

# User Evaluation of UbiQuitous Access Learning (UQAL) Portal: Measuring User Experience

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**Abstract**—The goal of user experience (UX) research in human-computer interaction is to understand how humans interact with technology. This paper aimed to evaluate the interface and user experience of UbiQuitous Access Learning Portal (UQAL) and make recommendations for the system interface. UQAL Portal is an e-learning web portal that teaches a targeted group of users how to start a business or an online business using an e-learning portal. The portal will be used to search for business-related information, among other things. The User Experience Questionnaire (UEQ) is used to evaluate user experience. The interface is evaluated using a heuristic evaluation technique based on Nielsen's ten heuristics. According to the UEQ results, the average score for each aspect in 30 UQAL users is: Attractiveness aspect: 1.77; Perspicuity aspect: 2.20; Efficiency aspect: 2.30; Dependability aspect: 1.73; Stimulation aspect: 0.63; and Novelty aspect: 1.27. A comparison of the average score in the dataset product of UEQ Data Analysis Tool revealed that the Perspicuity, Efficiency, and Dependability aspects of UQAL belonged to the Excellent category. The Attractiveness and Novelty aspects could be categorized as Good, and its stimulation could be categorized as Below Average. Four evaluators participate in the heuristic evaluation, which tests all user categories in UQAL. The findings of this study can be used as a suggestion and reference for UQAL Portal improvement.

**Keywords**—User experience questionnaire; user experience; user interface; heuristic evaluation

## I. INTRODUCTION

Because of the rapid evolution of digital technologies, new forms of human interaction and experiences are becoming possible. To achieve a positive user experience with technology, service providers must ensure a high user experience quality. Nowadays, users' demand for products is no longer limited to functional satisfaction but also includes psychological needs [1], which involve emotional, intellectual, and sensual aspects [2]. To date, user experience (UX) research has attempted to comprehend how humans interact with technologies such as computers, mobile phones, telecommunications networks, and other digital systems [3]. Similarly, user experience (UX) is a critical factor in the commercial success of digital products. It appears that the new UX movement is gaining traction among academics and industry practitioners who are looking for innovative approaches to improve the experiential qualities of technology use.

As a result, this paper aims to understand user experience better when interacting with technologies by measuring user experience while interacting with the UQAL Portal. UQAL is an abbreviation for UbiQuitous Access Learning. The UQAL Portal will bring a Digital Transformation for learners to access business-related information from the e-learning portal and for educators to supply business-related information into the e-learning portal. The B40 group in Malaysia is the target audience for the UQAL Portal. The B40 group represents the bottom 40% of income earners. The goal is to assist the B40 group in learning how to start a business or online business using the UQAL Portal.

Furthermore, the portal will be used as a platform for the B40 group to search for business-related information, among other things. UQAL is evaluated based on its user interface and user experience, and the interface is evaluated using a heuristic evaluation technique. A User Experience Questionnaire (UEQ) assesses UQAL's user experience. The evaluation of the user experience can provide feedback about the product or service and facilitate product improvements and acceptance among the targeted users.

The rest of the paper is structured as follows: Section II identifies the Experience Evaluation Methods (UXEMs) used to evaluate and measure user experience in previous papers. In Section III, the paper discusses UX evaluation methods on the UQAL Portal. Section IV discusses the findings, followed by the conclusion, which concludes and provides insight for the improvement and future direction of the UQAL Portal.

## II. BACKGROUND WORK

### A. User Experience (UX)

The International Organization for Standardization (ISO) 9241-110:2010 defines user experience as a person's perceptions and responses resulting from the use and anticipated use of products, systems, or services. Several studies have been conducted to explain the meaning and concept of user experiences with technology. User experience is used to stimulate the HCI (Human-Computer Interaction) research by focusing on the aspect of usability that goes beyond usability and its task-oriented instrumental values [4]. According to Vermeeren et al. [5], user experience examined how an individual felt about using a product, i.e., the experiential, affective, essential, and beneficial aspects. According to Melançon et al. [6], when interacting with a

product or service, the user experience was described as a fleeting, primarily evaluative feeling (good-bad), and it was about having a positive experience through a system. Lipp [7] emphasizes that user experience is subjective because it is about an individual's performance, satisfaction, feelings, and thoughts about a product or service. Despite the lack of a clear definition, the concept of user experience has emerged as an important design consideration for interactive systems [8]. According to Allam, Razak and Hussin [9], user experience is dynamic and involves multiple research areas, including HCI, product design and development, and psychology. As a result, user experience can be viewed as a phenomenon, field of study, or practice. Some work on measuring user experience and usability was carried out by [10] [11] [12] [13]. These studies assess user interaction and product usage, including satisfaction.

