The Impact of Technology on Knowledge Retention: A Systematic Review

Dr. Sallam Alsarayreh

British University in Dubai

ABSTRACT

Innovative Technologies of the 21st century, such as Haptic technologies, 3D printing, Chatbot, data mining, and brain-based learning played an essential role in E-learning, and interactive teaching techniques to support student knowledge management and knowledge retention. This study aims to provide a comprehensive analysis of five research articles published in the conference proceedings and journals. The main findings of this study indicate that among the technologies mentioned earlier, E-learning and virtual environments, where the most technologies studied in the field, have a significant impact on knowledge retention. Furthermore, questionnaires and actual tests for some technologies were the mainly used research method in data collection in the context of the effect of technology on knowledge retention. This study attempts to show the recent research progression made in studies considering the impact of technologies on knowledge retention. We used a systematic literature review (also known as a systematic review) to locate, review, and analyze all related studies on a specific research subject, topic field, or phenomenon of interest(Kitchenham et al., 2009).

Keywords: knowledge retention in education. use ai in knowledge retention, data mining techniques, chat-bot in education, haptic technologies in education, three dimensions printing, brain-based learning, the effect of technology on knowledge retention, systematic review.

Classification: DDC Code: 004.071 LCC Code: T56.4

Language: English

London Journals Press

LJP Copyright ID: 975822
Print ISSN: 2514-863X
Online ISSN: 2514-8648

London Journal of Research in Computer Science and Technology

Volume 22 | Issue 3 | Compilation 1.0

The Impact of Technology on Knowledge Retention: A Systematic Review

Dr. Sallam Alsarayreh

ABSTRACT

Innovative Technologies of the 21st century, such as Haptic technologies, 3D printing, Chatbot, data mining, and brain-based learning played an essential role in E-learning, and interactive teaching techniques to support student knowledge management and knowledge retention. This study aims to provide a comprehensive analysis of five research articles published in the conference proceedings and journals. The main findings of this study indicate that among the technologies mentioned earlier, E-learning and virtual environments, where the most technologies studied in the field, have a significant impact on knowledge retention. Furthermore, questionnaires and actual tests for some technologies were the mainly used research method in data collection in the context of the effect of technology on knowledge retention. This study attempts to show the recent research progression made in studies considering the impact of technologies on knowledge retention. We used a systematic literature review (also known as a systematic review) to locate, review, and analyze all related studies on a specific research subject, topic field, or phenomenon of interest(Kitchenham et al., 2009).

Keywords: knowledge retention in education. use ai in knowledge retention, data mining techniques, chat-bot in education, haptic technologies in education, three dimensions printing, brain-based learning, the effect of technology on knowledge retention, systematic review.

I. INTRODUCTION

In an age of digital transformation which transformed the educational possibilities to ensure the knowledge transfer and retention that the technology benefits students by breaking down barriers in education and providing a blissful moment in a variety of settings and subjects (Iyer, 2020). This study's focus is educating people in the field of conceptual learning, with more realistic examples of how to use technology to recreate the nature of practical understanding in the educational world and retain the knowledge of the students.

Knowledge retention is critical in many industries such as government, health, banking, and education. Considering COVID19 (viruses that infect humans) pandemic and transforming the learning method from manual-based to e learning, we observe the importance of developing the education method and saving the knowledge granted. This paper will focus on the impact of the new technologies to assist students in learning their general knowledge subjects and the impact of these technologies on knowledge retention instead of the traditional way. We conducted a systematic literature review for research on knowledge retention and the effects of technology usage in education to provide a thorough overview of the current studies and discuss the implications of the findings.

Teachers want their students to remember details for more than a week rather than memorizing facts for an exam. Teachers are finding it challenging to teach an ever-increasing amount of material. The Effect of Technology on Motivation and Retention for Covering a broad curriculum result in solid memories in students(Granito, Chernobilsky and Granito, 2012). Teachers must find different ways to teach the appropriate material and help students retain the requisite knowledge due to the demands of standardized tests (Granito, Chernobilsky and Granito, 2012).

