Integrating the PIECES Framework with Human Computer Interaction to Evaluate User Acceptance of E-Marketplace Information Systems

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Abstract. This study evaluates user acceptance of E-Marketplace information systems by integrating the PIECES Framework with a Human–Computer Interaction (HCI) approach. This integration offers a comprehensive view of both technical system performance and user-centered interaction, particularly for users with disabilities. The PIECES Framework assesses system quality and operational effectiveness, while the HCI approach emphasizes usability, user experience, and interaction patterns that influence acceptance and satisfaction. Using an action research design, data were collected via questionnaires from a sample of 30 respondents. The findings indicate that user interest has a partial yet significant effect on behavior, while other variables jointly influence user engagement. Notably, there was a marked increase in user understanding of internet tools—from 27% initially not understanding application use to 91% demonstrating improved comprehension. This progress underscores the importance of accessible and user-friendly design in enhancing trust and perceived security. The results highlight the critical role of consistent interface design, clear navigation, and inclusive visual elements in promoting usability and satisfaction. The study offers valuable insights for system developers and researchers to improve E-Marketplace platforms by aligning technical performance with inclusive, user-centric design—ensuring accessibility for all users, including persons with disabilities, and driving greater digital inclusion in the evolving digital economy.

Keywords: E-Markerplace, Disabilities, PIECES Framework, Human Computer Interaction

1. INTRODUCTION

In the digital age, the proliferation of social media platforms has accompanied in a revolutionary shift in the way businesses approach marketing and consumer engagement [1]. This transformation is particularly evident in the e-commerce sector, where social media not only serves as a direct channel for consumer interaction but also as a rich source of data that can be analyzed to glean insights into consumer preferences, behaviors, and trends. The strategic incorporation of social media analytics into e-commerce marketing practices offers a compelling advantage, enabling businesses to tailor their strategies more effectively and efficiently than ever before [2]. Utilization of technology as social media to communicate, deliver, and exchange offers has value for organizational stakeholders.

The role of digitalization through technology and information systems is the first step to promote products in a wider range[3]. That public information systems are a means of meeting the needs of people who adopt digital technology [4][5]. In commercial applications, an information system represents an integrated combination of technology, human resources, and procedures designed to collect, process, store, and disseminate data into valuable business information that supports operational, managerial, and decision-making functions within an organization [6].

Based on this research background, this study examines the use of the PIECES framework method, which has six categories in classification and problem solving: Performance, Information and Data, Economics, Control and Security, and efficiency. How is the quality of interaction, usability, and user experience on e-marketplaces for users with disabilities based on the Human–Computer Interaction (HCI) approach?
What factors have the greatest influence on the acceptance of disabled users in using e-marketplaces based on the PIECES–HCI integrative model?

This research is different from previous research because the survey was conducted on the behavior of users with disabilities. Although many studies have been carried out by previous researchers, research using the PIECES system analysis framework to evaluate user acceptance of information systems [7] especially those experienced by persons with disabilities [8], is still rarely carried out. Through this approach, it is

possible to evaluate how factors such as usability, interface design, user satisfaction, and user experience influence the acceptance of information systems. The PIECES Framework serves an essential role in the analysis, evaluation, and enhancement of information system quality. It provides a structured approach that enables researchers and system developers to identify system weaknesses and potential areas for improvement across multiple dimensions of performance [9]. There are many e-marketplace application platforms that are only concerned with the element of sales without paying attention to user needs, so it is necessary to analyze and evaluate the system framework for system improvement and development. One of the PIECES framework analysis methods is the development of information systems, work plans, system quality, accurate information, estimated costs of building systems, efficiency of security systems, and improvement of system services to users [10][11].

The important role of technology in being accepted by all users, especially persons with disabilities, is a system requirement for information system behavior. The results of the study state that intellectual limitations can be minimized by providing motivation for self-confidence and a willingness to learn independently through social media[12]. Digital proficiency is one of the stimulants that influence the motor skills of students with disabilities, 76% success rate of achievement of mentally retarded students are more interested in learning by using online information media devices. In previous studies that have been carried out, several researchers have stated that it is still necessary to research information systems that provide content marketing to meet the needs of users, especially people with disabilities [13]. An attractive and easy-to-use interface design is the reason for building an e-marketplace platform. The willingness to learn entrepreneurship independently for special school students as a provision to enter the world of work. This is an opportunity for new research and innovation to be generated from the proposed research, namely an e-marketplace information system that meets the functional and non-functional needs of the information system, so it is necessary to analyze the quality of service [14] on the acceptance of information system behavior.