The user experience is dynamic because it changes over time as conditions change. As a result, user experience should be valuable after interacting with an object and before and during the interaction. While evaluating short-term experiences is important, given the dynamic changes in user goals and needs resulting from contextual factors, it is also critical to understand how (and why) experiences evolve [5]. A product's effect on a user is called the user experience. In addition, Türkyilmaz, Kantar, Bulak and Uysal [14] stated that user experience is an emotional interaction that begins with usage as a feeling. It is about how we feel and remember after using the product. The term "user experience" refers to using a device to create an experience rather than just creating a fancy interface.

Although there is no agreement in the literature on defining user experience, everyone agrees that it is a complex concept and should not be confused with usability or user interface [15]. Hellweger and Wang [15] conducted a thorough examination of the user experience concept and proposed a user experience conceptual framework. There are numerous perspectives on user experience, and it is understood in various ways by various disciplines and can be viewed from various perspectives [16]. User experience can be academically defined as any aspect of a user's interaction with a product, service, or company [17]. Nonetheless, user experience is regarded as desirable. However, what something exactly means is still up for debate, and it is a highly interdisciplinary topic [18].

A large and growing body of literature has been devoted to understanding user experience (UX) better. Due to the variety of concepts and the flexibility of adding and removing them when stating a definition, it is not easy to have a unique and general definition for user experience. User experience, in our opinion, is primarily associated with the overall design and presentation of online software solutions such as websites or apps. To date, the analysis appears to have focused on user experience in specific domains and fields. For instance, user experience evaluations in games and interactive entertainment [8], [19], [20], [21], culture [22], [23], [24], robotic [25], safety-critical domains [26], and in business and management [18] and [27].

User experience evaluations in games, and more broadly in interactive entertainment systems, had previously been performed over the last ten years [19]. HCI user experience

evaluation methods are used during game development to improve user experience. To better understand the concept of user experience, HCI borrowed and explored aspects of the gaming experience such as immersion, fun, and flow [19]. Nagalingam and Ibrahim [21] conducted additional research on the user experience elements for the evaluation and design of educational games (EG). It is critical to identify the appropriate elements to model the right user experience framework for EG to assist the designer in producing an effective educational game [21].

Several studies have been conducted to investigate user experience with social robots. In 2017, Alenljung, Andreasson, Billing, Lindblom and Lowe [25] demonstrated how the user interacted with the humanoid robot Nao while conveying emotions to the robot through touch. The research objective was to gain a better scientific understanding of affective tactile interaction and see if theories and findings from emotional touch in user experience could be applied for future robotic technologies [25]. It was preliminary to conduct additional user experience studies in the Human-Robot Interaction research area.

Grundgeiger, Hurtienne, and Happel [26] recently emphasized the importance of the personal experience of consumers in security-critical domains who engage with technology such as healthcare. They summarized "interaction" concepts based on modern theories of HCI, which include personal user experience as an essential construct. They concluded that improving user experience could improve technology design, employee well-being, and modern safety management [26].

Luther, Tiberius and Brem [18] recently conducted a bibliometric analysis to identify the evolution of scientific research on user experience between 1983 and 2019. However, despite its importance for competitiveness, customer satisfaction, customer retention, and, ultimately, firm performance, the topic has so far been discussed in the HCI field rather than in business and management. As a result, businesses must adopt a successful user experience approach [18]. It is consistent with Erdos's [27] research, which found that user experience is one of the most important determining factors in the case of business software products and services. They recommended that future research concentrate on business and management-related topics.

### III. MATERIALS AND METHODS

The evaluation methods for user experience are another path for undergoing user experience studies. The primary goal of evaluating user experience is to support and aid in selecting the best design, ensure that development is on track, or measure and clarify whether the final product meets and exceeds the initial user experience targets [9].

There are an increasing number of methods for assessing user experience available at all stages of the development process. Several studies attempted to conduct a comprehensive review of user experience evaluation methods to understand the available methods better. Surveys on these contributions are already available [5], [28], and [29]. A study by Vermeeren et al [5] had discovered 96 user experience evaluation methods

both from academia and industry. They also discovered a need for development of UX evaluation methods, such as early-stage methods, methods for social and collaborative UX evaluation, and establishing practicability and scientific quality.

Bargas-Avila and Hornbk [28] conducted an integrated review of user experience, looking for similarities across products, experience dimensions, and methodologies (time frame restricted to 2005–2009). According to the study’s findings, questionnaires (self-developed questionnaires) were the most commonly used method of assessing user experience. In addition, qualitative methods included semi-structured interviews, focus groups, open interviews, user observation, video recording analysis, and diary analysis. However, psychophysiology is rarely used to improve user experience [28]. Table I summarizes the data collection methods used by Bargas-Avila and Hornbk [28].

