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ترسل البحوث وجميع المراسلات المتعلقة بالمجلة إلى العنوان التالي:

كلية العلـــوم – جامعـة الزيتونـة – ترهـــونة

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شروط وتعليمات النشر

1- أن يكون البحث أصيلاً ومبتكراً ولم يسبق نشره في أي جهة أخرى، وتتوفر فيه شروط البحث العلمي المعتمدة على الأصول العلمية والمنهجية المتعارف عليها في كتابة البحوث الاكاديمية.
2- أن يكون البحث مكتوباً بلغة سليمة، ومراعياً لقواعد الضبط ودقة الرسوم والاشكال – إن وجدت – ومطبوعاً ببنط (14) وبخط (Simplified Arabic)، وألا تزيد صفحات البحث عن (35) صفحة متضمنة الهوامش والمراجع.
3- يجب أن يشتمل البحث على العناصر التالية: - عنوان البحث باللغتين العربية والإنجليزية؛ - ملخص تنفيذي باللغتين العربية والإنجليزية في نحو 100-125 كلمة، والكلمات المفتاحية (keywords) بعد الملخص.
4- يتم توثيق الهوامش وفق طريقة **APA** (طريقة الجمعية الأمريكية السيكولوجية**)** بإصدارتها المختلفة.
5- يُفضل أن تكون الجداول والاشكال مدرجة في أماكنها الصحيحة، وأن تشمل العناوين والبيانات الإيضاحية الضرورية، ويراعى ألا تتجاوز أبعاد الاشكال والجداول حجم حيز الكتابة في صفحة Microsoft Word.
6- أن يكون البحث ملتزماً بدقة التوثيق، وحسن استخدام المصادر والمراجع، وأن تثبت مصادر ومراجع البحث في نهاية البحث.
7- تحتفظ المجلة بحقها في اخراج البحث وإبراز عناوينه بما يتناسب واسلوبها في النشر.
8- ترحب المجلة بنشر البحوث المكتوبة باللغة الأجنبية ويفضل أن يرفق البحث بملخص باللغة العربية (لا يتجاوز 200 كلمة).
9- ترحب المجلة بنشر ما يصلها من ملخصات الرسائل الجامعية التي تمت مناقشتها وإجازتها، على أن يكون الملخص من إعداد صاحب الرسالة نفسه.
10- تُرسل نسخة من البحث مطبوعة على ورق بحجم (A4) إلى مقر المجلة، ونسخة إلكترونية إلى إيميل المجلة: rwafedalmarefa@gmail.com، على أن يدون على صفحة الغلاف: اسم الباحث، لقبه العلمي، مكان عمله، تخصصه، رقم هاتفه وبريده الإلكتروني.
11- يخطر الباحث بقرار صلاحية بحثه للنشر من عدمها خلال مدة ثلاثة أشهر من تاريخ استلام البحث.
12- في حالة ورود ملاحظات وتعديلات على البحث من المحكم، ترسل تلك الملاحظات إلى الباحث لإجراء التعديلات اللازمة بموجبها، على أن تعاد للمجلة خلال مدة أقصاها شهر واحد.
13- الأبحاث التي لم تتم الموافقة على نشرها لا تعاد إلى الباحثين.
14- تؤول جميع حقوق النشر للمجلة.
15- دفع رسوم التحكيم العلمي والمراجعة اللغوية والنشر، إن وجدت.

البحوث المنشورة في هذه المجلة تعبر عن رأي أصحابها ولا تعبر بالضرورة عن رأي المجلة أو الجامعة.

الكلمة الافتتاحية

بسم الله الرحمن الرحيم، عليه نتوكل وبه نستعين، نحمده سبحانه كما ينبغي أن يُحمد، ونصلي ونسلم على رسوله محمد وعلى آله وصحبه والتابعين.