This paper will survey selected literature regarding the aspects of Haptic Technologies was introduced by L. Liu et al. (Iyer, 2020), which simply means "ability to touch" or "ability to grasp" (Revesz, 1950), is a user interface that allows them to touch virtually, force or control objects formed and/or displayed in a visual context (Hegedus, 2013), besides the use of three-dimensional printing in the classroom to remove obstacles to learning how students think and incorporate knowledge into proper subjects (Iyer, 2020) Including AI technologies such as Chat-bots which have the ability to mimic human conversation and can offer personalized services (Dutta, 2017), along with interactive mining, which enable users to be able to adjust the objective of a search on the fly, refine mining requests based on returned results, and drill, dice, and pivot through the data and information space interactively with interactive mining (Han, Kamber and Pei, 2012), and the philosophy of brain-based or brain-compatible learning theory focuses on concepts that provide an incentive for maximum knowledge acquisition and retention (Furlong, 1982).

The questions that guided this study were

Research Question 1: How can technologies support knowledge retention?

Research Question 2: Are the new technologies require to change the teaching methods and approaches? Discussion: Could we replace the teacher in the future?

II. LITERATURE REVIEW

Knowledge retention for curriculum learned is a challenge that persists in education, even though many methods help students maintain their knowledge. We see several technologies used in education to improve teaching in the twenty-first century, with the digital transformation reconstruction and improving the education system. Our literature review analyzes five related studies on using the new technologies in education and how they affected knowledge retention.

Virtual reality (Haptic System) is the first technology, which imitates sight, i.e. the sense of being present in the real world. Low-cost consumer VR headsets like the Samsung Gear VR, Google Cardboard, and Google Daydream have created a more open digital world than ever before. Individuals who had spent time in a virtual reality environment were polled, and the findings were interpreted using the theories as a guide. Virtual reality (VR) has also altered the educational environment. The main aim was to show that the Virtual Haptic System could be a helpful interaction technology for improving human ability in educational settings.

Accordingly, empirical evidence shows that technology benefits students by breaking down barriers in education and producing pleasurable moments in various contexts and topics, all of which affect their knowledge retention (Huang et al., 2019; Iyer, 2020).

Three-dimensional printing is another technique that is particularly useful for a variety of topics and even subjects at various levels of education. Teachers, for example, will print historical objects such as monuments and coins. Biology students can print organs and cells, and geography teachers can print a mountain range, and so on, paving the way for creativity and innovation in the field of education. The use of 3D automation in the classroom removes obstacles to learning how students think and incorporate knowledge into valuable subjects. (Iyer, 2020).

Chat-bot's can have a hugely positive effect on learning in education (Dutta, 2017). High school students react well to educational technologies such as conversational intelligent tutoring systems (Rus, Niraula and Banjade, 2015).Users go to Google, Yahoo, or other information retrieval systems to get information, but they get documents or links that are not important or useful. As a result of the need to solve such issues, the concept of a natural language dialog system emerges, in which a user asks a question in natural language and the system responds with a succinct and reasonable response (Abu Shawar and Atwell, 2007). The findings on students' learning outcomes and memory retention are contrasted between conventional search engines (Question Answering System) and intelligent

chat-bot systems. The findings show that using intelligent chat-bots to learn affects students' learning outcomes and memory retention.

Dialogflow.com (formerly Api.ai) intelligent chat-bot developed to assist high school students in learning general knowledge or social science subjects for the very important function that seeks to develop sub-intents in the light of a specific purpose(Dutta, 2017).

