

DEVELOPMENT OF HUMAN COMPUTER INTERACTION IN THE EDUCATION SECTOR: SYSTEMATIC LITERATURE REVIEW

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Abstract: Rapid technological developments have had a significant impact on various sectors, including education, where Human Computer Interaction (HCI) plays a role in increasing the effectiveness of technology-based learning. However, there are still challenges in the implementation of HCI, such as interface design, infrastructure, and user engagement. This study aims to evaluate the application of HCI in education by reviewing technologies such as chatbots, e-learning, Augmented Reality (AR), Virtual Reality (VR), Artificial Intelligence (AI), and the use of PowerPoint to support learning. Using the Systematic Literature Review (SLR) method based on journals published in 2020-2024 from Google Scholar, the results of the study show that chatbots increase communication efficiency and access to information, while AR and VR-based learning media help understand concepts, especially for students with special needs. The e-learning system designed with HCI principles provides an interactive and user-friendly learning experience, although there are still obstacles such as limited infrastructure and lack of training for educators. In addition, the use of AI in learning media has great potential in increasing engagement and quality of learning. Therefore, this study emphasizes the importance of user-oriented interface design, strengthening technological infrastructure, and collaboration between stakeholders to support more optimal implementation of IMK in the world of education.

Keyword: human and computer interaction (HCI); artificial intelligence (AI); augmented reality (AR); education.

Abstrak: Perkembangan teknologi yang pesat telah memberikan dampak signifikan di berbagai sektor, termasuk pendidikan, di mana Interaksi Manusia dan Komputer (IMK) berperan dalam meningkatkan efektivitas pembelajaran berbasis teknologi. Namun, masih terdapat tantangan dalam implementasi IMK, seperti desain antarmuka, infrastruktur, dan keterlibatan pengguna. Penelitian ini bertujuan untuk mengevaluasi penerapan IMK dalam pendidikan dengan meninjau teknologi seperti chatbot, e-learning, Augmented Reality (AR), Virtual Reality (VR), Artificial Intelligence (AI), serta penggunaan PowerPoint dalam mendukung pembelajaran. Menggunakan metode Systematic Literature Review (SLR) berdasarkan jurnal terbitan 2020-2024 dari Google Scholar, hasil penelitian menunjukkan bahwa chatbot meningkatkan efisiensi komunikasi dan akses informasi, sementara media pembelajaran berbasis AR dan VR membantu pemahaman konsep, terutama bagi siswa berkebutuhan khusus. Sistem e-learning yang dirancang dengan prinsip IMK memberikan pengalaman belajar yang interaktif dan ramah pengguna, meskipun masih ditemukan kendala seperti keterbatasan infrastruktur dan kurangnya pelatihan bagi tenaga pendidik. Selain itu, pemanfaatan AI dalam media pembelajaran memiliki potensi besar dalam meningkatkan keterlibatan dan kualitas pembelajaran. Oleh karena itu, penelitian ini menekankan pentingnya desain antarmuka yang berorientasi pada pengguna, penguatan infrastruktur teknologi, serta kolaborasi antar pemangku kepentingan guna mendukung implementasi IMK yang lebih optimal dalam dunia pendidikan.

Kata kunci: interaksi manusia dan komputer (IMK); artificial intelligence (AI); augmented reality (AR); pendidikan.

INDRODUCTION

The rapid development of information is felt in various sectors including education, agriculture, culture and the health sector. Especially in the field of education which has contributed a lot to the world related to social and scientific groups. This development requires humans to continue to learn about the increasingly rapid technological advances. Development in the field of Informatics, one of which contains a sub-chapter, namely Human and Computer Interaction. Human and Computer Interaction is a process that discusses the communication relationship between Users or Humans and Computers, both directly and indirectly.