وبعـــد،،،

إن سبيل نهضة الأمم إنما يكون بالبحث العلمي في شتى المجالات، فدوره مهم لمواكبة التقدم والرقي بالمجتمع فبالبحث العلمي ينمى القدرات البشرية وهو الأساس في الابتكاروالإبداع. بعون من الله وتوفيقه، وبعد الجهد الكبير الذي بذلته هيئة التّحرير تكاملت الاستعدادات لإصدار العدد التاسع من مجلة رو افد المعرفة، والذي نأمل أن يلبي طموحات المهتمين والباحثين. ومن هنا ندعو كل الباحثين والكتاب الإسهام في استمرار المجلة بتقديم نتاجهم العلمي للنشر، ونرحب بآراء القراء والباحثين ونقدهم البناء حتى تخرج المجلة في صورتها المثلى وليكون العدد التالي أفضل من سابقه. وختاما يجدر بنا مع إصدار هذا العدد والذي يحتوي على عدد أربعة عشر بحثاً أصيلاً مختلفاً، أن نتقدم بجزيل الشكر والتقدير للمحكمين والمؤلفين وكل من أسهم في إخراجه وتصميمه، آملين أن تكون محتوياته نافعة للجميع.

والحمد لله في بدءٍ ومُخْتَتَمِ.

هيئة التحرير

.

المحتويات

Evaluating the Usability of Online Payment Systems using ISO/IEC 9126 Quality Model

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Abstract:

The development of ICT and the online services have paved the way for the integration of different online payment services. This development has resulted in the use of online payment systems to promote the online payments between customers and sellers or owners. Furthermore, there are different companies which offer the online payment services which offer the same services to the users but have different specifications and usability features. This makes it difficult for a customer to use some of the payment due to the variations in the usability features. So, there is an urgent need for evaluating the usability of these payments systems to identify the alternative with the best usability features. Thus, this study aims to evaluate and compare top 5 best online payment systems in order to help users to select the best services. The comparison will be based on the ISO 9126 software quality model with emphasis on only the usability criteria. Finally, the results show that PayPal is the best payment system based on the used the criteria.

Keywords: evaluation; ISO 9126; online payment system, usability.

الملخص

إن التطور في تقنية المعلومات والاتصالات مهد الطريق لتضمين خدمات بيع إلكترونية مختلفة. هذا التطور نتج عنه استخدام أنظمة دفع الكرتونية بين البائع والزبون أو المالك. علاوة عن ذلك، هناك الكثير من الشركات التي توفر الدفع الإلكتروني عن طريق الأنترنت غرضها توفير نفس الخدمات للزبون أو المستخدم لكنها تحمل تصنيفات مختلفة وخصائص قابلية الاستخدام. مما يجعل الامر صعب على الزبون في استخدام بعض وسائل الدفع بسبب خصائص الاستخدام. لذلك هناك حاجة عاجلة لتقييم الاستخدامات الخاصة بأنظمة الدفع لتحديد النوع الافضل من حيث خصائص الاستخدام. عليه، فإن هذه الدراسة تهدف لتقييم ومقارنة أفضل 5 خدمات دفع الكترونية لمساعدة الزبون على اختيار أفضل الخدمات. المقارنة ستعتمد على برنامج ISO 9126 الخاص بالجودة مع التركيز فقط على معايير الاستخدام. وأخيراً، النتائج أظهرت انه PayPalهو أفضل نظام دفع بناء على المعايير المستخدمة في هذه الدراسة.

الكلمات المفتاحية: تقييم؛ برنامج ISO 9126؛ نظام الدفع عبر الإنترنت، سهولة الاستخدام

1. Introduction

Electronic-business has become a standard a part of human life because of its advantages for clients, particularly in Business to client (B2C) trade, where the client can place an order from home and use his time to accomplish more things [13]. there's no compelling reason to go to a store or a store. The client can visit different

shopping stores within the Internet within minimal time, then compare and contrast the things supported the costs or qualities. Besides, online payment systems have an important part in internet business. E commerce ventures utilize online payment systems that allude to paperless money related exchanges, which has altered the business preparing by decreasing printed material, exchange expenses, and work cost. Being easy to use and fewer tedious than manual preparing, electronic trade enables a business association to increase its market achievement extension [14]. in line with the Statista report [15]c, 39% of the payments made are performed using the web payment systems. Also about 90% of the net retail business in north America are done using the web payment systems [2]. Webpage-FX report [16] outlined the foremost popular online payment systems as; PayPal, Google pay, Amazon pay, Dwolla and Authorize.net. For a a few years now, using credit cards is growing and become one amongst the foremost popular means of payment for e-online businesses [1]. Also Jetsiktat et al (2015) in their research [2] outlined that about 90% of online retail businesses in America were made using this implies. in step with [1] it's very difficult for an internet shopping or business to carry without using the credit and debit cards thanks to its widespread of usage. Smartcards also like credit cards; moreover, it's an installed chip to transfers cash from the buyers' cards to the sellers' device [3]. These card and devices are getting used for online payments.