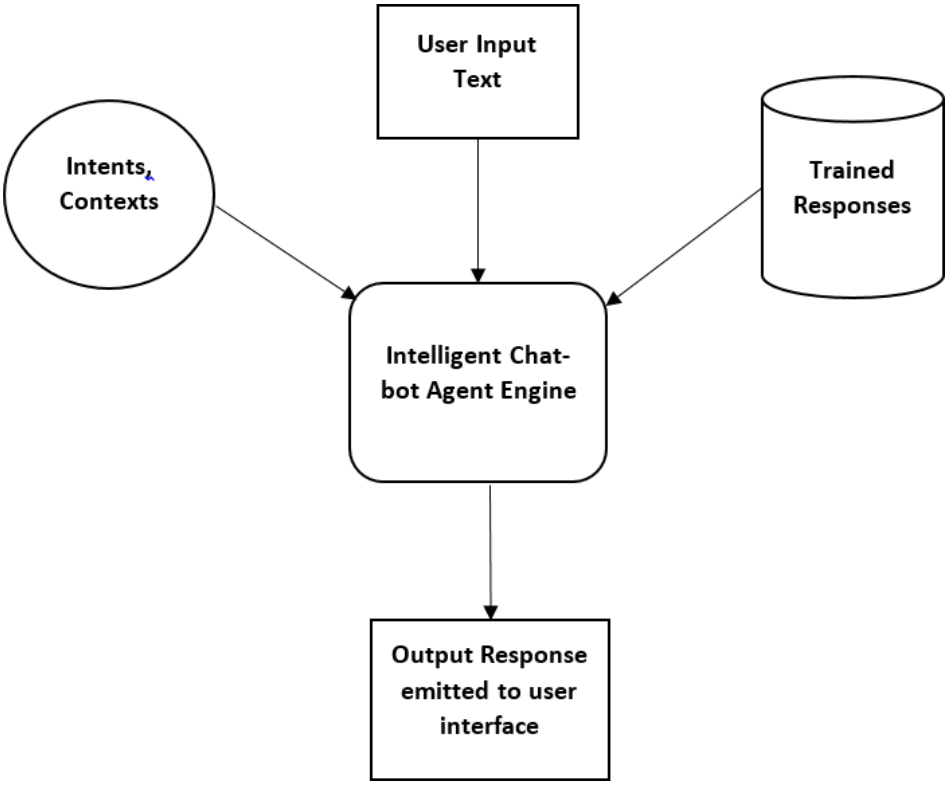

Fig. 1: Architecture of Propose Intelligent Chat-Bot (Dutta, 2017)

The work of (Koşar and Bedir, no date) presents an insight on the impact of brain-based learning on the retention of the English language on young adult trainees. The researchers utilized intervening the brain-based learning principles of the participants for nearly four and a half months.

The consequences of the proficiency tests regulated toward the start of and after the intervention were broken down with an end goal to investigate whether brain-based learning intervention applies influence concerning the improvement of test subjects' proficiency in English. The outcomes of the retention test directed a half year after the post-proficiency test were investigated. An interview was directed both after the post-proficiency and the retention test to acquire knowledge of the test subjects' perspectives on the brain-based learning intervention. The main findings achieved from examining both quantitative and qualitative information suggest that knowledge retention could be enabled by building up a learning climate viable with mind-based learning standards.

The work of (Ji et al., 2018) sheds light on the issue of supplementing insufficient data into the case-based reasoning methodology (CBR) by the duplication of suitable values can diminish the possible negative impacts on the solutions emerging from abrupt alterations. The case-based reasoning approach essentially depends on chronicled cases to take care of new issues. The problem stems from CBR researchers rarely inspecting the issue mentioned above. Moreover, to address the issue, the researchers proposed a knowledge retention based learning method that is based on CBR by utilizing a data mining method to administrate missing values of the

dataset. The learning technique with the CBR model accomplished higher precision of the general expense assessment and higher constancy in contrast to the past model. This exploration shows how cases can be created and considered as learning retention cases to conquer the hurdles of continuous updates in a wide scope of projects of construction in nature, in addition to that, it demonstrates why the case bases should be updated on a frequent basis.

Data mining, on the other hand, should have been renamed "information mining from data."(Han, Kamber and Pei, 2012).