The application of humans and computers themselves usually occurs in the work environment. Aspects that are usually discussed in it include design, language, color, layout, psychology and the social impact of Human and Computer Interaction (Chandra, 2024) The implementation of IMK is said to be successful if there is interaction between the user and the existing system, so that the user's desired goals can be achieved (Tuzzahrah et al., 2023). One of the benefits of learning about Human Computer Interaction is being able to carry out tasks well and produce a system that is considered safe (Putra & Wahyuningsih, 2024). Important factors in previous research on the discussion of Human Computer Interaction are humans, dependence on technology access, ergonomic system design, and satisfaction in user usability (Putra & Wahyuningsih, 2024).

The lack of in-depth reviews of the field of Human Computer Interaction has made researchers interested in discussing matters related to the relationship between Education. The collection and analysis of lots of data can improve capabilities and measure, as well as the process of calculating the scale of everything (Prawiyogi & Anwar, 2023). This study uses the Systematic Literature Review (SLR) method (Doni et al., 2023) with the aim of determining the platform, advantages and disadvantages of Human Computer Interaction in the discussion in the field of Education. Researchers try to conduct literature studies

and searches on certain databases to facilitate the search for previous research.

The collection of related information was carried out by searching journals in the 2020-2024 period to be used to understand the topic in depth. This study aims to evaluate the implementation of Human Computer Interaction (HCI) in education based on journals published in the 2020-2024 period. The main focus of the study includes the use of technologies such as chatbots, e-learning, Augmented Reality (AR), Virtual Reality (VR), Artificial Intelligence (AI), and the use of PowerPoint in supporting the learning process. This study assesses the effectiveness of HCI technology in improving communication, access to information, and learning experiences, while identifying challenges such as limited infrastructure and training. In addition, this study also provides recommendations for optimizing the application of HCI-based technology to improve the quality of education and support continuous learning in the digital era.

It is expected that the results of the study can support the development of more inclusive and sustainable educational technology. The novelty of this study lies in the latest analysis of the application of IMK in education, using the Systematic Literature Review (SLR) approach to identify trends, benefits, and challenges from various previous studies. In addition, this study highlights inclusivity in the use of technologies such as AR, VR, and AI to support learning for students with special needs and the role of user-friendly interface design in improving the learning experience. By identifying challenges such as data security and ethics in the use of AI, this study provides strategic recommendations for more optimal and sustainable implementation of IMK, so that it can be a major factor in improving the quality of education in the digital era.

METHOD

The method used in this study is the use of the Systematic Literature Review (SLR) model. The research is based on several previous studies whose sub-chapters discuss

the relationship between Human and Computer Interaction (HCI) in the field of Education.

The purpose of using the SLR method is to search for, find and trace literature in previous studies using structured procedures for each step. The process in it is related to the process of recognition, identification and evaluation of all available research for certain themes and fields that have been carried out by researchers (Alfajri et al., 2022).

Systematic searches were carried out with the help of Google Scholar. The determination of the keywords used includes "SLR Human and Computer Interaction" or "SLR HCI" or "SLR HCI Education". The following is available in Table 1. explaining the classification in the keyword search process used in this study.

Table 1. Klasifikasi Search Keywords

Keywords	Keywords Search Results
SLR IMK Education	69

The year of publication used to limit this study is 2020 - 2024. Restrictions were made on the clustering of the literature review in the form of educational themes including: (1) Application of chatbots in the field of education; (2) Use of similar technology, namely Augmented Reality (AR) in learning; (3) E-learning in IMK; and (4) Utilization of Artificial Intelligence (AI) in the learning process. Grouping in the four major themes is used to maintain the effectiveness of the search in the field of education. After the process of searching, reading, limiting and filtering carefully, there are 20 selected articles that are used as the main references to support this research.

