



Jurnal Review Pendidikan dan Pengajaran
<http://journal.universitaspahlawan.ac.id/index.php/jrpp>
 Volume 8 Nomor 1, 2025
 P-2655-710X e-ISSN 2655-6022

Submitted : 29/01/2025
 Reviewed : 02/02/2025
 Accepted : 02/02/2025
 Published : 24/02/2025

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A LITERATURE REVIEW ON USING AI CHATBOT APPLICATION TO ENHANCE STUDENTS PERFORMANCE ON STEAM

Abstract

The rapid development of technology demands continuous innovation of using artificial intelligent in aspect of education, social and economics is very intense and massive. Chatbot as the one kind the artificial intelligence is taking a big part in helping customer getting their needs and reduce the company reduce the worker cost. In applications in the educational sector, chatbot applications are used as intermediaries to improve students' abilities in various aspects such as STEAM (Science, Technology, Engineering, Art and Math) learning materials. However, the existence of chatbots does not always provide convenience or direct impact because non-technical problems can arise from the school, students or education processes. This study offers an overview on chatbots in terms of definition, usage, advantages and their evolution from the theory which triggered these systems to current implementation using the some available libraries in Javascript. Javascript as one of the popular programming languages used today has many libraries such as Botpress, Microsoft Bot Framework, Botkit and others which can be used to design, develop and implement chatbot applications to help the learning process. Finally, This research is trying to provide valuable insights and to find the right chatbot application model to be used in ai chatbot application development and understand the user's condition directly when interacting.

Keywords: Artificial Intelligence; Chatbot; Education; STEAM Education.

INTRODUCTION

The use of artificial intelligence (AI) is very common, intense and massive among learners, students, researchers, technology practitioners, enthusiastic these days (Kuhail, et al., 2023). The implementations of the AI development itself is widely applied (Wollny, et al., 2021) and can be founded in many various ways, forms or applications (Kingchang, et al., 2024). The condition is running with the line of computer science development and computational technologies, automatic, adaptive, and efficient (Xu, et al., 2022). One of various AI applications that are being discussed is Chabot Application (Kulkarni, et al., 2023). A chatbot application can be defined as "A computer program designed to simulate conversation with human users" (Adamopoulou, et al., 2020). Chatbots are also described as smart bots (Adamopoulou et al., 2020), interactive agents (Haristiani, 2019), digital assistants (Srivastava, et al., 2020), digital natural language (Haristiani, 2019; Lalwani, et al., 2018) or artificial conversation entities (Hwang, et al., 2020).

Education technology is being important part of learning development in students activities enhancement process (Saputra, et al., 2019). Through the growing times, education improvement research runs from school based integrated technology to smart school systems and become intelligent model system today (Saputra, et al., 2019) (Kumar, 2021). Smart school system is not only related to the process of learning, but also implemented in school curriculum or courses. This research limits the problem to aspect of STEAM education.

In process on increasing students interest in learning, Many schools applied STEAM (Science, Technology, Engineering, Art, and Math) education concepts in their curriculum to improve and enhance student knowledge and skills (Farwati, et al., 2021). The purpose is

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targeted to align with the Indonesian government's demand that every educational unit utilize the Merdeka curriculum (named Kurikulum Merdeka) in its education system, which 143,265 have already implemented with more than 10.2 million users of digital educational platforms in 2022 (Saputra, et al., 2024). Some other researches mention that concepts of STEAM have been examined to determine the benefits of enhancing the cognitive domain of students learning of memory, reaction time, innate intelligence, psychomotor and affective domain of self-confidence (Wu, et al., 2022)(Ku, et al., 2022) (Farwati, et al., 2021).

This literature review is essential research to the development of AI chatbots in STEAM education. The research is trying to explore the impact of AI-powered chatbots on education, both benefits and drawbacks. The research offers an overview on chatbots in terms of definition, usage and comparison that triggered the implementation and development using some available libraries in Javascript(Videnovik, et al. 2023). Javascript as one of the popular programming languages used today (Gupron, et al., 2021)has many libraries such as Botpress, Microsoft Bot Framework, Botkit and others which can be used to design, develop and implement chatbot applications to help the learning process(Janssen, et al., 2022). Apart from the frameworks mentioned above, there are also several commonly used applications such as Chat GPT and Bard AI.

The research itself is divided into several parts and the first part contains an introduction that tells the background of this research. In the second part, the discussion will be talking about some of the related research that support the information and data collected for the research. The next step is talking about research methodology used in taking data samples and the process of extracting information. The fourth part tells about the results and discussion of this study and the last part contains the conclusions of the research and recommendation for the future research. And finally as mentioned before, this research objective would aim to provide valuable insights into development of AI Chatbot application model for enhancement of student performances in learning process of STEAM education.