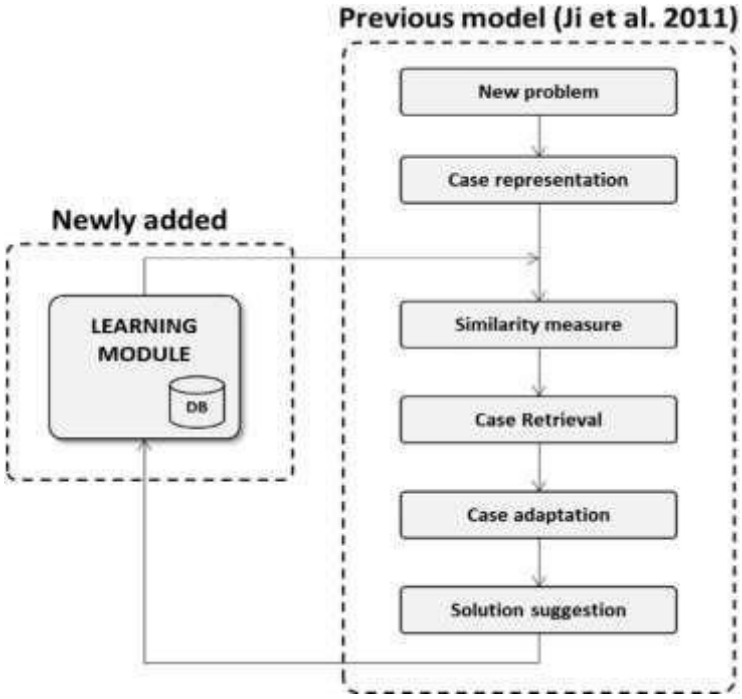

Fig. 2: Comparison of the Case-Based Reasoning (CBR) Model schemes. (Ji Et al., 2018)

Based on the existing literature, the current review research aims to add value to the body of knowledge by focusing on the effect of these innovations on knowledge retention in education and how we can use them.

III. SYSTEMATIC LITERATURE REVIEW METHOD

In this paper, we used a systematic literature review (also known as a systematic review) to locate, review, and analyze all related studies on a specific research subject, topic field, or phenomenon of interest (Kitchenham et al., 2009). A systematic literature review has many benefits by summarizing the current facts about the technology, such as the effect of paper-based manual and stereoscopic-based mobile (Lam, Sadik and Elias, 2021). Moreover, find any gaps in existing research so that areas for further study can be suggested.

Systematic reviews begin with the development of a review protocol that defines the study issue to be answered as well as the methods to be used to conduct the review. Systematic reviews are focused on a pre-determined search method that seeks to find as much relevant information as possible. In order to properly place new research activities, a framework/background must be provided. (Kitchenham et al., 2009).

3.1 Identify the Research Goal and Research Questions

This paper aims to conduct a comprehensive analysis of relevant literature to depict the effects of digital transformation technologies that enable e-learning and virtual worlds and test a new approach for ensuring long-term student knowledge retention. Our research questions were developed using the PICOS model (The PICOS tool focuses on the Population, Intervention,

Comparison, Outcomes, and Analysis of article) (Methley et al., 2014)The following information is given to help us develop our research questions:

Question number one: How can technologies support knowledge retention?

Question number two: Are the new technologies require to change the teaching methods and approaches?

Question number three to be discussed: Could we replace the teacher in the future?

3.2 Identify the Keywords

In the research text, we used the most related keywords to our mentioned question, starting from "knowledge retention" And "knowledge retention technologies."

Then we got interesting articles in practice 21st technologies in teaching, improving the students' knowledge retention in the long term. Accordingly, we expanded the keywords to cover "Data mining techniques" And "AI technologies used in education. Also, a string of "Haptic technologies in education.

3.3 Our inclusion criteria are shown in Table 1. Each study found in the search results must meet these criteria in order to be included in our SLR

Table 1: Identify the Inclusion/ Exclusion Criteria

Standard	Inclusion/ Exclusion
Date	The study has to be published in 21st century and provide accurate and updated information in the revolution age. Outdated information has to be excluded.
Language	The study has to be writing in English or translated to English.
Participants	The article study made on students in education sector.
Keywords	The article has to be related to the search keywords: Knowledge retention. Use AI in Knowledge retention · Data mining techniques Chat-bot in education. Haptic technologies in education. 3D printing. Brain- based learning. The Effect of Technology on knowledge retention. Systematic review
General criteria	Must meet the research keywords conditions and from approved resources.

3.4 Data Source and Search Strategy

For the present Systematic literature review, the following online library databases and search engines were used: Gartner, Google Scholar, Springer, Elsevier and Search gate. According to the study's creators, these databases would be the primary sources for gathering papers relevant to the Impact of Technology on Knowledge Retention.

