INVERGE JOURNAL OF SOCIAL SCIENCES
https://invergejournals.com/
ISSN (Online): 2959-4359, ISSN (Print): 3007-2018
Volume 4 Issue 2, 2025

CHAT-GPT IN EDUCATION: LEARNING OUTCOMES AND FACILITATING KNOWLEDGE ACQUISITION

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Abstract

Researches are required to determine how well AI-based Chabot succeeds in reaching learning outcomes and speeding up information acquisition. The current study is carried out to understand the effects of Chat GPT on learning outcomes including understanding, engagement, and retention. Moreover, it assesses the learners' perceptions and experiences in enhancing learning and knowledge acquisition, which may help to find out the key factors that contribute to Chat-GPT's effectiveness such as use interface design, customization, and adaptability. This study investigates the usage of Chat-GPT, and AI-based Chabot in order to improve learning outcomes and speed up knowledge acquisition in higher education. However, there is little empirical evidence about its efficacy, despite increased interest. The study evaluated students' opinions of Chat-GPT's educational usefulness as well as its effects on engagement, comprehension, and knowledge retention. Questionnaire was used to gather information from 540 postgraduate students at three different universities in Bahawalpur using a descriptive methodology with random sampling technique. By encouraging interaction, self-evaluation, and individualized learning, Chat-GPT has a good impact on both academic achievement and personal development, according to analysis using SPSS and thematic approaches. However, ethical issues like plagiarism and abuse draw attention to the necessity of appropriate training is highly noticed during this study. According to these study findings, the Chat-GPT has the potential to revolutionize education for teachers, students, and instructional designers.

Keywords: Chat-GPT, An AI-Based Chat-Bot, Benefits of Chat-GPT, Chat-GPT Language Model

Introduction

Technology can be defined as the practical use of scientific knowledge to improve human life, or as it is frequently referred to alter and control the human space. Many facets of life have been profoundly impacted by technological advancements including how the educational system functions and equips students for a world that is becoming more interconnected by the day. In addition to improving the educational experience, technology adoption is crucial for high school students because it gives them the tools they need to thrive in the contemporary workforce, where technology is essential (Czakoova & Stoffova, 2019).

Artificial intelligence has also certainly made the job of education and learning easier. Various AI-based educational tools including voice assistants, virtual mentors, smart classrooms, automated assessments, pers onal learning, content creators and ChatGPT are in use. Most of the users of these technologies in the industry 4.0 era are the Generations X, Y, and Alfa (Gazali, 2018).

ChatGPT emerging as a powerful means for enhancing educational experiences. With ChatGPT, a language-driven model, students could interact with content in natural and personalized ways, benefit from dynamic engagement, receive instant feedback, and have access to vast knowledge sources. It's a tool that can be employed in formal and informal learning opportunities, because it's able to emulate a conversational

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interface, and provide explanations, summaries, examples. Educators are already exploring how ChatGPT could foster student independence, align with instructional objectives, and cater to multiple learning modalities in different subject areas.

Literature Review

Moreover, Chat-GPT and further generic artificial intelligence (AI) systems are scheduled to be released in late 2022 and early 2023. The GPT-3-based Chat-GPT system was trained using 570 GB of text data that was accessible online through September 2021 (Amani et.al, 2023).

Chat-GPT continuously enhances its capabilities and learns from the internet through machine learning. Although it has drawbacks, GPT technology is an effective tool for NLP (natural language processing) jobs. The ability of statistically based GPT models to preserve pre-existing biases and trends in the data by identifying patterns in massive textual data sets is one of its primary drawbacks (Lucy & Batman, 2021). Books, articles, and websites are only a few of the Internet texts that Chat-GPT has been trained on. These texts cover a wide range of subjects, including news and novels. (Shen et al., 2023).

Unsupervised learning is the method used to train Chat-GPT as a language model on vast volumes of textual data, including books, papers, and web pages. "Generative Pretraining Transformer" (that is, the model's architecture) is what the "GPT" in Chat-GPT stands for. The goal of GPT models is to produce language that is similar to that of a human by using past words to anticipate the next word in a text string (Geoffrey & Currie, 2023). Search engine rival Chat-GPT has grown to be a formidable force. In our introduction, we stated that Google, the world's top search engine, views Chat-GPT as a threat to its monopoly. (Karan, 2022).