According to [29] Global (mobile) electronic payments services became increasingly important. Payment methods are how customers will pay for his or her goods and services. it's necessary to think about the payment methods which will be provided when starting a business and check periodically whether or not they are in line with their customers' payment preferences, whether or not they meet the wants of the business. They facilitate and simplify the payment process allowing payment to be made consistent with the consumer's preferences.

Dozens of online payment systems are available for customer's use, most of which are ideally controlled by third-party companies [2]. These companies make their profit by deducting a particular percentage for each transaction made. the net payment system has also been on an increase of development within the recent years thanks to the event in banking sectors that permits internet-based banking and shopping [4]. due to the technological advancement within the world nowadays, the event of the net payment systems and processing devices has also risen. e-commerce websites and online payment systems became the most interface to attach retailers and consumers because of the shortage of human interaction during online shopping [5] and it's been projected that e-commerce and therefore the use of online payment systems will increase will grow 20% annually and worldwide and 30% annually within the emerging markets like the center East and Africa [6].

This is why there's a desire for evaluating online payment systems to spot the most effective option for users [7]. the highest 5 online payment systems are listed below [8].

- **Amazon Pay** is an internet payment lunched by Amazon.com in 2007 within the US and so spread to about ten other countries within 10 years.
- **PayPal** was established in 1998 which became a subsidiary of eBay in 2002. Since then, it's been operating worldwide to support online transactions.
- **Google Pay** is developed by Google to permit online transactions using Android phones or tablets.
- **2Checkout** has been lunched in 2000 to support online transactions in over 200 markets using different payment methods and various currencies.
- **Dwolla** is a web payment system lunched within the US in 2010, it started with few banks and retailers with about 20 thousand clients.

The main aim of this study is to perform a usability evaluation study to check the 5 best online payment systems using the ISO/IEC 9126 quality evaluation model. to realize this aim, an in depth study must be dispensed, which is able to take into consideration all the system quality and usefulness characteristics of every of the chosen open source Learning Management Systems and so compare them with the aim of determining which amongst them has the most effective system quality characteristics.

1.1. Problem

There are different companies which offer services for the net financial transactions. Those companies have different policies, laws, and services; there's also a good variation within the usability features of those systems. This makes it difficult for purchasers to use a number of the payment systems, thanks to its poor usability. Therefore, there's a requirement for evaluating these systems to spot the best and best alternative which can be better in performance and repair delivery.

1.2. Aim

This research focused on the usability evaluation of the highest 5 online payment systems supported 2 experts` perceptions. The evaluation was supported the ISO/IEC 9126 usability standard. International standard organization ISO 9126 created a model to judge the standard of software products adopting accessibility, functionality, usability, efficiency, maintainability and portability as its criteria.

2. Related Research

Different companies offer various online payment services with different specifications and value functions, so there's a desire to see these payment systems supported some set of qualities to spot the foremost effective system for user`s needs. one altogether the foremost widely used standards for usability

evaluation is that the ISO/IEC 9126 quality model which is widely accepted globally with over 1 million certified companies worldwide [27].

In their research created a replacement [25] Academic model that's suitable to figure for a diffusion of educational systems for example E-learning systems. The place to begin for building our model is that the ISO 9126, just because it includes the common software quality characteristics that the choice six models incorporates. This novel model Identify basic attributes and their sub-attributes for measuring software quality in Information Systems. Then identifying relationships between them in preparation for comparison with one another, to detect potential weaknesses. Then build a customary approach that measures and evaluates the standard of the AIS, which mix several software quality standards to help system analysts, system developers, and system programmers in their AIS projects.