One of the applications of Human–Computer Interaction (HCI) [15] is in the design of mobile applications that are intuitive and easy to navigate, as well as in e-marketplaces with fast search features and attractive product displays. Through HCI [16], developers

can design systems that are functionally robust, user-friendly, easy to learn, and capable of supporting an optimal digital experience. The relationship between e-marketing and business innovation has a positive influence on the quality services. E-marketing, which includes the use of online platforms and digital strategies, provides opportunities to increase their visibility and customer reach. By using digital technology, MSMEs can run effective marketing campaigns, increase their brand exposure, and reach a wider target market [17]. The predictions for HCI's future growth in the Metaverse are made. In other words, HCI will be transparent to the user in the digital realm, and people will get along with the computer in a natural and equitable way. In the interaction, wearable devices allow for an immersive experience in the interaction, but they restrict the participants' freedom of movement and perception [18]. One of the applications of Human–Computer Interaction (HCI) is in the design of mobile applications [19] that are intuitive and easy to navigate, as well as in e-marketplaces with fast search features and attractive product displays. Through HCI, developers can design systems that are functionally robust, user-friendly, easy to learn, and capable of supporting an optimal digital experience [20].

2. METHODS

The research gap between previous studies and the current study lies in the focus and methodology used [21]. This study aims to fill this gap by analyzing PIECES to measure user satisfaction user satisfaction e-marketplace for disabilitas. This research is essential to (a) improve the quality of education academic, (b) enhance efficiency, (c) remain highly relevant to the local educational environment, and (d) contribute to academic literature.

This study uses action research. The reason for using action research is because it involves direct user involvement, empirical testing of user experiences, and implementation of system improvements based on real feedback. Data collection was carried out through interviews and observations of special school principals, culinary teachers as companions for superior SLB product managers, and students as users of information systems. Observation results to obtain information on the problems faced in improving the marketing of student-made products. Furthermore, it is used as a rule base, which is used as an analysis of the needs of the e-marketplace information