Maia and Furtado [29] conducted a systematic review on user experience evaluation (time frame restricted to 2010–2015). According to Maia and Furtado [29], most of the studies used questionnaires to assess the user experience rather than other tools and techniques such as interview, observation, reports, video recording, eye-tracking, etc. They reported that psychophysiological analysis was not yet used in user experience evaluation models because most studies evaluated the user experience manually. According to literature reviews, many different types of user experience evaluation methods are available in the industry and academia. However, methodological improvements in evaluating user experiences that focus on product use and their specific needs such as development phase, type of experience addressed, target users, and evaluation objective are required.

A. Respondents

Respondents were found through a WhatsApp Group announcement. Users who wish to participate in this survey have received an invitation to do so. All respondents had been informed about the survey’s objectives and methods. The invitation contained a link to our survey, which was created using the online survey tool Google Forms.

B. Data Analysis

The data gathered during the evaluation process is both quantitative and qualitative. The open-ended questionnaire yields qualitative data. The UEQ provided the quantitative data. The results of the evaluation are then summarized into a table. The data was then analyzed to determine the user experience level of UQAL. The system’s user experience is graded on six scales: Stimulation, Perspicuity, Efficiency, Dependability, Attraction, and Novelty. The level of user experience for each scale is calculated by processing statistical data with the UEQ Analysis Data Tool. After obtaining the score for each scale, the data is displayed using a benchmark graph to determine the quality of UQAL in comparison to other products in the data set UEQ Analysis Data Tool.

C. UQAL Portal Interface

Evaluation is a stage where the UQAL Portal’s effectiveness and efficiency are perceived. The user’s interface effect is measured, which concerns how simple the portal can be learned, its usability and user experience, and problems that

may occur on the portal are identified. UQAL is evaluated based on its user interface and user experience. This evaluation aims to measure the user experience and user interface when interacting with the portal. A heuristic evaluation technique is used to evaluate UQAL’s user interface. According to Nielsen [30], a heuristic evaluation is carried out by a group of evaluators who are given an interface. They are then asked to evaluate whether each element adheres to a set of established heuristic uses.

UQAL Portal is an e-learning web portal that teaches a targeted group of users how to start a business or an online business using an e-learning portal. The UQAL Portal can be found at <https://yutp-uqal.com/>. The B40 group in Malaysia is the target audience for the UQAL Portal, and the B40 group represents the bottom 40% of income earners. UQAL Portal will bring a Digital Transformation for learners to obtain business-related information from the e-learning portal and for educators to provide business-related information to the e-learning portal. The user will interact with the e-Learning portal through GUI elements such as menus, buttons, checkboxes, search fields, pagination, and notification. Fig. 1–3 depicts the UQAL interface’s main menu.

TABLE I. EXAMPLES OF DATA COLLECTION METHODS

Data Collection methods	Examples
Questionnaires	SAM scale: user feedback assessed with a self-developed questionnaire; AttrakDiff; Lavie & Traktinsky; Other surveys (e.g., FSS, IMI, Emocards).
Interviews (semi-structured and open)	Interview regarding interaction experience; engagement; to understand the enchantment.
User observation (live)	In-situ observation of apps usage; observation of people experience using apps.
Video recordings	Recordings of interactions with apps; videos to capture listening experiences on the apps.
Focus groups	Group discussion to investigate preferences.
Diaries	Emotions assessed with diaries; diaries using day reconstruction & experience narration.
Probes	Participants were given a probe kit with a brief personal explanation and instruction.
Body movements	The choreography of interaction with apps was evaluated by analyzing the movements.
Psychophysiological measures	Psychophysiology (galvanic skin response, EMG, heart rate).

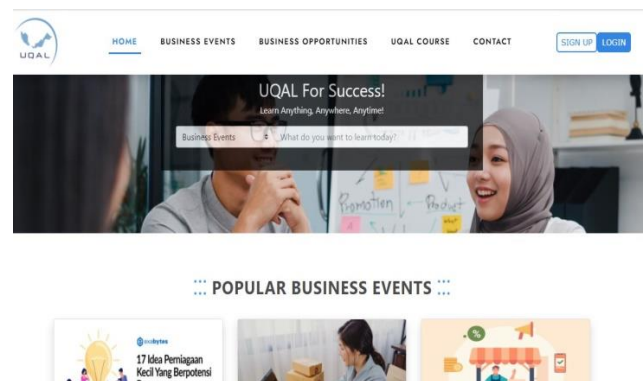


Fig. 1. Main page of UQAL Portal.