The keywords mentioned earlier yielded 30 papers in the search results. One paper was found duplicated, and they were removed. As a result, the total number of articles left is now 29. The authors verified each study's inclusion and exclusion criteria. As a result, seven research papers were identified as meeting the inclusion criteria and were included in the study. The Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) were used to conduct the search and refinement stages of this review shown in Table 1. Identify the Inclusion/Exclusion Criteria. The search and refinement stages in this review study were carried out according to the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) (Moher et al., 2009). Fig. 3 shows the PRISMA flowchart.

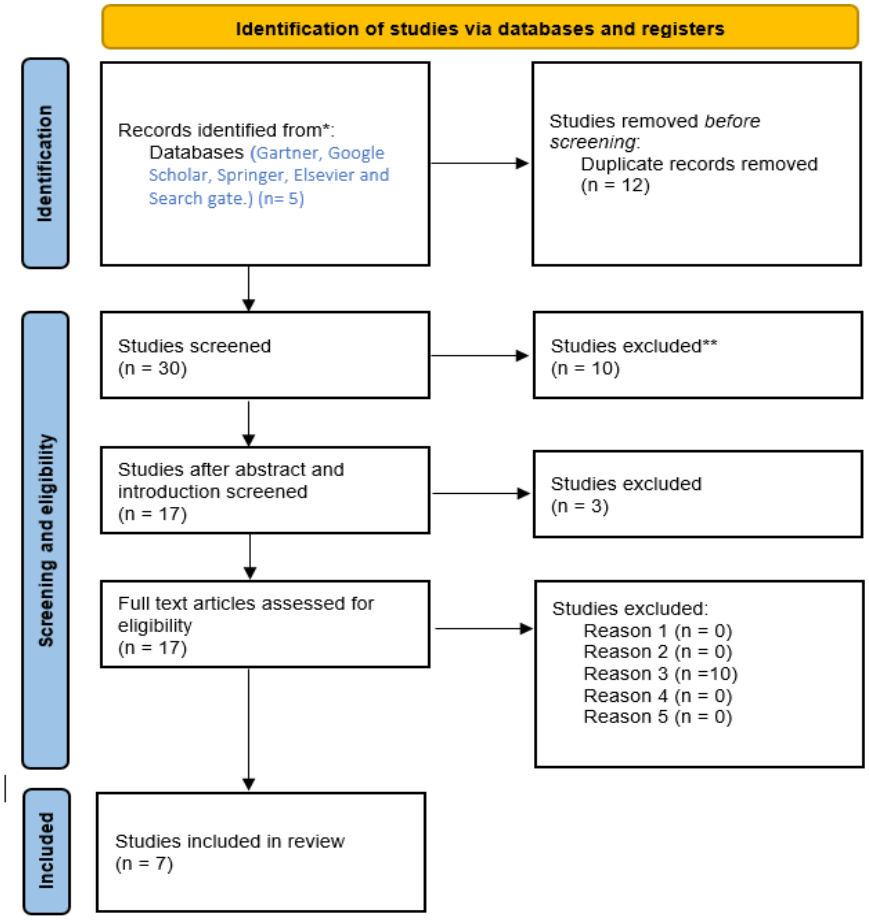

Fig. 3: PRISMA Flowchart for the Selected Studies

3.5 Quality Assessment

Along with the inclusion and exclusion requirements, the quality evaluation is an important consideration to consider (Al-Emran, Mezhuyev and Kamaludin, 2018). To include a way of appraising the content of the research papers that were retained for further review (N=5), a quality evaluation checklist as below:

1. Is there something in the analysis that you did not know or understand before?
2. Is the study's information system/technology clearly defined?
3. Is the research relevant to the field of education?
4. Is the technology mature and widely available?
5. Is the literature search comprehensive enough to include all relevant studies?

The checklist was based on suggestions made by (Kitchenham et al., 2009). Each query was graded on a three-point scale, with a "1" representing "Yes," a "0" represents "No," and a "0.5" representing a partial point.