system. This research is focused on the analysis of the PIECES framework consisting of performance, information, economy, control, efficiency, and service. As for the testing phase of evaluating the system's acceptance by users, it is carried out by distributing questionnaires and analyzing demographic data with statistical tests. The survey was conducted at the special school in Kudus, with the target audience being class X-XII high school students who will graduate from school. In this study, Developing an inclusive e-marketplace system for users with disabilities requires a structured and systematic approach. The system development method uses the system development life cycle (SDLC) method [22], [23], including the identification stage of requirements by formulating data that can be used to determine system requirements that suit the needs of the user, the mechanism for promoting sales products, and designing a system that is easy for people with disabilities to use. Next, the system requirements analysis stage, both functional and non-functional [24], is carried out. At this stage, the researcher determines the system's users. Application users include IT staff, administrators, teachers, students, and the general public. Furthermore, an analysis of non-functional system requirements was carried out for testing user acceptance using the PIECES framework used to find problems assessed in terms of Performance, Information, Economy, Control, Efficiency, and services. Usability testing was conducted to evaluate an inclusive e-marketplace system for users with disabilities, assessing aspects of effectiveness, efficiency, and satisfaction based on Human–Computer Interaction (HCI) principles. The testing procedure included: assessing the usability of e-marketplaces by users with disabilities, participants were selected by considering visual, mobility, hearing, cognitive. To measure the scale of system performance, information, timeliness, efficiency, cost and service using an interval scale [25]. The types of interval scales consist of: (1) Likert scale where the respondents' answers have positive and negative gradations. The highest score is given a positive answer. (2) The Guttman scale uses only two Yes or No answers. Score 1 for agree answers (Yes) and 0 for disagree answers (No) [26][27]. The evaluation of Human-Computer Interaction (HCI) is carried out using the usability testing method among others, the usability evaluation focuses on several aspects, including navigation and menu structure, design consistency, system feedback, access speed, text readability, user errors, and user satisfaction [28]. The stages of the research are as shown in Figure 1.
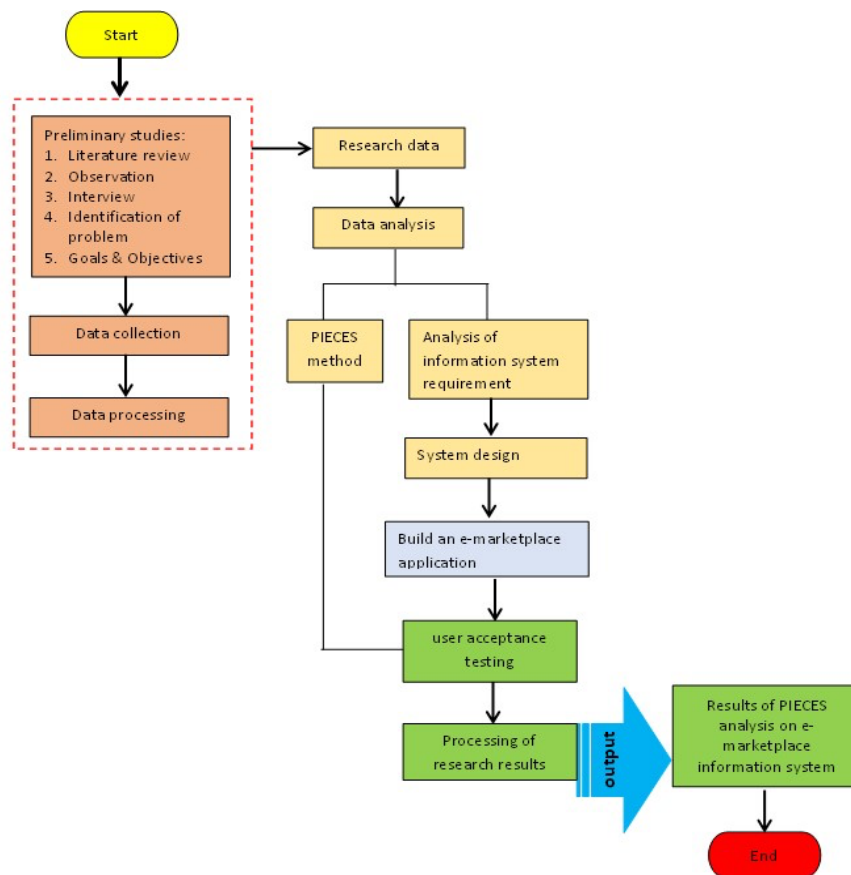
Figure 1. The Stages of Research

In Figure 1, it is explained that the stages of the research that will be carried out are steps to achieve the goals set so as to produce the output of an e-marketplace information system application that suits the needs of users, especially people with disabilities. The first step is to do a literature study to obtain research data. The second stage is to analyze functional and non-functional data. The third stage is designing and building an e-marketplace system. Then the fourth stage is to test and evaluate the system until the final results of the PIECES analysis research are obtained.

3. RESULTS AND DISCUSSION

3.1. E-Marketplace Evaluation

The e-marketplace application is able to accommodate user data in using the product offered Internet services according to consumer tastes. The e-marketplace application

system plays an important role in service quality because the system is used as buying and selling information, online promotions. This information will later be used as a decision support system and become a reference for managers to assess the implemented system. This system is one of the business strategies to see the needs and desires of buyers. The results of this study resulted in an e-marketplace information system application. This website is used as a promotional space for buying and selling online the superior products of SLBN Purwosari Kudus. Next, do the User Acceptance Testing. Beta testing was conducted on 30 respondents on functional, interface, and system benefits using the questionnaire method consisting of statements of the respondents' consent. The selection of sample size was based on methodological considerations that the number had met the minimum limit recommended in statistics, establishing that a sample size ≥ 30 allows data distribution to approach normality, so that descriptive and inferential analysis can be carried out more stably.