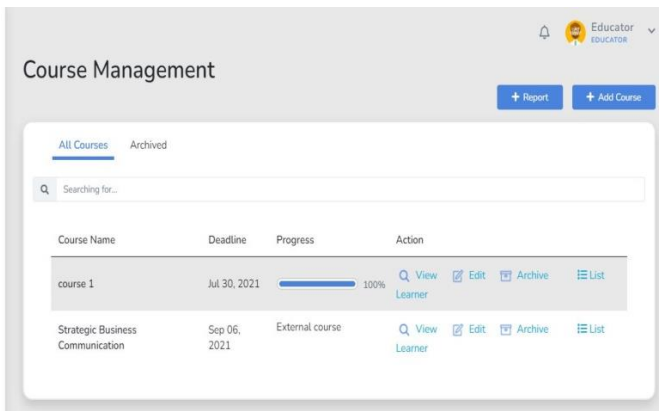


Fig. 2. Course Management Menu for Educator Interface.

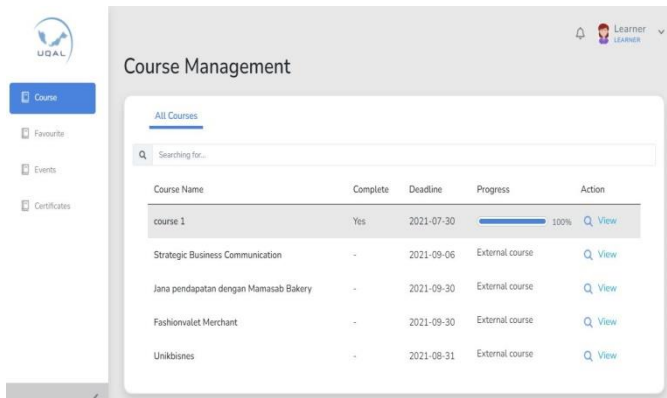


Fig. 3. Course Management Menu for Learner Interface.

D. Instruments

1) *User Experience Questionnaire (UEQ)*: The method was chosen for this study. The questionnaire was divided into four sections. The first section asked a few questions about the user's demographic information (i.e., age, gender, race, occupation, working experiences). Users rate the usability evaluation, including the portal interface, ease of use, and learnability. These sections used a five-point Likert scale with 1 (Strongly Disagree), 2 (Disagree), 3 (Neutral), 4 (Agree), and 5 (Strongly Agree) was employed. The UEQ in the third section is used to assess the user experience of the UQAL e-learning portal. The UEQ can be accessed for free and is available at <https://www.ueq-online.org/>. The UEQ has seven scales and 13 items in total (as shown in Fig. 4). This study employed only the 13 items of UEQ related to the user experience to cover the user's psychological aspects such as feelings of pleasure, disappointment, and stimulation when using the portal interface. Table II shows each of these scales in detail. This section allows users to choose their own experiences and opinions while interacting with the portal. Finally, we ask the user to provide any comments or suggestions for the portal's improvement for the open-ended questions.

	1	2	3	4	5	6	7	
Boring	○	○	○	○	○	○	○	Exciting
Not interesting	○	○	○	○	○	○	○	Interesting
Difficult to use	○	○	○	○	○	○	○	Easy to use
Complicated	○	○	○	○	○	○	○	Easy
Inefficient	○	○	○	○	○	○	○	Efficient
Impractical	○	○	○	○	○	○	○	Practical
Does not Meet Expectations	○	○	○	○	○	○	○	Meets Expectations
Demotivating	○	○	○	○	○	○	○	Motivating
Cluttered	○	○	○	○	○	○	○	Organized
Inferior	○	○	○	○	○	○	○	Valuable
Unattractive	○	○	○	○	○	○	○	Attractive
Dull	○	○	○	○	○	○	○	Creative
Unpleasant	○	○	○	○	○	○	○	Pleasant

Fig. 4. User Experience Questionnaire (UEQ) Items.

TABLE II. USER EXPERIENCE QUESTIONNAIRE (UEQ) ASPECTS

Aspects	Items
1. Attractiveness General impression of the product. Do users like or dislike the product?	unattractive/attractive, unpleasant/pleasant
2. Perspicuity Is it easy to understand how to use the portal? Is it easy to get familiar with the portal?	difficult to learn/easy to learn, complicated/easy
3. Efficiency Is it possible to use the product fast and efficiently? Does the user interface look organized?	inefficient/efficient, impractical/practical, cluttered/organized,
4. Dependability Does the user feel in control of the interaction? Is the interaction with the product secure and predictable?	does not meet expectations/ meets expectations
5. Stimulation Is it interesting and exciting to use the portal? Does the user feel motivated to further use the portal?	boring/exciting, not interesting /interesting, demotivating/motivating, inferior/valuable
6. Novelty Is the design of the portal innovative and creative? Does the portal grab attention?	dull/creative

2) Heuristic Evaluation

a) Nielsen's ten heuristic principles are described below:

1) *Visibility of system status*: This system should always keep users informed of what is going on by providing appropriate feedback in a timely manner.