RESULT AND DISCUSSION

The following is Table 2, which discusses more in-depth details about each of the literature reviews used, namely:

Table 2. Systematic Literature Review (SLR)

No	Year	Article Title	Benefits	Obstacle	Development Recommendations
1.	2020	<i>Augmented Reality as an Educational Media Health for School Age Children</i> (Suciliyana & Rahman, 2020)	Media used for education that provides new perspectives. Information is delivered using real and virtual objects. AR can increase children's knowledge and support users who are still in school as an effort to realize health promotion.	AR is still not widely used in the health sector, especially nursing.	Education is needed for nurses in implementing AR media to provide education in the form of promotive actions.
2.	2021	<i>Droidcam Application Analysis Based on Principles and Human-Computer Interaction Paradigm</i> (Ziaul et al., 2021)	<i>droidcam</i> application is used for online learning processes . The following are the advantages when viewed from the IMK factor on <i>Droidcam</i> : 1. Make it easier for users to use this application 2. For settings, both input and output applications are also easy to implement. 3. Usability and ergonomic aspects	Barriers were not described in detail in previous studies.	Applications that have been built by implementing aspects and supporting factors in IMK.

			have been adjusted and assessed for the <i>droidcam</i> application.		
3.	2022	Collaborative Interaction Using Web Based <i>Virtual Reality</i> in English Language Learning (Revianti & Anggoro, 2022)	The students' experience using VR was considered quite good, they could collaborate and the students could understand the message conveyed by the teacher.	a. The need for students to pay attention to the desktop display b. Duration of VR usage tends to be longer. c. Audio and video interference is often experienced d. Students' experiences of learning using VR are low e. Connection settings for each student are less controlled f. The VR application used, namely Hubs, does not have a whiteboard type mechanism, clock and student recording.	1. Pay more attention to the VR applications used 2. Connections are also taken into account to improve the functionality of access to the platform.
4.	2022	Implementation of IMK on Student Cards based on <i>Augmented Reality</i> (AR) (Anshori et al., 2022)	a. Providing interactive experiences through the integration of Human-Computer Interaction with <i>Augmented Reality</i> technology. b. Facilitating access to information through digital interfaces.	The analysis of the integration of Human-Computer Interaction is not yet in-depth enough.	a. repeated <i>usability</i> testing to ensure optimal integration of Human-Computer Interaction. b. Develop additional features that are relevant to <i>users</i>, such as direct links to their systems.
5.	2022	Evaluation of LPPM IKIP PGRI Bojonegoro Management Information System using <i>Usability Testing</i> (Zainudin et al., 2022).	Provide relevant recommendations to improve system efficiency.	It does not cover all aspects of evaluation of the system, so the results are less comprehensive.	a. Involve <i>users</i> from various backgrounds to get a broader evaluation. b. Using Human Computer Interaction to simplify navigation and user interface.
6.	2022	<i>Powerpoint</i> Material on Human Interaction with the Environment for Elementary School Classes (Setiawan et al., 2022)	There are pictures of scenery, bright colors, various forms of writing, accompanied by the addition of videos, music and many pictures that children like, namely cartoons. You can add <i>games</i> such as guessing the picture and <i>quizzes</i> using automatic	Collaboration between several <i>stakeholders</i> is needed in combining the main elements and factors in IMK to develop interactive Powerpoint media.	The development of interactive PowerPoint media is based on several stages, namely: 1. Potential & Problem Stage, 2. Data collection, 3. Product Design, 4. Product design validation, 5. Design revisions, and 6. Final Product