Some researchers have done the identical study for evaluating the usability of online payment systems. In their research [9] compared BulaPay with other well-known third party payment systems. The comparison criteria used are supported the key requirements of e-commerce systems as follows. Security, Independence, Affordability, Scalability, Inerrability, Realworldability and Reliability. The systems are evaluated from the customer's and e-shopper's perspective by installing BulaPay and also the selection two e-commerce sites on a sever with the broadband Internet connection. Thirty four participants volunteered to be subjects for our usability study of BulaPay. They were an equal mixture of non-IT specialists and graduate students. Also four participants who had the net site design or software development background (HTML and PHP programming) act as e-shoppers for our usability study of BulaPay. In their study [26] Quality testing on the net site bios portal using the ISO 25010: 2011 method on email has been successfully disbursed. The test is finished by calculating the burden calculation for the six parameters using the AHP method, then determining the symptoms for every of the sub-criteria. Next is to check each sub-group with the blackbox testing method, observation and questionnaire distribution. Also [10] Compared 9 of the foremost popular online payment systems from the past, current and future perspectives. All features of the web payment systems and its services yet because the factors that affect its adoption by customers were reviewed and analyzed from various studies. the standards used for the comparison are; Merchant account, cost, setup cost, charge back fee, currencies, countries, card type, mobile payment, on-form payment required SSL and phone support. While in their study [17] developed a framework for evaluating B2C e-commerce websites supported three main criteria i.e. information quality, system quality and repair quality, these three main criteria contains total number of 17 sub-criteria. Website user's and also the owners

function the panelists, which 6 e-commerce website was evaluated.

Also in [28] created a web site allows the users to guage a specific product by answering the framework questions those directed to the user and providing his opinion about the merchandise. the web site registration policy assumes that the user has already used the merchandise before evaluating it. thanks to cultural issues, the net site user interfaces were written in Arabic, similarly because the framework questions directed to the user. The users' evaluations are stored and accumulated within the online site database. When a possible customer tends to buy for for a few product for his business needs from the local market, he can visit the net site, view products by categories, search by products' features, and appearance at stored evaluations about products, so on urge a transparent concept supports his purchase decision.

ISO/IEC 9126 QUALITY MODEL

The International Standard Organization ISO 9126 could be a model designed for software quality which has 6 main criteria; accessibility, functionality, usability, efficiency, maintainability and portability as its criteria. Usability refers to the characteristics that outline the standard, that is, it deals with how a package is employed to understand certain goals within the only and effective manner possible in any given situation [11].