Given the physical limitations of the user, the questionnaire was distributed manually and filled in by the respondent, assisted by a companion teacher translator to test its legibility. Statements for respondents can be seen in Table 1.

Table 1. List of Beta Testing Statement

No	Statement
1	The ease of operation of e-marketplace applications
2	The convenience of using the application as a whole
3	The suitability of the application for increasing the effectiveness of the information access process
4	Updated application suitability
5	The accuracy of the application is in accordance with the benefits.
6	Appropriateness of applications based on user access rights
7	The suitability of the use of the color of the text and the design of the background (background)
8	The accuracy of button and menu functions for the desired purpose
9	Accuracy of naming buttons and menus
10	The accuracy of the displayed message (success or failure)

Beta testing was obtained from the questionnaire answer scores of 10 questions, the number of respondents was 30 and the feature assessment used a Likert scale of 1-5. The reliability test results showed a Cronbach's Alpha value of α = (enter value here). This value is above the threshold of 0.70, thus declaring the questionnaire reliable. This means that all questions consistently measure user perceptions regarding the experience of using features on the e-marketplace system. The results of beta testing of the statements submitted to respondents can be seen in Table 2.

Table 2. Beta Testing Results of e-marketplace applications

Statement	Score	Percentage	Decission
1	70	70%	Good
2	80	80%	Very Good
3	60	60%	Enough
4	80	80%	Very Good
5	70	70%	Good
6	70	70%	Good
7	70	70%	Good
8	70	70%	Good
9	80	80%	Very Good
10	70	70%	Good

The score distribution pattern indicates that some aspects received high ratings, while others still require improvement. The lowest scores indicate areas that respondents still considered less than optimal. These lower scores may reflect barriers to interaction, such as confusing processes, uninformative displays, or features that are not yet fully accessible to users with disabilities. The difference in scores between bars also reflects improvement priorities: aspects with low scores become the primary focus for subsequent iterative development, as shown in Figure 1.

Figure 1 shows user perceptions of various aspects of the system more easily and intuitively. By examining the high and low results, identifying platform strengths and HCI-based improvements significantly contributed to increased user understanding and satisfaction. The test results show that the existing system functionality in the e-marketplace is running well and in accordance with system requirements.
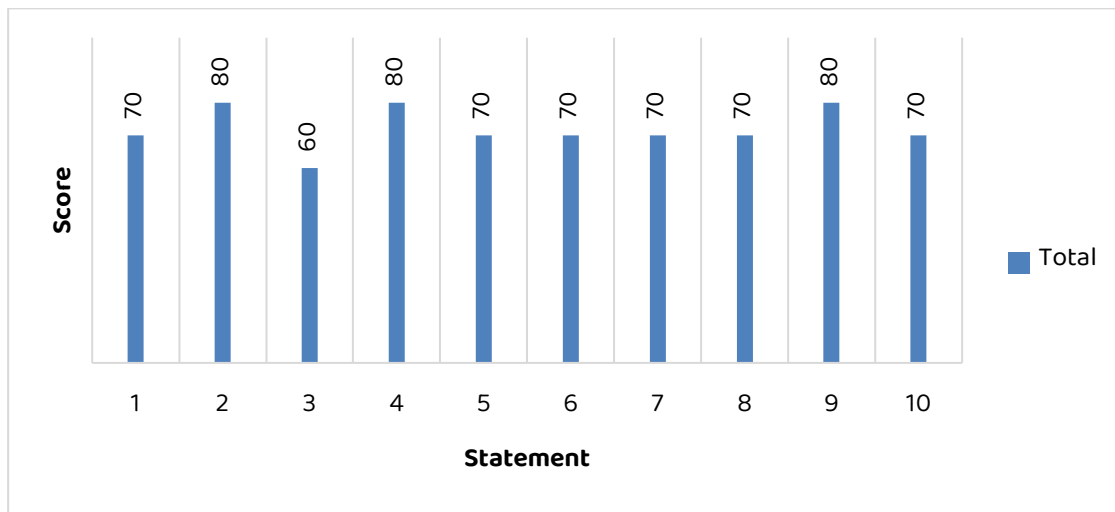
Figure 1. Statement Score

Furthermore, data from respondents was processed using the PIECES Framework method by calculating as many as six variables.