Chat-GPT is capable of a wide range of academic tasks, including automatically writing essays according to context and mode (formal, casual, etc.) and giving immediate feedback on any text to raise the standard and accessibility of instruction. However, Chat-GPT may provide difficulties in the classroom. BlenderBot, Meta's chatbot, has received comparatively poor user response because the developer has tightened restrictions on its output hardware. (Kelsey, 2022).

Research Objectives

The objectives of the study are:

1. To assess the impact of Chat-GPT on learning outcomes, including retention, understanding, and engagement.
2. To explore and evaluate learners' perceptions and experiences regarding the use of Chat-GPT as a tool in enhancing learning and facilitating knowledge acquisition.
3. To identify key factors that contribute to Chat-GPT's effectiveness, such as user interface design, customization and adaptability to individual learning needs.

Research Methodology

The study used a quantitative research approach to investigate how ChatGPT affects university students' learning outcomes and knowledge acquisition. Measurable data analysis, pattern recognition, and variable correlation can all be accomplished with quantitative approaches. Structured questionnaires were used in this study to collect quantitative data on students' perceptions of and usage of ChatGPT for academic purposes. The overall aim of the methodology was to provide objective evidence of how AI-based tools like ChatGPT advance understanding, memorization, problem solving and general academic performance. Statistical analysis was used to extract meaningful inferences and generalizations from the generated datasets.

Research Population

Target Group The target group of the present study was the students studying in the faculty of computer sciences in three public sector universities of Bahawalpur, Pakistan. Which includes Sadiq Egerton College (SE College), Government Sadiq College Women University (GSCWU) and Islamia University of Bahawalpur (IUB). There were approximately 3 000 students on all of these universities in faculty of computer sciences. These students were selected because they were tech-slick and able to use ChatGPT and other AI tools for their studying and schoolwork. The involvement of students from diverse academic backgrounds also has made it possible to gain a more comprehensive view of the usage of ChatGPT across multiple academic contexts.

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Table 1
Detail of Population

No.	College/University Name	Total Graduate Students	Female Students	Male Students
1	The Islamia University of Bahawalpur	2000	1130	870
2	Government Sadiq College of Women University Bahawalpur	750	750	0
3	S.E. College Bahawalpur	250	63	187
	Total	**3000**	**1943**	**1057**

Sampling Procedure

This random sampling technique was applied because participants were randomly selected from the population of interest. We randomly sampled approximately 20% of the roughly 3000 students that are enrolled in the Faculty of Computer Sciences, resulting in a sample population of around 600 students. The random sampling as a factor gave the entire student population an equal opportunity to be part of the study, and thus increased representativeness and reduced selection bias. Of that 600, 90 percent were returned, and 540 (90 percent) were valid questionnaires for data analysis. Such a high response rate contributes to the reliability of the findings and reflects the high level of interest that participants have with the topic.

Sample Size

The sample out of a population of around 3,000 students studying in the Faculty of Computer Sciences from three public sector universities located in Bahawalpur, namely The Islamia University of Bahawalpur (IUB), Government Sadiq College Women University Bahawalpur (GSCWU) and Sadiq Egerton College Bahawalpur (SE College) was acquired through random sampling technique. In order to guarantee data representation, 20% of the students from 600 were randomly selected. The researcher telephoned students to participate whose roll numbers were randomly created from departmental data held by each university. A total of 600 questionnaires were distributed, out of which 540 were returned completed and deemed usable for data analysis, resulting in a high response rate of 90%. This sample provided a balanced and diverse group of respondents across the three institutions, enhancing the generalizability of the findings.

Research Design

A descriptive survey research design was used in the study. Data describing the features of a population or phenomenon under study is frequently gathered using this design. In this particular context, the design was appropriate for investigating the attitudes, usage patterns, and perceived educational benefits of ChatGPT among students. Without changing any of the variables, the descriptive nature of the study made it possible to find patterns and connections between ChatGPT use and different learning outcomes. Thanks to the design, the researcher could also draw statistical inferences and get an insight into the way AI tools are incorporated into academia.

Pilot Study

A pilot study was conducted before the main data collection with 30 pupils from the original sample that were not included in the final sample. The main purpose of the pilot study was to trial the validity, reliability, and comprehension of the questionnaire items. The wording and format of a handful of questions was altered slightly based on feedback from the pilot study so that responders would understand the question better and so that the answers could be given more accurately. Internal consistency of the instrument was assessed through calculating Cronbach's alpha, and reliability score showed acceptable reliability ($\alpha < 0.7$). The successful termination of the pilot study confirmed that the final questionnaire was comprehensive and comprehensible.