			scoring.		
9.	2022	Implementation of Human and Computer Interaction System on <i>E-Learning Website</i> at STMIK Tegal (Lugianti et al., 2022)	<i>user interface</i> design on the website is very easy to understand because several system features meet good usability criteria.	There have been no significant obstacles in previous research.	STMIK Tegal developed an <i>e-learning website interface design</i> that can add <i>Google Calendar</i> as a reminder (notification) for the start of lecture schedules and exam times.
11.	2023	Interaction in Philosophy (Simamora, 2023).	A strong philosophical perspective, offering deep insights into interface design that takes into account ethical, social and cultural aspects.	Application Limitations: Philosophical approaches tend to be more conceptual and provide less direct solutions for practitioners.	Translating the ideas of philosophers to become a guide in designing applications for Educational technology. Then, involving practitioners to bridge philosophy by implementing it in Educational applications.
12.	2023	<i>E-learning Applications</i> at UNIPAS Singaraja (Tjahyanti & Gitakarma, 2023)	a. Improving user experience , regular evaluations help improve interface design, thereby increasing student comfort in using the application. b. Increasing the effectiveness of learning, better design interfaces can make students' focus undivided for the material being delivered.	The evaluation was not carried out comprehensively, so there is still a chance that there are aspects that are not assessed.	Conducting in-depth evaluations of all aspects, including accessibility for users with special needs. Then also being able to develop an adaptive interface.
13.	2023	Utilization of <i>Artificial Intelligence</i> in Learning and Assessment in the Digitalization Era (Oktavianus et al., 2023)	IMK is applied in the field of Education by implementing AI. In learning it is used for (1) <i>chatbots</i> , (2) Voice Recognition, (3) Image Recognition, (4) Recommendation Systems, and (5) <i>Machine Learning</i> . Providing learning experiences for students is also a focus of AI utilization.	It is necessary to be literate towards technology so that continuous adaptation is needed to be more responsive to the presence of AI. Ethics and Privacy are also at stake with the use of this omnipresent AI.	Clear regulations are needed to protect student data and ensure that AI systems do not harm students or teachers.
14.	2023	Implementation of <i>Artificial Intelligence</i> (AI) in Vocational Education in the Era of Industrial Revolution 4.0 (Yahya et al., 2023)	IMK focuses on Vocational Education by paying attention to: 1. Basic concepts and principles. 2. Designing AI that is relevant and tailored to students' needs, 3. Understanding statistics and AI supporting tools 4. Technical skills	1. The need for readiness in the advancement of AI 2. It requires high levels of adaptation and willingness to continue learning and follow AI developments.	Training is needed that supports AI technology. Among them are Presentation and Discussion activities that discuss the introduction of AI. The Second Stage is a demonstration and workshop related to the implementation of AI technology. Then you can do a <i>pre-test</i> and <i>post-test</i> .

			5. Effective collaboration and communication, 6. Understanding issues related to ethics and privacy		
15.	2023	Analysis of the Influence of <i>Virtual Reality</i> on the Development of Indonesian Education (Charles et al., 2023)	VR is a learning media solution because it will be more comfortable, fun, creative, innovative for all collage interests. IMK supporting factors are supported more efficiently with <i>the user interface</i> in <i>Virtual Reality</i> . Improve <i>hard skills</i> in the case of making <i>mind maps</i> .	Limitations in finding samples, thus affecting the generalization of findings for larger and more diverse findings so as to improve the <i>output results</i> .	The need for support in the form of additional training and efforts to overcome existing obstacles. Primarily promotional media used for the introduction of VR learning.
17.	2024	Implementation of <i>Artificial Intelligence</i> to Support Student Learning (Lediwara et al., 2024).	a. Increasing students' awareness and interest in AI b. Encourage exploration and innovation in advanced research	Having limited infrastructure and training	a. Providing adequate infrastructure to support AI Training b. Conduct training programs to support creativity between lecturers and students.
18.	2024	The Role of <i>Artificial Intelligence</i> (AI) in Islamic Religious Education Learning (Huda & Suwahyu, 2024)	There are influences, namely: (1) Easier access to information, (2) Increase the effectiveness and understanding of the concept of Islamic religion, (3) AI assistance, especially in <i>chatbots</i> and AR, can provide fast responses, (4) The analysis process runs quickly and effectively.	The obstacle explains that: 1. The need to maintain values and ethics in accordance with religious teachings. 2. Requires special attention so as not to ignore religious understanding. 3. The spread of personal data can reduce the level of data security for students.	In this condition, the influence of IMK, especially on the great potential that can apply AI to improve the learning process effectively. Its nature is adaptive so that it can adjust to the needs of the individual. In addition, it also focuses more on developing interactive simulations and educational games, and in religious studies plays a role in helping translate important texts.
19.	2024	Using Artificial Intelligence to Personalize Learning Experiences (Arnadi & Aslan, 2024)	1. Complex data analysis 2. Identifying learning patterns, strengths and weaknesses of each individual. 3. Provide timely <i>feedback</i> . 4. Improving student learning outcomes and motivation	Some things to consider are student data privacy, potential bias in AI algorithms and the risk of over-reliance on AI. The use of AI does not diminish the main aspects of the learning elements. Then it is necessary to maintain a balance in teaching methods to support student development.	The need for proper and ethical implementation, so that it can be inclusive, adaptive and effective according to complex needs. Collaboration is needed between many parties, namely educators, developers, policy makers and <i>stakeholders</i> .
20.	2024	Artificial Intelligence in Education: Enhancing Personalized Learning	a) There is an increase in efficiency and quality of learning <i>Feedback</i> is provided in <i>real time</i> and provides	a) Unsupervised use of AI can cause students to become dependent on technology, thereby making them less independent.	Training is needed that contains exploration of <i>Artificial Intelligence</i> (AI). In addition, the development of digital infrastructure in remote areas is also needed for