2) *Match between system and the real world*: The system should speak the user's language, using words, phrases, concepts that the user is familiar with, and adhere to real world conventions rather than system-oriented terms.

3) *User control and freedom*: Users frequently select system functions by accident, necessitating a marked “emergency exit” to exit the undesirable state without going through an extended dialogue.

4) *Consistency and standards*: Users should not guess whether various words, situations, or actions mean the same thing. Observe platform conventions.

5) *Error prevention*: A careful design that prevents a problem from occurring in the first place is even better than good error messages. Either eliminate error-prone conditions or check for them and provide users with a confirmation option before proceeding with the action.

6) *Recognition rather than recall*: Make objects, actions, and options visible to reduce the user’s memory load. The user should not have to recall information from one section of the dialogue to the next. When appropriate, system instructions should be visible or easily accessible.

7) *Flexibility and efficiency of use*: Unseen accelerators may frequently speed up the interaction for the expert user, allowing the system to cater to both inexperienced and experienced users. Allow users to personalize frequently performed actions.

8) *Aesthetic and minimalist design*: Dialogues should not include irrelevant or used infrequently. Every additional unit of information in a conversation competes with the relevant information units, reducing their relative visibility.

9) *Help users recognize, diagnose, and recover from errors*: Error messages should be written in plain language (no codes), accurately describe the problem, and constructively suggest a solution.

10) *Help and documentation*: Even though it is preferable if the system can be used without documentation, assistance and documentation may be required. Any such information should be easy to find, focused on the user’s task, list concrete steps to be taken, and not be too large.

*b) Data Collection Procedures*: The following are the data collection steps in the heuristic evaluation:

- Step 1: Establish an appropriate list of heuristics. This survey used the model based on Nielsen’s 10 heuristics.
- Step 2: Identify 3 to 4 evaluators (experts). They were assuring their knowledge of the relevant industry. Experts were defined in this survey as people with several years of job experience in the software and information technology fields.
- Step 3: Briefing the evaluator/expert. They inform the evaluator about what they are expected to do and cover during their evaluation. The evaluator has explained the scope and objective of the portal inspection and the characteristics of the portal’s users.
- Step 4: Evaluation phase. Evaluators must have free access to the portal to identify elements to analyze. Individual elements are examined by evaluators using heuristics. They also investigate how these fit into the overall design, meticulously documenting all issues encountered.

- Step 5: Report issues/problems. Evaluators complete the questionnaire given and report any issues and problems they discover. The evaluator’s task at this stage is to assess the list of 10 Usability Heuristics for User Interface Design [30] in Table III.

TABLE III. NIELSEN’S 10 HEURISTICS

Heuristics	Yes/No	Comment/ Remark
1. Visibility of system status		
2. Match between systems and the real world		
3. User control and freedom		
4. Consistency		
5. Prevent Errors		
6. Recognition rather than recall		
7. Flexibility and efficiency of use		
8. Aesthetic and minimalist design		
9. Help users recognize, diagnose, and recover from errors.		
10. Help and Support		

The data obtained from this technique is a list of interface problems based on the evaluators’ heuristic principles. The evaluation results are then compiled into a table that provides a detailed breakdown of the issues and recommendations.

## IV. RESULTS AND DISCUSSION

### A. Demography

Thirty users participated in the user experience survey (19 females, 11 males). Most respondents were between the ages of 18 and 35 (n = 23), followed by those between the ages of 36 and 55 (n = 6), with the remainder being over the age of 55 (n = 1). Malay (97%) and Chinese are the most common ethnic groups (3%). The majority had a bachelor’s degree or were enrolled in a bachelor’s degree program (70%). 7% had high school diplomas, 10% had college diplomas, and 13% had graduate degrees.

In terms of current employment status, 63% were full-time employees, 20% were students, 7% were self-employed, and 1% were full-time freelancers, unemployed, or retired. Respondents’ current occupations were education and training (17%), computer and software (13%), administrator (7%), students (6%), and other fields (1%), in that order. The average working experience ranged from more than seven years (37%) to four to six years (30%), one to three years (13%), less than six months (7%), and none at all (13%).

Furthermore, approximate monthly household income for the respondent shows that 37% have more than 4500 Malaysian Ringgit, 20% have 2500–3500 Malaysian Ringgit, 10% range from 1500–2500 Malaysian Ringgit and less than 2500 Malaysian Ringgit. In addition, 7% ranges from 3500–4500 Malaysian Ringgit. The remaining respondents (17%), on the other hand, preferred not to respond. Table IV summarizes the detailed demographic information.