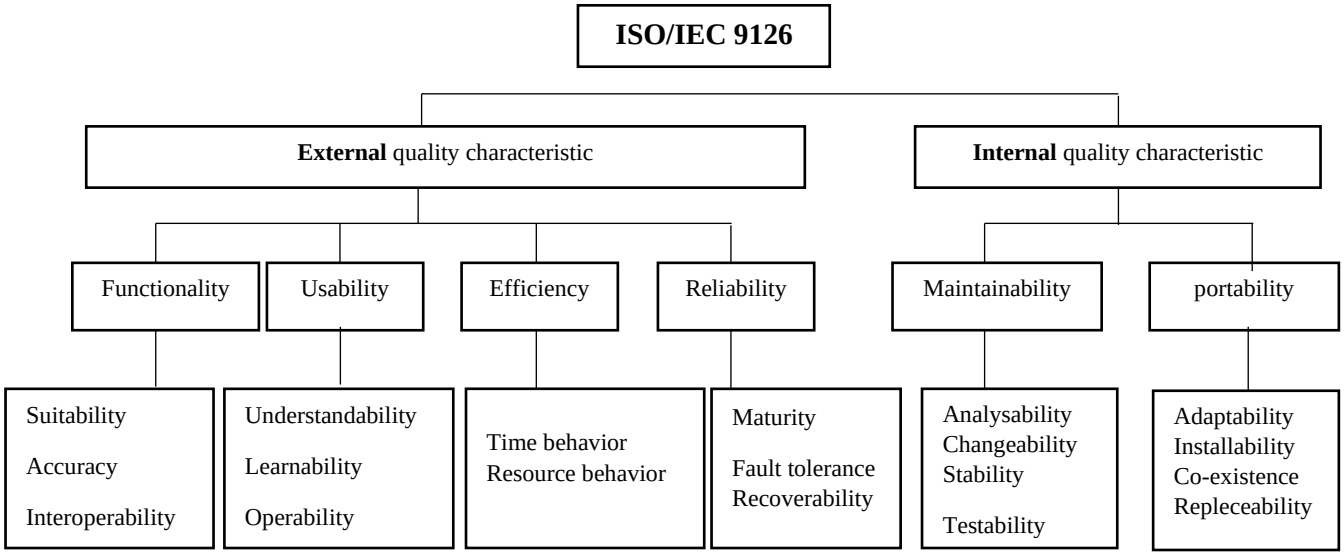

Figure 1. ISO/IEC 9126 Quality Model [18]

In this study, only the main criteria will be considered for the evaluation because of large number of the sub-criteria.

- **Functionality**: can be defined as the attributes designed to ensure that software carry out its specified set of functions. Functionality attributes are those aimed at that satisfying the stated requirements of the user. These include sustainability, interoperability, accuracy, standard and security [19].
- **Reliability**: refers to the software attributes with the ability to enable the software to maintain a high level of performance under specific time and condition. It involves fault tolerance, maturity, recoverability [20].
- **Usability**: relates to the attributes of software, which make it easy to use or user friendly either by individual assessment or an assessment guided by specific guidelines. It is important to have a very clear and user-friendly user interface [21]. Therefore, in order to have a high usability level for payment systems, there are some associated factors; understandability, learnability and operability.
- **Efficiency** refers to the level of performance of the payment systems, it involves the time efficiency and the resource efficiency. In order to be efficient, the performance and response time must be fast so as to fully satisfy the needs of the users [22]. The systems should give a user fast access to resources.
- **Maintainability** refers to the ability of the payment system to be upgraded, updated repair or maintain over long period of time [23]. It includes analysability, changeability stability and testability.
- **Portability** refers to the ability of the system to be used everywhere and on different environments and platforms. It also includes how the system can be used on mobile gadgets [24], See appendix 1 (Table 1).

3. Methodology

The 5 most popular online payment systems were compared by 2 experts with computer technical background (computer information systems specialist and information technology specialist) and have the knowledge of online payment systems, the evaluation based on the ISO 9126 software quality standard. Because of the large number of payment systems available, there is a need to carry out an evaluation to outline the best payment system. The online payment systems used in the study are Amazon payment, Dwolla, Google pay, Paypal and 2Checkout. The 6 main criteria and the 22 sub-criteria of the ISO/IEC9126 model were used for this study. See (Figure 2 & Table 2) as shown in appendix (1) the evaluation flowchart and evaluation scale.

4. Results

Now, after the allocation of each criteria scores by the experts, the total score of each online payment system based on individual qualities is derived by taking the cumulated average score of each sub-criteria, and the overall system quality of each payment system is determined by taking the sum of all main criteria scores, this will help identify the aspects that are very good and the one that in need of improvements. The overall quality is the total scores in each alternative which is analyzed based on the evaluation formula as used by [12] in order to identify the most preferred payment system from the top 5 selected from this study, As shown in appendix 1 (table 4).

5. Discussion

The online payment systems used in this study have different levels of system quality specification. From the above result, the systems qualities of PayPal payment system are almost all complete, and it has the highest system quality among the evaluated online payment systems with score of 20.8. The second online payment system based on the ranking is Amazon pay with very little deficiency and has a score of 18.8. The third online payment system is Google pay with slight deficiency compared to Amazon pay, it has a score value of 18.3. The last two online payment systems have the highest deficiencies especially in the "Efficiency", "Usability" and "Reliability" features, 2Checkout has a score value of 16.25 while Dwolla has score value of 15.2. This shows that the ranking order of the online payment systems based on this study is; PayPal, Amazon pay, Google pay, 2Checkout and Dwolla.

In some related research that perform similar study on online payment systems evaluations, [9] shows that PayPal is the most preferred online payment system followed by Authorise.net and then Wepay. Also in another study [10], the result shows that PayPal is the best online payment system followed by Alipay, As shown in appendix 1 (Table 3).