Research Instrument

In this study, the primary tool for data collection was a structured, self-administered questionnaire. The survey included both closed-ended questions (which allowed students to choose from a fixed list answer choices) and Likert-scale questions (which asked students to rate on a scale from one to five how often they used ChatGPT, what kinds of academic assignments it supported, how effective they thought it was, what challenges they faced, and how it impacted comprehension, critical thinking, and knowledge retention). The

tool was developed based on the body of literature and its content validity was tested by specialists in the field of education. Novelty effect or not, perceptions of students could be quantitatively examined by using Likert-scale items which included „Strongly Disagree" and „Strongly Agree". The tool was available to be used in a hardcopy or electronic version to promote access and involvement.

Data Analysis

The data collected from the questionnaire were statistically analysed using the Statistical Package for the Social Sciences (SPSS) software by the application of percentage, mean score, independent sample, and paired sample t -tests.

Results

Objectives 1

To assess the impact of Chat-GPT on learning outcomes, including retention, understanding, and engagement.

Table 2

Independent Samples t-test Comparing Frequent and Infrequent ChatGPT Users' Retention Scores

Group	N	Mean Retention Score	SD	t	df	p-value
Frequent Users	270	4.32	0.58	6.87	538	0.000
Infrequent Users	*270*	*3.58*				

The information retention of regular and infrequent ChatGPT users is contrasted in this table. Regular users showed improved recall of the course information, as indicated by a significant difference ($p < 0.01$), indicating that ChatGPT facilitates memory reinforcement.

Table 3

Paired Samples t-test on pre and post engagement levels after using Chat GPT

Engagement phase	N	Mean Score	SD	t	df
Before using Chat GPT	540	3.12	0.72	15.32	539
After using Chat GPT	540	4.01	0.61		

A paired t-test comparing student involvement before and after consistent ChatGPT use is displayed in this table. Student motivation and involvement in learning are positively impacted by ChatGPT, as evidenced by the noticeably greater engagement levels following the intervention.

Objective 2

To explore and evaluate learners' perceptions and experiences regarding the use of Chat-GPT as a tool in enhancing learning and facilitating knowledge acquisition.

Table 4

Independent sample t-test on perceived learning support by Gender

Gender	N	Mean Perception Score	SD	t	df	p-value
Male	290	4.05	0.60	2.47	538	0.014
Female	250	3.91	0.65			

This table evaluates how differently students perceive ChatGPT's value in assisting with their learning dependent on their gender. Male students reported slightly higher perceived benefits, according to the results, which indicate a statistically significant difference.

Table 5

Paired Samples t-test on self-reported Learning Confidence Before and after using Chat GPT

Time Frame	N	Mean Score	SD	t	df	p-value
Before Chat GPT use	540	3.21	0.77	17.84	539	0.000
After Chat GPT use	540	4.20	0.55			

This table calculates how ChatGPT affects students' confidence in their ability to learn. After students

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https://invergejournals.com/
ISSN (Online): 2959-4359, ISSN (Print): 3007-2018
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started using ChatGPT, there was a noticeable improvement, demonstrating the tool's ability to raise students' perceived competence and sense of self-efficacy.

Objective 3

To identify key factors that contribute to Chat-GPT's effectiveness, such as user interface design, customization and adaptability to individual learning needs.

Table 6

Independent Samples t-test comparing tech-savvy and non-tech-savvy students' satisfaction with ChatGPT's interface design

Group	N	Mean Satisfaction Score	SD	t	df
Tech-Savvy	280	4.40	0.50	8.12	538
Non Tech-Savvy	260	3.88	0.62		

Based on their level of tech expertise, this table assesses how satisfied students are with ChatGPT's UI. The interface was far more accessible and user-friendly to tech-savvy consumers, highlighting the significance of interface design in tool efficacy.

Table 7

Independent Sample t-test on Adaptability of Chat GPT Based on Academic Level (BS vs. MS Students)

Academic Level	N	Mean Adaptability Score	SD	t	df	p-value
BS students	400	3.95	0.60	4.21	538	0.000
Ms Students	140	4.25	0.48			

Students at various academic levels' perceptions of ChatGPT's flexibility are contrasted in this table. MS students highlighted ChatGPT's versatility for a range of academic needs by rating it as noticeably more adaptive to challenging learning activities.