TABLE IV. DEMOGRAPHIC PROFILE OF RESPONDENT

Demographic Profile	Total N = 30 (%)
<b>Age</b>	
18– 35	23(76.7)
36–55	6(20)
>55	1(3.3)
<b>Race</b>	
Malay	29(96.7)
Chinese	1(3.3)
<b>Education level</b>	
Bachelor’s degree	21(70)
Graduate degree (MS, Ph.D.)	6(13.4)
College Graduate	3(10)
High School	2(6.7)
<b>Employment status</b>	
Full-time employment	19(63.3)
Student	6(20)
Self-employed	2(6.7)
<b>Working experience</b>	
7 years or more	11(36.7)
4 to 6 years	9(30)
1 to 3 years	4(13.3)
No working experience	4(13.3)
<b>Monthly household income</b>	
>RM 4500	11(36.7)
RM3500–RM4500	2(6.7)
RM 2500–RM3500	6(20)
RM1500–RM2500	2(6.7)
Less than RM1500	2(6.7)

**B. Usability Evaluation**

This survey evaluates the portal's usability with a few items identifying general interface design and layout, ease of use, and

learnability. Overall, participants gave positive feedback on usability aspects, as shown in Table V. 79.9% thought the portal interface was pleasant and easy to use (n = 24). In comparison, 83.3% thought the sequence of screens, organization of information presented, and graphical presentations were simple to understand (n = 25). As a result, 89.9% agreed that the portal was simple to use (n = 27), 86.6% agreed that it was easy to find needed information (n = 26), and 90% of respondents understood the menu (n = 26). Overall, most of the participants, 86.6%, were satisfied with the easiness of the portal (n=26). In terms of learnability, most respondents (96.6%) said that it was easy to learn how to use the portal; 89.9% said it helped them become more productive quickly. Another 93.3% found the information in the portal to be effective and helpful.

**C. User Experience**

Overall, the score indicates that the UQAL Portal gets a positive evaluation from users. Results from UEQ show that the overall score is in the positive range. The Likert scale data has been transformed into the UEQ Data Analysis Tool in an Excel sheet to calculate the scale means and compare the products in the benchmark data set. The measured scale means are determined by comparing them to existing values from a benchmark data set (<https://www.ueq-online.org/>). Comparing the results for the evaluated product with the data in the benchmark allows conclusions about the quality of the evaluated product compared to other products. Table VI shows the score of each user experience aspect.

TABLE V. MEAN AND STANDARD DEVIATION FOR EACH USABILITY ITEM

Usability Aspect	Mean and Standard Deviation, SD						
	1	2	3	4	5	Mean	SD
<b>A. General Interface Design and Layout</b>							
The interface of the portal is pleasant.	1	0	5	20	4	3.87	3.42
I like using the interface.	1	0	5	18	6	3.93	3.49
The sequence of screens was clear.	1	0	4	13	12	4.17	3.74
The organization of information presented was clear.	1	0	4	13	12	4.17	3.74
The graphical presentations (i.e., icons) are easy to interpret.	1	1	3	18	7	3.97	3.54
<b>B. Ease of Use</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>Mean</b>	<b>SD</b>
It was simple to use this portal.	0	0	3	16	11	4.27	3.79
It was easy to find information I needed.	0	0	4	15	11	4.23	3.76
It is easy to understand the functions of the menu items.	0	1	2	15	12	4.27	3.80
The information (i.e., online help, on-screen messages, and other documentation) provided in this portal is clear.	0	1	3	16	10	4.17	3.71
Whenever I make a mistake using the portal, I recover easily and quickly.	0	0	3	15	12	4.3	3.82
The portal gives error messages that clearly tell me how to fix problem.	0	1	9	16	4	3.77	3.31
Overall, I am satisfied with how easy it is to use this portal.	0	0	4	19	7	4.1	3.61
<b>C. Learnability</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>Mean</b>	<b>SD</b>
It was simple to use this portal.	0	0	1	16	13	4.4	3.91
I would imagine that most people would learn to use this portal very quickly.	0	0	2	18	10	4.27	3.78
I believe I became productive quickly using this portal.	0	0	3	21	6	4.1	3.61
The information provided in this portal is effective and helpful.	0	1	1	16	12	4.3	3.83
The online Help facility is useful.	0	1	3	15	11	4.2	3.74



TABLE VI. USER EXPERIENCE QUESTIONNAIRE (UEQ) RESULTS

Aspects	Average Score	Compared to Benchmark
1. Attractiveness	1.77	Good
2. Perspicuity	2.20	Excellent
3. Efficiency	2.30	Excellent
4. Dependability	1.73	Excellent
5. Stimulation	0.63	Below Average
6. Novelty	1.27	Good

The benchmark results from UEQ Data Analysis Tool revealed that perspicuity, efficiency, and dependability aspects belonged to the Excellent category, indicating that UQAL is included in the best 10% range of results, implying that 10% of the products in the dataset are better and 75% are worse. However, the stimulation aspect of UQAL could be classified as Below Average, which means that 50% of products on the dataset are better than UQAL while 25% are worse. The overall score is in the positive range, according to the evaluation of UEQ results. Minor issues on UQAL have not been shown to impact user experience significantly. Fig. 5 depicts the benchmark graph.