1. Performance (P) analyzes the software and hardware requirements needed to create an e-marketplace application. The results of the distribution based on display performance indicators are easy to understand for those who have used computer technology devices. As a result, the initial and final conditions are that 75% of users are already using mobile devices and computers. Meanwhile, 25% of respondents have never or rarely used a device.

2. Information (I) is an analysis of data requirements. The data needed includes the Purwosari SLBN profile, product catalog, orders, transactions, and service information. Information indicators include easy-to-understand displays and information as needed. The results obtained at the initial and final conditions are 100% according to user requirements. The information generated is timely.

3. Economy (E) is an analysis of the costs that will be incurred in making the system, as well as the cost of maintaining a domain or year-long hosting subscription that can be borne by the SLB manager. Economic indicators include the quality of service according to cost and the use of internet data for access speed. In the initial condition, 15% used personal data, and in the final condition, 85% used SLB service facilities. This shows that the implementation and provision of facilities can meet the needs of users.

4. Control (C) analyzed the access control system. The indicators used for system security are guaranteed, and it's easy to place product orders. The results

obtained at the initial conditions of 50% and 70% show that there is a significant increase in the use of the system.

5. An efficiency (E) analysis is carried out regarding the increase in performance achieved when this application is run. The indicators used are time, cost, and effort. The results of the initial conditions are 80% and the final conditions are 100%, which shows that the application can improve online marketing performance.

6. Service (S) In this stage, an analysis of the menus and services needed in the web application to be built is carried out. Indicators based on the services and types of services offered are appropriate. The results obtained at the initial conditions are 75% and the final conditions are 100%, which shows that the services provided on the e-marketplace meet the needs of acceptance of usage behavior.

The results of the study indicate that the analysis using the PIECES framework focuses on the presentation of conditions, findings, and identification of user problems as found in the field, aspects of system performance, information quality, efficiency, and services perceived by users. In the final stage, an analysis is carried out to determine the extent to which information system user behavior is. The results of the analysis of an increase in revenue related to the implementation of the e-marketplace application are shown in Table 3.

Table 3. PIECES analysis on acceptance of e-marketplace information system user behavior

No	Statement	Initial Conditions		Final Conditions	
		Yes	No	Yes	No
1	Have you ever used a computer device?	75%	25%	75%	25%
2	Have you ever used social media facilities?	100%	0%	100%	0%
3	Have you ever heard the term e-markerplace before?	15%	85%	100%	0%
4	Is e-marketplace the same as online selling?	15%	85%	100%	0%
5	Have you ever done online shopping?	50%	50%	50%	0%
6	Do you understand the menus in the e-	15%	85%	100%	0%

No	Statement	Initial Conditions		Final Conditions	
		Yes	No	Yes	No
	marketplace application?				
7	Do you order goods online?	0%	100%	100%	0%
8	Have you ever made an online transaction?	0%	100%	100%	0%
9	Is the information technology training easy to understand?	0%	100%	80%	20%
10	Is the facility menu on the website interesting?	0%	100%	100%	0%
	Average	27%	73%	91%	5%

Based on the results of the analysis in Table 3, it shows that there has been an increase in students' and teachers' knowledge of digital technology. On average, there was an increase of 91% in understanding the use of internet media devices from only 27% previously not understanding the use of e-marketplace applications. These findings indicate that the interventions provided in the form of training and HCI-based interface improvements were successful in improving the digital literacy and operational capabilities of users with disabilities who previously had certain limitations in using digital technology.

3.2. Discussion

The findings of this study reinforce the critical role of usability and accessibility in shaping user acceptance of e-marketplace systems—particularly for users with disabilities. The integration of the Human–Computer Interaction (HCI) approach with the PIECES Framework has proven effective in uncovering key technical and human-centered design challenges that influence system usability, user experience, and interaction behavior.