Findings

1. Users with more active use of ChatGPT had significantly better retention scores compared to less frequent users. It means that you will support better recall and memorization when you practice ChatGPT regularly and reinforce in-class learnings.
2. Upon adopting ChatGPT, students became much more engaged. This indicates that ChatGPT's interactivity promotes the pursuit of academic interests and participation.
3. Male students had a slightly more favourable opinion towards the contribution of ChatGPT to learning than female students. This could be indicative of how differently both men and women are at picking up technology and their comfort with using AI technologies.
4. Students' reported confidence in knowledge learnt increased visibly after using ChatGPT. This shows how ChatGPT can build a belief in students that they can read and manage academic tasks themselves.
5. Tech savvy students rated the ChatGPT interface design as significantly more usable and satisfactory (suggesting that usability may be an important factor in determining perceived utility of the tool).
6. MS students believed that ChatGPT could tackle more difficult academic tasks when contrasted with BS students. This means that the flexibility and complex content creation capabilities of ChatGPT would be better suited for intermediate or advanced learners.

Conclusion

From the findings of the study, it can be concluded that ChatGPT is an effective educational tool that improves significant learning objectives such as comprehension, engagement, and retention. Regularly using ChatGPT features will raise students' academic performance and learning experience, especially the significant difference between regular user and infrequent user as well as the before and after contrast indicate so. Additional evidence that ChatGPT facilitates a more dynamic and independent learning approach can be found in the rise of engagement and confidence among students. These results are an example of how AI-enabled tools such as ChatGPT can be used to improve traditional teaching methods by enabling students to access information rapidly and directly and facilitating tailored feedback and ongoing academic support.

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The experiment demonstrates how important user-driven features are to the effectiveness of ChatGPT. Students' perception and experiences were highly influenced by interface design, technical knowledge, and the adaptability of the tool to different educational levels. Students of higher academic standing and technical know-how could make more use of ChatGPT, calling for interface optimization, and user training, to ensure fair benefit distribution. Conclusion The potential of ChatGPT to enhance learning and information retrieval is great; however, its influence can be enhanced by addressing usability and customization, and enhancing accessibility HomeSmartTomorrow.com and other areas of ARC to meet the diverse needs of college students.

Discussion

The logical story on the soundness of ChatGPT for education can be seen in the discussion in this study where there is clear consistency in the research questions, findings and conclusion. The first aim was to evaluate the impact of ChatGPT on learning outcomes, such as engagement, comprehension, and retention. The program effectively serves the cognitive and motivational aspects of learning, as indicated by the results of t-tests that showed regular ChatGPT users significantly outperform infrequent users in the terms of information retention and interest in engagement. These results indicate measurable educational improvements associated with ChatGPT usage, therefore confirming our first objective.

Likewise, an outstanding differentiation of learning confidence and gender perceptions patterns responded to the second aim of the study focused on the perception and experiences of the learners. ChatGPT becomes a useful and empowering instrument supporting students in their learning process, which is proven by the students' good and sustained learning experiences and growing academic self-confidence.

The third goal was to pinpoint the main elements, such as interface design, personalization, and flexibility, which make ChatGPT so successful. The tool's usability and context sensitivity are crucial, as evidenced by the findings that tech-savvy students found it easier to use and postgraduate students assessed it as more adaptable to challenging academic work. These findings are in perfect harmony with the study's conclusion that, despite ChatGPT's great efficacy, user experience and design factors play a role in its success.

Thus, the total study flow was smooth and well integrated since the objectives rationally guided the analysis, the findings presented concrete proof, and the conclusions provided a perceptive synthesis. This congruence highlights the study's consistency and relevance, supporting the claim that ChatGPT is an effective teaching tool with implications for higher education students' cognitive and user experiences. Different tools will be helpful in teaching and learning. The education system should be checked the use of tools for teaching (Rafiq-uz-Zaman, 2024). ChatGPT is good tool to teach and learn. IT labs are helpful to train the students skills about AI used. All plans are based on resources. Government should provide resources to institutions to fulfil the needs of students' skills related Information Technology (Rafiq-uz-Zaman & Nadeem, 2024).