		(Widodo et al., 2024)	appropriate. b) The role of the teacher is to provide emotional and motivational guidance for students.	b) There are concerns regarding the privacy data of each student.	the equal distribution of educational technology with AI.
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Discussion of the overall results of previous research is that technology is very useful for all sectors. However, especially in the field of education, it is widely used for technological renewal. For example, for recommendation systems, artificial intelligence (AI), Augmented Reality (AR), Virtual Reality (VR), both Powerpoint creation and e-learning.

The benefits of technological renewal itself also depend on the type that will be focused on. The benefits that are usually obtained are being able to analyze large or complex data, increasing learning awareness by students and students, encouraging exploration of innovation in the field of technology, increasing user comfort, increasing technical skills because they are proficient in using supporting tools, then being able to access the information provided, speed in communication to collaborate between stakeholders and motivating users to use or apply the technology used.

In terms of obstacles, there are many things that can hinder the process in several existing studies. The obstacles that occur include (1) The duration used is long so that there is irregularity in the arrangement of technology; (2) The need for a stable connection to access it; (3) The need for fast access for each learning; (4) Limitations on infrastructure and facilities; (5) The ease of spreading personal data that is private in nature; (6) Excessive dependence on the use of AI technology, and (7) Potential misuse of data or information obtained with technology.

Recommendations for development in each study are constructive, adaptive, effective and inclusive. Then, special training is also needed to provide detailed explanations to users. The creation of clear guidelines or regulations can also be used as a foundation for developing systems with the

help of AI. The addition of infrastructure also plays an important role in the process of implementing the latest technology. The addition of interactive features can accommodate the implementation of integrated & enjoyable learning. Promotion is also no less intensive to be carried out because it is used as an introduction to identity to the general public. The evaluation carried out can produce data that can later be developed to be better than what has been done beforelumnya.

CONCLUSION

Human and Computer Interaction (HCI) is an intermediary in achieving the goals of the existing technology renewal process. Many things are considered in the supporting factors and important aspects of achieving HCI. Interactive learning with the help of technology. The benefits obtained from the proper use of HCI in the education sector are: (1) being able to analyze large or complex data, (2) encouraging exploration of innovation in the field of technology, (3) increasing user comfort, then being able to (4) access the information provided, (5) speed in communication to collaborate between stakeholders and (6) motivating users to utilize the specific technology used. The obstacles that arise are the duration of application use which is long so that there is irregularity in arranging the schedule; (2) The need for a stable connection to access it; (3) The need for technology used to access it quickly for each learning; (4) Limitations on infrastructure and facilities; (5) The ease of spreading personal data that is private in nature; (6) The occurrence of excessive dependence on the use of AI technology, (7) The potential for misuse of data or information obtained with technology and (8) The costs incurred to design it are quite high.

Not only that, but also understanding the development recommendations in fixing everything that has been done previously. Among them are (1) special training is needed to provide detailed explanations to users; (2) Making clear guidelines or regulations can also be used as a foundation for developing systems with the help of AI; (3) Adding infrastructure also plays an important role in the process of implementing the latest technology. Hopefully, the preparation of this Systematic Literature Review can facilitate the selection, access, learning and improvement in terms of the quality of user reading. Good references are also required during the process of searching for articles in previous research.

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