6. Conclusion

This study evaluated the top 5 online payment systems based on the usability characteristics of ISO 9126 usability standard; understandability, learnability, operability and attractiveness. The evaluation was carried out by 2 experts who have used these systems before. This study is limited to only 5 payment systems identified as the most popular. The results show that Paypal is the best payment system based on the used the criteria. Among the limitations is that only the usability characteristics of the ISO9126 were considered. This research proposed using more criteria in the future, and also involving more payment systems in the evaluation.

7. References

1. Shaikh, A. A., Hanafizadeh, P., & Karjaluoto, H. (2017). Mobile Banking and Payment System: A Conceptual Standpoint. International Journal of E-Business Research, 13(2) 14-27.
2. Jetsiktat, G., Panthuwadeethorn, S., & Phimoltares, S. (2015). Enhancing user authentication of online credit card payment using face image comparison with MPEG7-edge histogram descriptor. In International Conference on Intelligent Informatics and Biomedical Sciences pp. 67-74. IEEE Tokyo.
3. Khan, B. U. I., Olanrewaju, R. F., Baba, A. M., Langoo, A. A., & Assad, S. (2017). A Compendious Study of Online Payment Systems: Past Developments, Present Impact, and Future Considerations. International journal of advanced computer science and applications, 8(5), 256-271.
4. Chiu, C. M., Wang, E. T., Fang, Y. H., & Huang, H. Y. (2014). Understanding customers' repeat purchase intentions in B2C e-commerce: the roles of utilitarian value, hedonic value and perceived risk. Information Systems Journal, 24(1), 85-114.
5. Atkinson, R. D., Castro, D., Ezell, S., McQuinn, A., & New, J. A Policymaker's Guide to Digital Infrastructure. Information Technology and Innovation Foundation (2016).
6. Report linker, https://www.reportlinker.com/ last accessed 2018/04/02
7. Luo, M., Zhang, Y., Khan, M. K., & He, D. (2017). A secure and efficient identity-based mutual authentication scheme with smart card using elliptic curve cryptography. International Journal of Communication Systems, 30(16).
8. Chatterjee, K., & De, A. (2016). A Novel Multi-Server Authentication Scheme for e-commerce Applications Using Smart Card. Wireless Personal Communications, 91(1), 293-312.
9. Huang, X., Dai, X., & Liang, W. (2014). BulaPay: a novel web service based third-party payment system for e-commerce. Electronic Commerce Research, 14(4), 611-633.
10. Khan, B. U. I., Olanrewaju, R. F., Baba, A. M., Langoo, A. A., & Assad, S. (2017). A Compendious Study of Online Payment Systems: Past Developments, Present Impact, and Future Considerations. International Journal of Advanced Computer Science And Applications, 8(5), 256-271.
11. Moumane, K., & Idri, A. (2018). A Systematic Map of Mobile Software Usability Evaluation. In World Conference on Information Systems and Technologies (pp. 58-67).
12. Rochimah, S., Rahmani, H. I., & Yuhana, U. L. (2015). Usability characteristic evaluation on administration module of Academic Information System using ISO/IEC 9126 quality model. In Intelligent Technology and Its Applications (ISITIA), 2015 International Seminar on (pp. 363-368).
13. Chiu, C. M., Wang, E. T., Fang, Y. H., & Huang, H. Y. (2014). Understanding customers' repeat purchase intentions in B2C e-commerce: the roles of utilitarian value, hedonic value and perceived risk. Information Systems Journal, 24(1), 85-114.
14. Pfister, J., & Schwabe, G. (2016). Going Paperless with Electronic Data Safes: Information Ecology Fit and Challenges.
15. Statista. https://www.statista.com/statistics/508988/preferred-payment-methods-of-online-shoppers-worldwide/. 2017
16. WebPageFX. https://www.webpagefx.com/blog/web-design/online-payment-systems/. 2018
17. Wahab, A. A., Ahmad, F., Baharom, F., & Yahaya, J. (2014). A case study of quality evaluation from consumers' perspectives on Malaysian B2C e-commerce websites. Management and Technology in Knowledge, Service, Tourism & Hospitality, 19.
18. Behkamal, B., Kahani, M., & Akbari, M. K. (2009). Customizing ISO 9126 quality model for evaluation of B2B applications. Information and software technology, 51(3), 599-609.
19. Sarrab, M., Elbasir, M., & Alnaeli, S. (2016). Towards a quality model of technical aspects

for mobile learning services: An empirical investigation. Computers in Human Behavior, 55, 100-112.

