowledge economy has focused on interactive software that characterizes online learning platforms. The choice of these platforms, which are the cornerstone of initial and continuing training systems, is not obvious to most users. This requires equipping these users with the methodology and benchmarking tools to help them make a relevant choice of the appropriate platform for their learning [51]. Where to describe a platform user profile [48].

#### 4.2. Evaluation of the quality and success of the i-uh2c platform

##### 4.2.1. Target audience and sampling

The study also looked at measuring the quality and success of the i-UH2C platform through semi-structured interviews with teachers, administrators, and learners (20 interviewees in total). This was based on DeLone and Mclean's recommendations on the three key areas of quality: system quality, information quality, and service quality.

##### 4.2.2. Results after coding the interviews

The results of the interview coding on the quality of the i-UH2C platform show that it offers users the opportunity to connect and learn according to their schedule, without restriction of place or time. Courses and resources are organized in separate

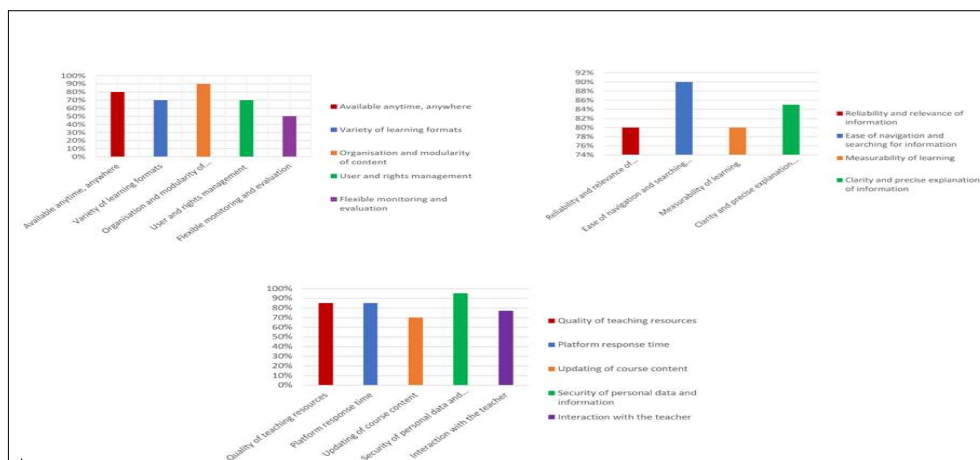


Figure 6 : i-uh2c platform quality measurement results

satisfaction.

For the majority of students, satisfaction with ICT integration was relatively good. This is the case with several studies in this direction [49];

Satisfaction with e-learning and the introduction of electronic technologies is higher if there are

modules, allowing users to choose and access content in the order that suits them best. The platform also offers a variety of learning formats to meet users' learning preferences and facilitate knowledge acquisition. It allows flexible user management, offering adapted roles and permissions (student, teacher, administrator) to

meet various learning and administration configurations.

For information quality, thanks to the i-uh2c platform, learners have reliable, relevant, clear and measured information based on the ability of learners to progress through their learning path.

Regarding the service quality, the study showed that the platform is a relevant learning tool and provides services and functionalities corresponding to users' expectations in terms of the quality of educational resources, response time of the platform, course content update and security of personal data and information.

## 5. CONCLUSION

Distance learning in universities is a changing sector, presenting both opportunities and challenges. It is essential to assess the efficacy of the systems in place to improve their usability and quality, in order to ensure meaningful learning. Our research focused on the satisfaction of students from different institutions of the Hassan II University in Casablanca. First, we analyzed the results of a survey conducted among 97 students at this university, to assess the usability of the i-UH2C platform dedicated to distance learning. We have based this on a study by Nilsen [2].

To enhance the relevance of the system, it is crucial to assess the quality of the i-UH2C e-learning platform. To this end, and referring to the model of Delon and McClone [3], we conducted a second study through semi-structured interviews with various users of the i-UH2C platform. The results of these two studies led us to propose a holistic model.

The application of this proposed model allows not only to evaluate the usability and performance of e-learning platforms, but also to identify areas for improvement to strengthen the user experience and maximize organizational success.

This study highlights the potential of a platform such as i-UH2C to revolutionise higher education in Morocco by reducing inequalities in access to education through improved quality and user-friendliness of e-learning services tailored to 'vulnerable' environments (rural areas, etc.), with a focus on non-traditional students. However, to achieve this goal, several key factors must be addressed, including strengthening digital infrastructure, training teachers, importing new technologies, etc. All of this could give i-UH2C considerable advantages in becoming a model for

other universities. Finally, the study advocates for the widespread adoption of best practices identified at the national level, as well as the implementation of public policies aimed at strengthening digital access in marginalised regions.