RESEARCH METHOD

This research identified and reviewed more than 100 research papers in the last 5 years (2020 to 2024). All the papers are related to AI Chatbot application, Artificial Intelligence, and STEAM educations topic. The following papers is colleted from online databases included ACM (Assosiation for Computing Machinery) digital library, Sciencedirect, Scopus, IEEE (Institute of Electrical and Electronics Engineers) Explorer, Dimensions.ai and SpringerLink. This study follows literature review research guidelines provided by (Snyder, 2019). The basics steps and important choices involved in conducting a literature review as suggested and discussed using four phases; (1) designing the review, (2) conducting the review, (3) analysis and (4) writing up the review.

RESULTS AND DISCUSSION

Currently, The terminology of STEM is contained with Science, Technology, Engineering and Math (Essel, et al. 2022). In this research, the terminology is added word “Art” and become STEAM. The “A” in STEAM is a term that represents liberal arts, language arts, social studies, physical arts, fine arts, and music (Makeblock, 2023). STEAM education is about applying creative thinking to learner’s STEM projects (Land, 2013), igniting students imagination and creativity (Segarra, et al. 2018) through the arts. It also exploring where art naturally propers or fits into the STEM subjects. The proses of studying art subjects can contribute to the development and improvement of essential skills like collaboration, communication, problem-solving, and critical thinking (He, et al., 2021). It also enhances a student’s flexibility, adaptability, productivity, responsibility, and innovation (Oh, et al., 2013).

There are many researches related to this topics. Some of the previous studies have tried to evaluate the value of STEAM education in primary, secondary , high schools and even university students to enhance the learning ability of the subject. Since 2011, Since 2011, research in the field of AI technology has also become part of many research in topic of STEM (Xu and Ouyang, 2022) or STEAM (Chen, et al. 2018). In term of this research, a number of primary keywords which might be having a realtion to the topic are determined first, but main keywords such as “steam” are not consulted. This is due to the fact that using the acronym

STEAM will change the meaning of the term "steam." The term "steam" can refer to "the process of becoming a vapor" and is frequently used in the energy research community.

This research decided to not using STEAM abbreviation in keyword at least the term is following with the word education. Using this kind of keyword, help the research to find the proper papers or research articles from the database. The following table (Table 1) below describe the number of research papers related to STEAM topic in 3 main keywords. Based data collected from last 5 years (2020-2024), the most research paper might be found at ACM Digital Library. Using the first keyword, there are 156.479 papers, the second one is 66.548 papers and the last one is 137.696 papers.

The Tabel 1 also identified that the second keyword reveals many papers in sciencedirect, dimension.ai and springelink. This issue most likely arose from the inclusion of the word "education" in the search. When conducting a search, the databases show both the particular phrase "education" and the specific combination keyword "steam education." On the other hand, the system may gather all the data associated with a certain keyword.

Table 1: Number of Research Papers Related to STEAM

Sources of Online Library	Keywords		
	science technology engineering art math	steam education	integration of arts and sciences
	Number of Research Papers		
ACM Digital Library	156.497	66.548	137.696
IEEE Explorer	157	285	1477
Sciencedirect	1.548	9.255	12.227
Dimensions.ai	204	2.103	1.572
SpringerLink	1.039	1.999	1.615
Scopus	352	489	35

As mentioned before, this research collected some papers to be studied. The research inquired more than 100 papers related to STEAM education, artificial intelligence and AI Chatbot Application. The distribution of papers collected can be found in Table 2 below,

Table 2: Distribution amount of paper collected for the research

Topic Of papers	Number of papers
STEAM Education	26 Papers
AI Chatbot Application	42 Papers
Artificila intelligence	11 Papers
Others Related	21 Papers

Table 2 above shows figures for this research based on the number of papers with specific keywords. In the first one, 26 papers were studied. There are 42 papers that utilize the second keyword, while 11 papers use the third keyword. The second and third keywords share certain similarities in title composition. Some studies include the phrase AI before or after the term Chatbot, while others do not. The final one is a collection of papers that do not specifically mention another three main keywords.