Table 2: Quality Assessment Results

	Question # 1	Question # 2	Question # 3	Question # 4	Question # 5	Total	Percentage
Study number 1	1	1	1	0.5	0.5	4	80%
Study number 2	1	1	1	0.5	1	4.5	90%
Study number 3	0.5	1	1	1	0.5	4	80%
Study number 4	1	0.5	0	0.5	0.5	2.5	50%
Study number 5	0.5	0.5	0.5	0.5	0.5	2.5	50%

IV. RESULTS AND DISCUSSION

This study reports a "systematic literature review" regarding the impact of technology on knowledge retention education. This study's focus is educating people in conceptual learning, with more realistic examples of how to use technology to recreate the nature of practical understanding in the educational world and retain the students' knowledge. The study reviewed 30 research articles related to open the discussion on our research questions and comment on the exciting results we found from the extracted data in this section:

Research Question 1: How can technologies support knowledge retention?

We believe that the answer to this question lies in three areas of the current education problem, the use of the technology and ability to implement:

The problem is related to retain the knowledge that has been getting and the challenge that persists in education. Even though many methods help students maintain their knowledge, but this problem still exists. The use of technology has created a more open digital world (Iyer, 2020), which has changed educational possibilities and promoting students by overcoming educational barriers and generating blissful moments in various contexts and across various subjects.

We have been representing how the technologies of VR, 3D printing, chat-bot, data-mining and brain-based education have a significant impact on knowledge retention by

- Creating a path for creativity and innovation in the field of education (Huang et al., 2019; Iyer, 2020)
- Using mentioned technologies together would enable professors to immerse students in an intense environment where they can perform several tasks at once, such as visualizing and designing new objects or 3D models, in order to better understand the concept in a fun and imaginative way. (Huang et al., 2019; Iyer, 2020)
- The intelligent chat-bot tool will be trained on a knowledge base of general knowledge questions and answers, and it will be able to engage in small conversations with its users. (Dutta, 2017) (Abu Shawar and Atwell, 2007) (Abbasi and Kazi, 2014)
- Brain based learning more logical and effective learning method (Koşar and Bedir, no date)
- More reliable estimation results were obtained when the number of retained cases was increased using the learning process.(Ji et al., 2018)

Considering COVID19 (viruses that infect humans) pandemic and transforming the learning method from manual-based to use the technologies provide users with the advantage of depth perception, which may aid in memory improvement (Lam, Sadik and Elias, 2021).

Research Question 2: Are the new technologies require to change the teaching methods and approaches?

Traditional teaching methods include rote practice in which students are expected to take copious notes, and vocabulary, in which students are expected to memorize meanings and spellings of key terms. This approach has been shown to be effective in passing exams while still retaining information over time. Instead, students should employ the elaborative meaningful learning technique. When students are taught using 21st-century technologies, they are more likely to maintain the knowledge for a longer time. Students would be able to remember new knowledge more quickly if they collect new information that is foreign to them and compare it to information they already know. (Granito, Chernobilsky and Granito, 2012)

Teachers in traditional classrooms must use innovative resources to encourage students' imagination and devote a significant amount of time to researching the effect of each method on students' actions and outcomes.

Computers seem to be at the forefront of education in an ever-changing technical world

(Granito, Chernobilsky and Granito, 2012), enhancing the teaching method from all angles, such as the ability to interpret class materials, open the doors for creativity, and create a solid knowledge base that can be easily retained, as several studies have shown.

Moving from traditional attendance to school to e-learning will add more space, flexibility to student attendance. Adopt a self-drive learning approach and involve new teaching methods by concentrating on innovative aspects rather than saving all of the details and focusing on the critical facts to create a new thinker generation.

Discussion: Could we replace the teacher in the future?

As discussed earlier, the studies that represent the impact of the technology on knowledge retention and representing the value added to education explores one crucial question that needs to be discussed and answer in further research, which is " Could we replace the teacher in the future?"

The new technology will not replace the teacher. However, their role and teaching method will be changed from curriculum instructor to be more creative, instruct the machine and share their experience with the broader range of students worldwide to start from what they reach to collaborate to enhance the education sector and concentrate long-term knowledge retention.

V. CONCLUSION

In this paper, we concentrated on the use of emerging technology to aid students in learning general knowledge subjects and the effect of these technologies on knowledge retention rather than the conventional method. To provide a detailed summary of current studies and address the implications of the findings, we conducted a systematic literature review for research on information retention and the impact of technology use in education. Rather than memorizing information for an exam, teachers want their students to recall specifics for more than a week. Teachers are struggling to teach an ever-increasing amount of material.