In perspective, we will look at the study of e-assessment of students during internship periods using the i-UH2C e-learning platform.

## 6. Limitations and recommendations for future research

In this study, the majority of respondents (80.4%) found i-uh2c easy to use and satisfactory, although difficulties remain, particularly in terms of memorisation (22.7%) and technical access (27.8%), while several studies conducted in developing countries on e-learning show that infrastructure and user training are key factors for satisfactory use [52]. Certain limitations can be noted, such as the sample being restricted to a single university, although it is diversified by the inclusion of students from different courses. It is also regrettable that data was not collected on socio-cultural factors (e.g. reluctance to embrace digital technology), which would merit further study. future research should better incorporate longitudinal approaches and comparative field studies, which would provide better input for evaluation models.

## REFERENCES:

- [1] C. G. Keramidas, "Are Undergraduate Students Ready for Online Learning? A Comparison of Online and Face-to-Face Sections of a Course," *Rural Spec. Educ. Q.*, vol. 31, no. 4, pp. 25–32, Dec. 2012, doi: 10.1177/875687051203100405.
- [2] M. Mastafi, "Intégration et usages des technologies de l'information et de la communication (TIC) dans le système éducatif marocain: contraintes, obstacles et opportunités," 2014.
- [3] K. Benmoussa, M. Laaziri, S. Khouliji, and M. L. Kerkeb, "Intelligent System for the use of the Scientific Research Information System-Moroccan Information System for Scientific Research (SIMARECH); intelligent system; E-learning systems; learning process; interactive learning environments; intelligent tutoring systems," 2018.
- [4] M. Laaziri, K. Benmoussa, S. Khouliji, and K. M. Larbi, "Integration of an Intelligent System for a University Governance Information System," Springer, Cham, 2019, pp. 379–390. doi: 10.1007/978-3-030-11196-

- 0\_33.
- [5] M. Laaziri, K. Benmoussa, S. Khouliji, M. L. Kerkeb, and A. El Yamami, "Implementation of an intelligent tutoring system for the use of university governance information systems," in *Proceedings of the 3rd International Conference on Smart City Applications - SCA '18*, 2018, pp. 1–7. doi: 10.1145/3286606.3286819.
- [6] M. Laaziri, K. Benmoussa, A. Mouchtachi, and A. E. A. El Amrani, "Intelligent System for the Professional Insertion of Graduates in the Moroccan Digital University," *Lect. Notes Networks Syst.*, vol. 926 LNNS, pp. 461–474, 2024, doi: 10.1007/978-3-031-54664-8\_39.
- [7] S. Ardchir, Y. Ouassit, S. Ounacer, M. Y. El Ghomari, and M. Azzouazi, "An Integrated Ensemble Learning Framework for Predicting Liver Disease," *Int. J. online Biomed. Eng.*, vol. 19, no. 13, pp. 138–152, 2023, doi: 10.3991/IJOE.V19I13.41871.
- [8] A. Daif, S. Ounacer, S. Ardchir, M. Ghazouani, and M. Azzouazi, "EXPLORING THE CAPABILITIES OF DEEP LEARNING FOR ADVANCING CREDIT CARD FRAUD DETECTION: A REVOLUTIONARY APPROACH," *J. Theor. Appl. Inf. Technol.*, vol. 31, p. 24, 2023, Accessed: Oct. 16, 2024. [Online]. Available: [www.jatit.org](http://www.jatit.org)
- [9] M. El Assad, S. Nouh, I. C. Idrissi, S. E. K. Alaoui, B. Aylaj, and M. Azzouazi, "A new efficient decoder of linear block codes based on ensemble learning methods," *IAES Int. J. Artif. Intell.*, vol. 13, no. 2, pp. 2236–2246, Jun. 2024, doi: 10.11591/ijai.v13.i2.pp2236-2246.
- [10] Y. Chemlal and M. Azouazi, "Implementing quality assurance practices in teaching machine learning in higher education," *Math. Model. Comput.*, vol. 10, no. 3, pp. 660–667, 2023, doi: 10.23939/MMC2023.03.660.
- [11] D. Peraya, "La formation à distance: un dispositif de formation et de communication médiatisées. Une approche des processus de médiatisation et de médiation," *Calidoscòpio*, vol. 4, no. 3, pp. 200–204, 2006,
- [12] K. Hernandez, S. Hogan, C. Hathaway, and C. D. Lovell, "Analysis of the Literature on the Impact of Student Involvement on Student Development and Learning: More Questions than Answers?," *NASPA J.*, vol. 36, no. 3, pp. 184–97, 1999.
- [13] C. Cleary, "Formation et pratiques d'enseignement en questions L'intégration des TIC dans l'enseignement secondaire".
- [14] R. M. Ziphorah, "Information and Communication Technology Integration: Where to Start, Infrastructure or Capacity Building?," *Procedia - Soc. Behav. Sci.*, vol. 116, pp. 3649–3658, Feb. 2014, doi: 10.1016/j.sbspro.2014.01.818.
- [15] A. H. Bouchaib, H. Mezouara, et B. Miloud, « Enseignement à distance au Maroc : défis et opportunités pour réaliser l'équité, la qualité et l'amélioration du système éducatif », E, 2024.
- [16] K. Oulmaati, S. Ezzahri, and K. Samadi, "The Use of ICT in the learning process among the students of History and Civilization at Abdelmalek Essaadi University, Morocco," *Int. J. Sci. Eng. Res.*, vol. 8, no. 2, pp. 972–979, 2017,
- [17] K. Benmoussa, M. Laaziri, A. E. A. El Amrani, and M. Diouri, "The Transition of the Moroccan University to a Digital and Intelligent University: An Overview," *Lect. Notes Networks Syst.*, vol. 926 LNNS, pp. 435–445, 2024, doi: 10.1007/978-3-031-54664-8\_37.
- [18] J. Nielsen and R. Mack, *Heuristic Evaluation*. 1994. doi: 10.1089/tmj.2010.0114.
- [19] W. H. DeLone and E. R. McLean, "The DeLone and McLean model of information systems success: A ten-year update," *J. Manag. Inf. Syst.*, vol. 19, no. 4, pp. 9–30, 2003, doi: 10.1080/07421222.2003.11045748.
- [20] Université Hassan II, "L'UH2C donne un coup d'accélérateur à sa stratégie numérique - MapCasablanca," May 18, 2020. <http://www.mapcasablanca.ma/fr/luh2c-donne-un-coup-daccelerateur-a-sa-strategie-numerique/>
- [21] M. Idriss, "Projet De Developpement De L ' Université Hassan Ii Casablanca: Plan D ' Action 2013-2017," 2017.
- [22] ISO, "ISO 9241-11," *Ergonomic requirements for office work with visual display terminals (VDTs) -- Part 11: Guidance on usability*. p. 22, 1998.
- [23] Lazar, J., Feng, J. and Hochheiser, H. (2017) *Research Methods in Human-Computer Interaction*. 2nd Edition, Morgan Kaufmann, Cambridge. - References - Scientific Research Publishing." <https://www.scirp.org/reference/referencespapers?referenceid=3086682>.
- [24] Jakob Nielsen, « Usability engineering », p. 358, 1993.
- [25] B. Shackel, "Usability - Context, framework,