20. Ghadirli, H., & Rastgarpour, M. (2014) . A paradigm for the application of cloud computing in mobile intelligent tutoring systems. International Journal of Software Engineering & Applications, 4(2), 63-73.
21. Rabi, S., Semi, A., & Hector, O. (2012). Usability characteristics of mobile applications. Proceedings of First International Conference on Behavioural and Social Science Research, 13-21.
22. Moumane, K., Idri, A., & Abran, A. (2016). Usability evaluation of mobile applications using ISO 9241 and ISO 25062 standards. SpringerPlus, 5(1), 548.
23. Kundu, S., & Tyagi, K. 92017). Selection and classification of common factors affecting the maintainability on the basis of common criteria. International Journal of Business Information Systems, 26(3), 402-412.
24. Djouab, R., & Bari, M. (2016). An ISO 9126 Based Quality Model for the e-Learning Systems. International Journal of Information and Education Technology, 6(5), 370.
25. Al_Nawaiseh, A. J., Helmy, Y., & Khalil, E. (2020). A New Software Quality Model for academic Information System (case study E-learning system). INTERNATIONAL JOURNAL OF SCIENTIFIC & TECHNOLOGY RESEARCH, 9(01), 271-282.
26. Yulianty, A., & Kurniawati, A. (2021). Quality Analysis of Bios Portal Website at Banking Companies Using ISO/IEC 25010: 2011 Method. Int. Res. J. Adv. Eng. Sci, 6(2), 11-16.
27. ISO (2014). The ISO 2013 survey. ISO Ediciones.
28. Elorfi, A., Aljabour, B., Younis, M. A., & Ihwas, R. (2020, September). Developing a Framework for Measuring and Evaluating the Quality of Libyan Locally Developed Software Products. In Proceedings of the 6th International Conference on Engineering & MIS 2020 (pp. 1-5).
29. Tounekti, O., Ruiz-Martínez, A., & Skarmeta-Gómez, A. F. (2021). Users' Evaluation of a New Web Browser Payment Interface for Facilitating the Use of Multiple Payment Systems. Sustainability, 13(9), 4711.

Appendix

Table 1: ISO/IEC 9126 characteristics and sub-characteristics

ISO Feature	Criteria	Explanation
Functionality	Suitability	Can the software perform required tasks?
	Accuracy	Is the expected result achieved?
	Interoperability	Does the system interact with other systems?
	Security	Does the system stop unauthorized access?
Reliability	Maturity	Have the faults of the software been eliminated?
	Fault Tolerance	Does the system handle errors?
	Recoverability	Does the system still work after data loss?
Usability	Understandability	Is the system easy to use?
	Learnability	How easy can the user learn to use the system?
	Operability	Can the system be used with less effort?
	Attractiveness	Does the user interface look good?
Efficiency	Time Behaviour	How quickly does the system respond?
	Resource Utilization	Does the system utilize resources?
Maintainability	Analysability	Can the system deficiencies be diagnosed?
	Changeability	Can the system be modified?
	Stability	Has the system passed all software tests?
	Testability	Can the system be tested?
Portability	Adaptability	Can the system be changed to fit requirement?
	Installability	Can the system be installed?
	Co-existence	Can the system perform given task?
	Repleceability	Can the system be used in place of other?