The idea of interactive learning using Haptic Technologies, three-dimensional printing, Chatbots, interactive mining, and brain-based learning presented realistically has been shown in this study to increase students' understanding and comprehension abilities and revolutionize the teaching-learning process. Finally, each of the technologies addressed has its strength and weakness, which must be carefully examined and combined to create a teaching method with high knowledge retention value- added.

REFERENCES

1. Abbasi, S. and Kazi, H. (2014) 'Measuring Effectiveness of Learning Chatbot Systems on Student's Learning Outcome and Memory Retention', Asian Journal of Applied Science and Engineering, 3(7), p. 57. doi: 10.15590/ajase/2014/v3i7/53576.
2. Abu Shawar, B. and Atwell, E. (2007) 'Chatbots: are they really useful?', LDV-Forum: Zeitschrift für Computerlinguistik und Sprachtechnologie, 22(1), pp. 29–49.
3. Al-Emran, M., Mezhuyev, V. and Kamaludin, A. (2018) 'Technology Acceptance Model in M-learning context: A systematic review', Computers and Education, 125(June), pp. 389–412. doi: 10.1016/j.compedu.2018.06.008.
4. Dutta, D. (no date) Developing an Intelligent Chat-bot Tool to assist high school students for learning general knowledge subjects.
5. Granito, M., Chernobilsky, E. and Granito, M. D. (2012) The Effect of Technology on a Student' s Motivation and Knowledge Retention Technology and its Effect on Motivation and Retention 1 The Effect of Technology on a Student's Motivation and Knowledge Retention. Available at: https://opencommons.uconn.edu/nera_2012/17.
6. Han, J., Kamber, M. and Pei, J. (2012) 'Third Edition : Data Mining Concepts and Techniques', Journal of Chemical Information and Modeling, 53(9), pp. 1689–1699. Availableat:http://library.books24x7.com/toc.aspx? bkid=44712 .
7. Huang, K. T. et al. (2019) 'Augmented versus virtual reality in education: An exploratory study examining science knowledge retention

when using augmented reality/virtual reality mobile applications', Cyberpsychology, Behavior, and Social Networking, 22(2), pp. 105–110. doi: 10.1089/cyber.2018.0150.
8. Iyer, V. L. (2020) 'An Exploratory Research Examining Knowledge Retention using Virtual Reality and 3D printing in Education', International Journal for Research in Applied Science and Engineering Technology, 8(11), pp. 438–443. doi: 10.22214/ijraset.2020.32184.
9. Ji, S. H. et al. (2018) 'Learning method for knowledge retention in CBR cost models', Automation in Construction, 96, pp. 65–74. doi: 10.1016/j.autcon.2018.08.019.
10. Kitchenham, B. et al. (2009) 'Systematic literature reviews in software engineering - A systematic literature review', Information and Software Technology, 51(1), pp. 7–15. doi:10.1016/j.infsof.2008.09.009.
11. Koşar, G. and Bedir, H. (no date) 'European Journal of Education Studies IMPROVING KNOWLEDGE RETENTION VIA ESTABLISHING BRAIN - BASED LEARNING ENVIRONMENT'. doi:10.5281/zenodo.1298919 18.
12. Lam, M. C., Sadik, M. J. and Elias, N. F. (2021) 'The effect of paper-based manual and stereoscopic-based mobile augmented reality systems on knowledge retention', Virtual Reality, 25(1), pp. 217–232. doi: 10.1007/s10055-020-00451-9.
13. Methley, A. M. et al. (2014) 'PICO, PICOS and SPIDER: A comparison study of specificity and sensitivity in three search tools for qualitative systematic reviews', BMC Health Services Research, 14(1). doi: 10.1186/s12913-014-0579-0.
14. Moher, D. et al. (2009) 'Preferred reporting items for systematic reviews and meta-analyses: The PRISMA statement', PLoS Medicine, 6(7). doi: 10.1371/journal.pmed.1000097.
15. Rus, V., Niraula, N. B. and Banjade, R. (2015) 'Deeptutor: An effective, online intelligent tutoring system that promotes Deep learning', Proceedings of the National Conference on Artificial Intelligence, 6, pp. 4294–4295.