The data indicate that navigation structure, menu clarity, and consistent design elements significantly impact the ease of use and overall satisfaction for users. Specifically, the incorporation of common, recognizable icons and adherence to design standards—such as color contrast and button placement—emerged as usability enhancers. Moreover, real-time system feedback through visual cues or notifications

helped users understand their interactions more intuitively, reducing confusion and enhancing learning curves.

Despite these improvements, the study also reveals persistent accessibility barriers, especially in the areas of navigation complexity, information overload, and interaction efficiency. These findings align with prior literature suggesting that many digital systems are not designed with inclusive principles in mind. Users with sensory, cognitive, or motor impairments continue to face challenges due to non-intuitive layouts, inaccessible elements, and inconsistent interface behaviors.

The PIECES–HCI integration allowed for a more structured and layered evaluation—assessing both system performance and user-centered design in a complementary manner. By mapping user behavior and experience data to the PIECES variables (Performance, Information, Economy, Control, Efficiency, and Services), the study demonstrates that an inclusive interface can significantly increase understanding and digital engagement. For instance, there was a notable shift in comprehension and usage, with users reporting increased ability to navigate and complete transactions after the interface and training interventions—rising from 27% baseline comprehension to 91% post-intervention understanding.

In addition, these results validate that system elements such as performance responsiveness, data clarity, and ease of control are not only technical metrics but also usability indicators that influence emotional trust and acceptance. When disabled users feel that a system is responsive and easy to control, they are more likely to continue using it, thus supporting sustained adoption and user retention.

Another important discussion point emerging from the study is the sustainability of digital platforms in special needs educational settings, such as SLBs (Special Needs Schools). Although digital transformation opens up economic and educational opportunities, its success hinges on the institution's capacity to manage operational costs—including hosting fees, security updates, and infrastructure maintenance. The results emphasize that SLBs must adopt strategic and collaborative approaches to ensure long-term platform viability. For instance:

1. Leveraging educational hosting packages or open-source platforms can help minimize cost overhead.

2. Partnerships with universities, IT communities, or startups may provide technical support, subsidized resources, or co-managed maintenance solutions.

3. Capacity-building initiatives, such as staff and student training in basic digital maintenance, can reduce dependency on external services.

Moreover, beyond functional use, the system's role in empowering entrepreneurship and self-reliance among students with disabilities is critical. The ability to participate in online marketplaces fosters not just economic engagement, but also confidence and digital inclusion. This aligns with broader educational goals of promoting independence and bridging digital divides. The study supports the conclusion that a user-centered, inclusive design strategy, guided by structured analysis tools like HCI and PIECES, offers a viable pathway to creating e-marketplace platforms that are both functional and equitable. Importantly, it shifts the paradigm from treating accessibility as an afterthought to embedding it as a core design principle—enhancing usability for all, not just users with disabilities.

4. CONCLUSION

Based on the analysis of Human–Computer Interaction (HCI) using the PIECES Framework, it can be concluded that the application of HCI principles plays a crucial role in enhancing the overall quality of an information system. The results of calculations and data analysis using the PIECES Framework method, it is considered very effective because it analyzes the system per variable so that the system can be evaluated more deeply. The results of the data analysis show that all PIECES variables get a very good category for ease and benefits of using the system, as do menu availability, performance time efficiency, and access speed. Information systems are made according to needs based on problem analysis and system design. This website helps the public obtain buying and selling information quickly, precisely, and efficiently because they can access it online. Performance aspect, the system should ensure optimal response speed and intuitive navigation to enable users to complete tasks efficiently. In terms of Information, the presentation and display of information must be clear, easily understood, and relevant to user needs. From the Economics

perspective, the implementation of good HCI design can reduce user training time and operational costs resulting from system misuse.

Furthermore, the Control aspect highlights the importance of proper security mechanisms and feedback features to minimize user errors and maintain data integrity. The Efficiency aspect emphasizes that a consistent and intuitive. interface design can improve user productivity and streamline workflow. Finally, from the Service aspect, a positive user experience is reflected in users' satisfaction and comfort when interacting with the system. Practical Implications for Inclusive Design Developers need to ensure that the interface is usable by a wide range of disabilities, including blindness, low vision, physical disabilities, cognitive disabilities, and deafness, with the availability of universal icons and simple language.

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