The Evaluation Flowchart & Evaluation scale

Figure 2: evaluation flowchart

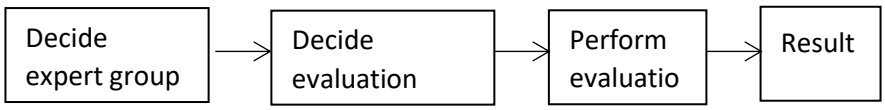

Table 2: Evaluation scale

Scale	Interpretation
1	Poor
2	Fair
3	Good
4	Very good
5	Excellent

Table 3: Expert's evaluations of the online payment systems

Metric Name	Sub-criteria	Ideal value	Expert1 Score					Expert 2 Score					Average score				
			PayPal	Amazon Pay	Google Pay	2Checkout	Dwolla	PayPal	Amazon Pay	Google Pay	2Checkout	Dwolla	PayPal	Amazon Pay	Google Pay	2Checkout	Dwolla
Functionality	Suitability	1	1	1	1	0.9	0.6	1	1	0.9	0.9	0.6	1	1	0.95	0.9	0.6
	Accuracy	1	1	1	1	0.9	0.8	1	1	0.9	0.9	0.6	1	1	0.95	0.9	0.7
	Interoperability	1	1	1	1	0.9	0.6	1	1	0.9	0.9	0.5	1	1	0.95	0.9	0.55
	Security	1	1	1	1	0.4	0.7	1	1	0.9	0.5	0.8	1	1	0.95	0.45	0.75
Reliability	Maturity	1	1	1	0.8	0.8	0.6	1	1	0.8	0.8	0.6	1	1	0.8	0.8	0.6
	Fault Tolerance	1	1	1	0.9	0.9	1	1	0.9	0.8	0.7	1	1	0.95	0.85	0.8	1
	Recovery	1	1	1	0.9	0.9	1	1	0.9	0.8	0.7	1	1	0.95	0.85	0.8	1
Usability	Understandability	1	1	1	0.9	0.8	0.5	0.9	0.8	0.9	0.8	0.6	0.95	0.9	0.9	0.8	0.55
	Learnability	1	1	1	0.9	0.6	0.5	0.9	0.8	0.9	0.7	0.6	0.95	0.9	0.9	0.65	0.55
	Operability	1	1	1	0.9	0.6	0.8	0.9	1	0.9	0.6	0.7	0.95	1	0.9	0.6	0.75
	Attractiveness	1	1	1	0.8	0.7	0.6	0.9	1	0.9	0.6	0.7	0.95	1	0.85	0.65	0.65
Efficiency	Time Behavior	1	1	0.7	0.9	0.8	0.9	1	0.8	0.8	0.8	0.8	1	0.75	0.85	0.8	0.85
	Resource Utilization	1	1	0.8	0.9	0.8	0.9	1	0.8	0.8	0.8	0.8	1	0.8	0.85	0.8	0.85
Maintainability	Analysability	1	1	1	1	0.8	0.8	1	1	0.8	0.8	0.7	1	1	0.9	0.8	0.75
	Changeability	1	1	1	1	0.9	0.8	1	1	0.8	0.8	0.7	1	1	0.9	0.85	0.75
	Stability	1	1	1	1	0.9	0.7	1	1	0.8	0.6	0.7	1	1	0.9	0.75	0.7
	Testability	1	1	1	0.9	0.8	0.8	1	1	0.8	0.8	0.6	1	1	0.85	0.8	0.7
Portability	Adaptability	1	1	0.6	0.8	0.8	0.7	1	0.8	0.8	0.8	0.7	1	0.7	0.8	0.8	0.7
	Installability	1	1	0.5	0.8	0.8	0.8	1	0.5	0.8	0.8	0.8	1	0.5	0.8	0.8	0.8
	Co-existence	1	1	0.5	0.8	0.8	0.7	1	0.5	0.8	0.8	0.7	1	0.5	0.8	0.8	0.7
	Repleceability	1	1	0.9	0.8	0.8	0.6	1	0.8	0.8	0.8	0.6	1	0.85	0.8	0.8	0.6

Table 4: Evaluation result

Criteria	**Ideal Value**	**Scores**				
		Amazon Pay	**2Checkout**	**Dwolla**	**Google Pay**	**Paypal**
Functionality	**4**	4	3.15	2.6	3.8	4
Reliability	**3**	2.9	2.4	2.6	2.5	3
Usability	**4**	3.8	2.7	2.5	3.55	4
Efficiency	**2**	1.55	1.6	1.7	1.7	2
Maintainability	**4**	4	3.2	2.9	3.55	4
Portability	**4**	2.55	3.2	2.9	3.2	4
Total	**21**	**18.8**	**16.25**	**15.2**	**18.3**	**20.8**