After identification number of papers related to main topic, this research studied the correlations of the papers using research mapping application named VOSViewer. This phase helps the study to discover relation between the keywords in the papers. The appellation describes in Figure 1 below,

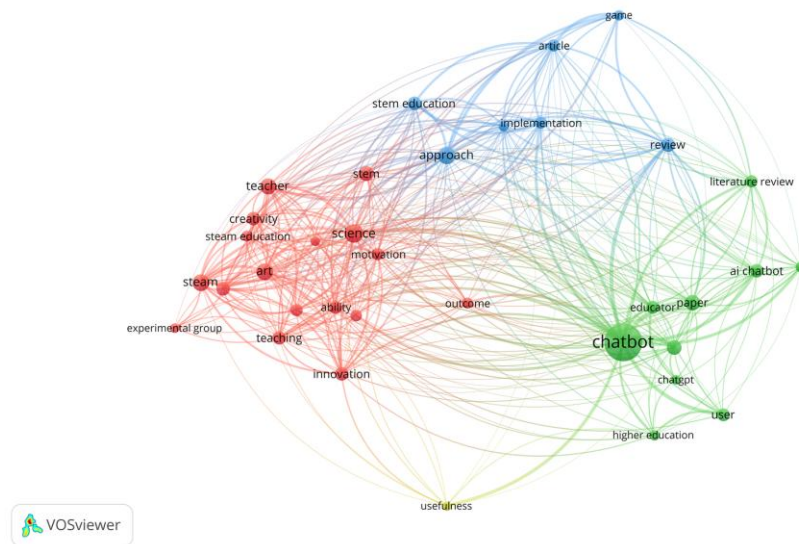


Figure 1: Network visualizations of Keywords from Collected Papers

Figure 1 distributes the word items from collected papers to 4 main clusters. The words distributions can be found in the table below,

Table 3: Items clustering from Network Visualizations

Cluster	Items
Cluster 1	ability, art, course, creativity, engineering, experimental group, innovation, mathematics, motivation, outcome, problem, science, steam, steam education, stem, teacher, teaching.
Cluster 2	ai chatbot, artificial intelligence, chatbot, chatbots, chatgpt, educator, higher education, literatur review, paper, user.
Cluster 3	approach, article, game, implementation, review, stem education, year.
Cluster 4	usefulness.

The next step in this research is to identify authors and co-authors among the publications gathered. This stage presented various challenges in the information extraction process. Using VOSViewer, the authors and co-authors do not have a strong association with the research issues. This circumstance may occur when the researcher published fewer than five papers in the aforementioned internet databases. This phase uses a dataset from dimensions.ai to produce a more accurate result in detecting author relationships. The papers dataset is set to last 5 years and the keyword used is only ai Chatbot.

In analysis phase, the process related to Co-Authorship with unit of analysis assigned to Authors and made fractional counting as the method. The process also ignore documents with large number of authors and set the maximum number of author per documents to 10. The limitation of document for author is setting to 5, while the citation is setting to 0. The result of dimensions.ai dataset can be found in the Table 4 below,

Table 4: Auhctors Contribution in AI Chatbot Topics

No.	Author	Documents	Citations
1.	Wu, Haiyang	7	171
2.	Elbanna, amany	6	83

3.	Gkinko, lorentsa	6	83
4.	Lee, seyoung	6	52
5.	Mai, vanessa	6	24
6.	Park, gain	6	52
7.	Richert, anja	6	24
8.	Seth, ishith	7	139
9.	Xie, yie	6	129
10.	Cheng, kunming	6	141

In the context of AI Chatbot Development, selecting the appropriate AI Framework can be a pivotal decision, influencing the capabilities, scalability, and performance of your chatbot. This study recommends some AI Chatbot open sources for development and research testing. Botpress is designed to build chatbots using visual flows and small amounts of training data in the form of intents, entities, and slots. This vastly reduces the cost of developing chatbots and decreases the barrier to entry that can be created by data requirements (Bhanderi, 2024). Microsoft Bot Framework is a collection of libraries, tools, and services that let user build, test, deploy, and manage intelligent bots with modular and extensible SDK for building bots and connecting to artificial intelligence services (JonathanFingold, 2022). Another open-source is Rasa. Rasa is an open-source bot-building framework that focuses on a story approach to building chatbots (Nichol, 2020). This is also a pioneer in open-source natural language understanding engines and a well-established framework.

Rasa is focusing on AI and building the framework that allows developers to continually build and improve their AI assistants. This framework allows developers to create training data scenarios that are designed to train the bot. Rasa is on-premises with its standard NLU engine being fully open source. This framework also has many premium features that are available with an enterprise license (Josphineleela, et al. 2023)(Narendra and Setyaningsih, 2021).

CONCLUSIONS

This research informed some many useful insight next phase of research in field of AI Chatbot. The study identified many related keywords might be used in many trusted online databases, the numbers of papers and the relations of authorship. The framework and libraries for development of AI Chatbot also recommend in this research where the Rasa is the most reliable to use.

In the final, this research is far from perfect. There are many deficiencies and lack of information should be informed and identified. For example, the collections of dataset from other online databases is not included in this research as comparison. There are many other future work can be define from this research included the development the AI Chatbot itself related to education topics, comparison of the chatbot libraries in development, mapping the research in phase of co-authors relation in online databases.

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