- definition, design and evaluation,” *Interact. Comput.*, vol. 21, no. 5–6, pp. 339–346, 2009, doi: 10.1016/J.INTCOM.2009.04.007.
- [26] K. Benmoussa, M. Laaziri, S. Khouliji, M. L. Kerkeb, and A. El Yamami, “Evaluating the Usability of a Moroccan University Research Management Web Platform,” in *The 12th International Conference Interdisciplinarity in Engineering*, 2019, vol. 32, pp. 1008–1016. doi: 10.1016/j.promfg.2019.02.315.
- [27] K. Benmoussa, M. Laaziri, S. Khouliji, M. L. Kerkeb, and A. El Yamami, “Enhanced model for ergonomic evaluation of information systems: application to scientific research information system,” vol. 9, no. 1, pp. 683–694, 2019, doi: 10.11591/ijece.v9i1.pp.683-694.
- [28] P. Zaharias and A. Poylymenakou, “Developing a Usability Evaluation Method for e-Learning Applications: Beyond Functional Usability,” *Intl. J. Human-Computer Interact.*, vol. 25, no. 1, pp. 75–98, Jan. 2009, doi: 10.1080/10447310802546716.
- [29] D. Al-Fraihat, M. Joy, R. Masa’deh, and J. Sinclair, “Evaluating E-learning systems success: An empirical study,” *Comput. Human Behav.*, vol. 102, pp. 67–86, Jan. 2020, doi: 10.1016/J.CHB.2019.08.004.
- [30] H. H. Turhangil Erenlergil Erenler, “Heuristic Evaluation of E-Learning,” *Int. J. Organ. Leadersh.*, vol. 7, no. 2, pp. 195–210, Apr. 2018, doi: 10.33844/IJOL.2018.60235.
- [31] W. Kettinger and C. Lee, “Perceived Service Quality and User Satisfaction with the Information Services Function\*,” *Decis. Sci.*, vol. 25, no. 5–6, pp. 737–766, 1994, doi: 10.1111/j.1540-5915.1994.tb00829.x.
- [32] T. P. van Dyke, L. A. Kappelman, and V. R. Prybutok, “Measuring Information Systems Service Quality: Concerns on the Use of the SERVQUAL Questionnaire,” *MIS Q.*, vol. 21, no. 2, p. 195, 1997, doi: 10.2307/249419.
- [33] R. Ladhari, “Developing e-service quality scales: A literature review,” *J. Retail. Consum. Serv.*, vol. 17, no. 6, pp. 464–477, Nov. 2010, doi: 10.1016/j.jretconser.2010.06.003.
- [34] V. Venkatesh, M. Morris, G. Davis, and F. Davis, “User Acceptance of Information Technology: Toward a Unified View,” *MIS Q.*, 2003, doi: 10.2307/30036540.
- [35] K. Benmoussa, M. Laaziri, S. Khouliji, M. L. Kerkeb, and A. El Yamami, “Impact of System Quality, Information Quality and Service Quality on the efficiency of information system,” in *Proceedings of the 3rd International Conference on Smart City Applications*, 2018, no. 41. doi: 10.1145/3286606.3286818.
- [36] K. Benmoussa, M. Laaziri, S. Khouliji, and M. L. Kerkeb, “Enhanced Model for Measuring Information Systems Success,” Springer, Cham, 2019, pp. 713–726. doi: 10.1007/978-3-030-11196-0\_59.
- [37] S. Petter, W. DeLone, and E. McLean, “Measuring information systems success: models, dimensions, measures, and interrelationships,” *Eur. J. Inf. Syst.*, vol. 17, no. 3, pp. 236–263, 2008, doi: 10.1057/EJIS.2008.15.
- [38] Allouli, *Guide de déconfinement-université Hassan II de casablanca*. 2020.
- [39] UH2C, “officiel website-Université Hassan 2 de Casablanca – Université Hassan 2 de Casablanca.” <http://www.univh2c.ma/>
- [40] T. Andrews and B. Tynan, “Distance learners: Connected, mobile and resourceful individuals,” *Australas. J. Educ. Technol.*, vol. 28, no. 4, pp. 565–579, May 2012, doi: 10.14742/AJET.828.
- [41] J. Nielsen, “Heuristic Evaluation,” in *Usability inspection methods*, 2011, pp. 25–62.
- [42] S. Petter, W. DeLone, and E. McLean, “Measuring information systems success: Models, dimensions, measures, and interrelationships,” *Eur. J. Inf. Syst.*, 2008, doi: 10.1057/ejis.2008.15.
- [43] Z. Yu and X. Deng, “A Meta-Analysis of Gender Differences in e-Learners’ Self-Efficacy, Satisfaction, Motivation, Attitude, and Performance Across the World,” *Front. Psychol.*, vol. 13, p. 897327, May 2022, doi: 10.3389/FPSYG.2022.897327/BIBTEX.
- [44] A. Hantem, “Les conditions de l’enseignement à distance pendant le confinement dû au COVID19: Cas de l’enseignement supérieur au Maroc”,
- [45] Y. Ha and H. Im, “The role of an interactive visual learning tool and its personalizability in online learning: Flow experience,” *Online Learn. J.*, vol. 24, no. 1, pp. 205–226, 2020, doi: 10.24059/OLJ.V24I1.1620.
- [46] B. Riyami, K. Mansouri, and F. Poirier, *ICT as Learning Tools and Collaborative Work Facilitators in the Moroccan University Educational System: Summary, Review and Optimization Approach*, CSEDU-8th In... 2016.