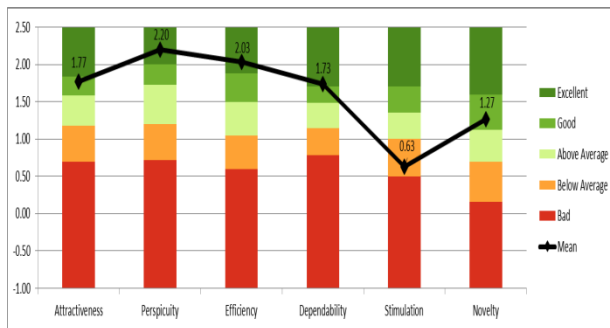


Fig. 5. UQAL's Benchmark Graph.

Another thing that this survey wanted to look into was whether UQAL should have any additional essential features. Table VII includes some comments on all the missing features mentioned.

We are looking at which aspects/features the UQAL Portal users like the least and most. According to the survey results, some respondents like how simple it is to use and understand the portal. Some respondents said they were straightforward when asked about the portal's features. For example, "I like the portal structure; it is straightforward." They commented, "This portal is simple and easy to understand." Some of the respondents commented, "User-friendly." This portal helps me find any business courses. I can easily organize and manage courses from the beginning to the end". Others commented that it is "so easy for people to understand the flow of the system because each page has different information".

Some respondents stated that the user interface design is their least favorite. They felt the portal's interface was not interesting enough to draw their attention. Some of them stated:

"The theme of the portal does not seem very interesting. Color combinations could be used to make the portal look better."

"The thing I like the least is the inconsistent type of fonts used and the size of the fonts. I found certain words or sentences do not start with a capital letter, which does not represent the professional side."

"The color of the portal. This e-learning web portal is for Malaysians who want to start a business online. The color of a website plays a vital role in attracting more B40 groups."

"The team can research which fonts are compatible for each part, especially for the Business Opportunities interface and UQAL course interface. I found certain fonts used are 'awkward', and the layout and the color of the fonts should be consistent. "

TABLE VII. USER EXPERIENCE QUESTIONNAIRE (UEQ) RESULTS

Features	Comments
1. Course/Event details	"Course introduction, course timeline, and instructors' information" "State the date when this portal updates the information of the course and event. So, the user will know the information was updated." "Can display multiple categories of data like all courses, my courses, external courses in a single screen." "Add more information of the courses." "Have a calendar to show/ list next course register." "Add description for the courses." "Have a list of courses by category."
2. Customer Service Chat/Online Chat	"Chabot or online helper to assist users when they face any issues when using the portal." "Chat feature to allow peer engagement and learners-instructor interaction." "Any online learning platform should have chat features to enable for peer engagement as well as learner-instructor interaction."
3. Information/Content	"Give information about another interesting portal" "Can add detail grant for SME, provided from the government" "Introduced more local corporate and business com-pany starter." "Maybe can add 'dashboard' that include information such as a graph to prove how UQAL Portal help the B40 group start the business using this portal." "Information on business events and business oppor-tunities" "Company and corporate sector involved mostly big known." "Should have "about" section which could explain to people what the portal is about."
4. User Interface Design	"Perhaps the portal should be more organized with a drop-down menu..." "No attractive colors or graphics." "Greyish button. Hope more eye-catchy." "Add more pictures or graphics to make this portal interesting." "More interesting interface maybe can add animation, the welcoming or introduction video." "It would look nicer with better images resolution."
5. Advanced Search	"Have sort and filter searching" "Allow multiple searching criteria in one screen."
6. Bilingual (BM/BI)	"Make it friendlier for example, bilingual feature for easy to understand."

D. Heuristic Evaluation Analysis

Four evaluators evaluate with backgrounds in software and information technology. Two of them have more than seven years of experience as software developers. One has over ten

years of experience as an information technology administrator, and the other is a research graduate in usability. Based on the severity rating, the evaluators discussed some issues and made recommendations for improvement.