- [47] Bouchai and Riyami, “Analyse des effets des TIC sur l’enseignement supérieur au Maroc dans un contexte de formation en collaboration avec une université française”,
- [48] N. Belarbi, A. Namir, N. Chafiq, and M. Talbi, “Technical quality of a mobile SPOC,” *Int. J. Interact. Mob. Technol.*, vol. 12, no. 5, pp. 140–151, 2018, doi: 10.3991/IJIM.V12I5.9093.
- [49] N. Belarbi, N. Chafiq, M. Talbi, A. Namir, and E. Benlahmar, “User Profiling in a SPOC: A method based on User Video Clickstream Analysis,” *Int. J. Emerg. Technol. Learn.*, vol. 14, no. 01, pp. 110–124, Jan. 2019, doi: 10.3991/IJET.V14I01.9091.
- [50] M. Todorova, D. Karamanska, E. Koleva, et L. Koleva, « E-LEARNING Ergonomic criteria for evaluating the quality of e-learning ».
- [51] V. Devedžić et I. Kraljevski, « E-learning benchmarking: methodology and tools review ».
- [52] Al-Fraihat, D., Joy, M., Masa'deh, RE, & Sinclair, J. (2020). Évaluation du succès des systèmes d'apprentissage en ligne : une étude empirique. *Computers in human behavior*, 102, 67-86.