TABLE VIII. UQAL HEURISTIC EVALUATION RESULTS

Heuristic	Comments/Issues	Recommendations
1. Visibility of system status	Some courses are already marked as completed, yet in the listing, it still shows “No” under the complete column and the progress bar; I’m not sure how it works/functions (already complete, but the progress bar still shows 25%).	This portal should always keep users informed about what is going on, through appropriate feedback within reasonable time.
2. Match between systems and the real world	The portal has no elements of positive encouragement (rewards, praise, personalization, etc.) to boost users' motivation. This type of element is essential in online learning since it requires users to learn independently.	The system should speak the user’s language with words, phrases, and concepts familiar and follow real world conventions rather than system-oriented terms.
	There are no features that allow learners to interact with one another and with instructors/ lecturers/ trainers.	Any online learning platform should have chat features to enable peer engagement and learner-instructor interaction.
3. User control and freedom	When the user makes an error on a certain field, the system removes all the information that the user has filled in, even though that information is supposedly correct.	Support undo and redo.
4. Consistency	Some buttons are not suitable. For example, there is a button ‘Report’ I thought it was for adding a report, but it was to generate Report.	Use the standard color of buttons. Users should not have to wonder whether different words, situations, or actions mean the same thing. Follow platform conventions.
5. Prevent errors	The function is not working well for evaluation. When I try to add a new course as an educator, the system makes it compulsory to add the image of the banner. When I didn't add the image, it showed an error message. However, the page redirects me to the front page. So, I need to re-key the form again.	Properly test the portal to make sure all functionality is working. The system must be functioning well to be successful. Prevents a problem from occurring in the first place. Present users with a confirmation option before they commit to the action.
6. Recognition rather than recall	There is no error warning message when the user makes a mistake.	The system should prevent users from making mistakes. Minimize the user's memory load by making objects, actions, and options visible. The user should not have to remember information from one part of the dialogue to another.
7. Flexibility and The efficiency of use.	Advance search feature: Users do not get the benefit of a search menu there.	The search feature should add sorting and a filtering function.
	Its multi-platform, but it can't be used for the mobile version well.	Create a mobile-friendly web portal for users to access because not everyone has a laptop or tablet to access the portal.
	It would be better if you could add the calendar management for learners and educators to view the courses and events they join/conduct. For example, if I’m a learner and I click to join the event/course, then the event will be added to my calendar.	Make the calendar to be viewed monthly/weekly. So, that it easier to check which event/course that I have joined or to join.
	I’m not sure how the courses will be conducted. So that learner can always come to this website to review back the provided material. When the course is already marked as complete, there is nowhere for me to view back what the courses are all about.	It would be better if an educator can up-load the teaching material (e.g., Power-Point slides or others material).
8. Aesthetic and minimalist design	The interface for “Course Management” (learner view) is not convenient to use. All the courses are displayed in one listing.	It would be better if you could display the listing for the courses that have already been completed in one tab and the courses not yet completed in another tab. Or you could just add the filter there to allow users to filter the listing.
	The portal theme appears to be uninteresting. This portal does not appear to employ vivid colors.	Color combinations could be used to improve the portal's aesthetic value.
	The image size used does not fit and not match the box provided.	It is possible to match all the pictures at the same size and clear.
	The dashboard for learners should be appealing and dynamic.	Choose dashboard UI elements carefully; otherwise, learners will become discouraged.
	The sidebar’s use of repetitive icons appears to be confusing.	The button positioning should be consistent and clear (e.g., the Join button).
9. Help users recognize, diagnose, and recover from errors.	When the user makes an error on a certain field, the system totally removes all the information that the user has filled in, even though that information is supposedly correct.	Recovery from Error. Help user to recover if making an error. Error messages should be expressed in plain language (no codes), precisely indicate the problem, and constructively suggest a solution.
10. Help and support	Lack of Help to guide users.	Put Guideline to help the user. Create a help menu to make it easier for users to use the portal.
	There is no sitemap of the portal.	Create a site map to make it easier for users to navigate the portal.



The majority of problems can be found in Aesthetic and Minimalist Design principles. Two of the evaluators noticed some issues with UQAL's interface's aesthetic. The principle issues include a colorless interface, size, images resolution, icons, and buttons that should have aesthetic values according to the evaluator. The Search and Course function menus should be improved based on flexibility and efficiency of use. Some errors occur while performing certain tasks. Table VIII displays the outcome of the heuristic evaluation.

Although heuristic evaluation revealed some significant flaws in the UQAL's user interface design, it had no direct impact on the UEQ's overall score, which was positive. Previous research on heuristic evaluation has shown that it identifies more minor usability issues in an interface than other methods [31]. Regardless, the UEQ results show that the overall score is positive. Minor issues discovered during the heuristic evaluation do not appear to significantly impact user experience on UQAL.

## V. CONCLUSION

Finally, based on the heuristic evaluation results, the evaluators discovered some issues with Nielsen's heuristic principles on UQAL's user interface design, which are commonly found in the Aesthetic and Minimalist Design principles, as well as flexibility and efficiency of use. The outcome of heuristic evaluation is a recommendation of issues and problems that must be addressed. Nonetheless, according to UEQ results, the user experience of the UQAL Portal is adequate. The sufficient average score of each aspect demonstrates this. The results of this experiment can be used as a reference for the developer to improve the UQAL Portal in the future.

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