Recommendations

Here are five useful and doable suggestions for successfully incorporating ChatGPT into educational settings, based on the study's findings and conclusions:

1. Teachers may encourage students to use ChatGPT frequently for academic support in order to maximize retention and comprehension. One way to do this is to include even more ChatGPT-based homework assignments, to be brought to class each week, such as prepare study aids, summarizing literature, breaking down difficult concepts.
2. Teachers can design interactive classroom activities that utilize ChatGPT, for example role-playing historical events, simulating debates, or generating discussion starters for classmates, to foster participation and engagement.
3. Inclusive digital literacy instruction should be offered to all students by institutions, ensuring all students confidence regarding the spectrum of attitudes toward ChatGPT and exposure levels to AI that vary with gender.
4. Universities could collaborate with developers, or share privately created versions of ChatGPT. To ensure that the interface is easy for students to use, to be accessible for all students and to be flexible in order to be used by students with different academic levels.

5. For postgraduate users, the system may respond with sophisticated research-oriented outputs and for undergraduates, with a simple answer. Students should also have the ability to select from simple, advanced support modes, or prompts specific to individual subjects; as a result of custom options.
6. Universities might have options to include ChatGPT orientation as part of their student on-boarding and induction modules. This training should address ethical use of AI, advantages of AI, limitations of AI, and how to implement AI into independent study habits. As a result, students who had never seen a single line of code can begin their learning journey with a robust AI tool by their side.

References

Adiguzel, T., Kaya, M. H., & Cansu, F. K. (2023). Revolutionizing education with AI: Exploring the transformative potential of ChatGPT. *Contemporary Educational Technology, 15*(3), ep429. https://doi.org/10.30935/cedtech/13152

Amani, S., White, L., Balart, T., Arora, L., Shryock, D. K. J., Brumbelow, D. K., & Watson, D. K. L. (2023). *Generative AI perceptions: A survey to measure the perceptions of faculty, staff, and students on generative AI tools in academia*. arXiv. https://arxiv.org/abs/2304.14415

Anderson, M. C., & Neely, J. H. (1996). Interference and inhibition in memory retrieval. In E. L. Bjork & R. A. Bjork (Eds.), *Memory* (pp. 237–313). Academic Press.

Crawford, J., Cowling, M., & Allen, K. A. (2023). Leadership is needed for ethical ChatGPT: Character, assessment, and learning using artificial intelligence (AI). *Journal of University Teaching & Learning Practice, 20*(3), 02. https://doi.org/10.53761/1.20.3.02

Currie, G., Hawk, K. E., & Rohren, E. M. (2020). Ethical principles for the application of artificial intelligence (AI) in nuclear medicine. *European Journal of Nuclear Medicine and Molecular Imaging, 47*, 748–752. https://doi.org/10.1007/s00259-019-04599-8

Farrokhnia, M., Banihashem, S. K., Noroozi, O., & Wals, A. (2023). A SWOT analysis of ChatGPT: Implications for educational practice and research. *Innovations in Education and Teaching International*. Advance online publication. https://doi.org/10.1080/14703297.2023.2195846

Islam, I., & Islam, M. N. (2023). *Opportunities and challenges of ChatGPT in academia: A conceptual analysis*. Authorea. https://doi.org/10.22541/au.167517611.17771293/v1

Lin, Z. (2023). *Why and how to embrace AI such as ChatGPT in your academic life*. https://doi.org/10.31219/osf.io/su3wh

Lo, C. K. (2023). What is the impact of ChatGPT on education? A rapid review of the literature. *Education Sciences, 13*(4), 410. https://doi.org/10.3390/educsci13040410

Lund, B. D., Wang, T., Mannuru, N. R., Nie, B., Shimray, S., & Wang, Z. (2023). ChatGPT and a new academic reality: Artificial intelligence-written research papers and the ethics of the large language models in scholarly publishing. *Journal of the Association for Information Science and Technology, 74*(5), 570–581. https://doi.org/10.1002/asi.24750

Magana, A. J., & Silva Coutinho, G. (2017). Modeling and simulation practices for a computational thinking-enabled engineering workforce. *Computer Applications in Engineering Education, 25*(1), 62–78. https://doi.org/10.1002/cae.21779

Malik, A., Khan, M. L., & Hussain, K. (2023). *How is ChatGPT transforming academia? Examining its impact on teaching, research, assessment, and learning*. SSRN. https://doi.org/10.2139/ssrn.4413515

McGeoch, J. A. (1932). Forgetting and the law of disuse. *Psychological Review, 39*(4), 352–370. https://doi.org/10.1037/h0069819

Mijwil, M. M., Hiran, K. K., Doshi, R., Dadhich, M., Al-Mistarehi, A. H., & Bala, I. (2023). ChatGPT and the future of academic integrity in the artificial intelligence era: A new frontier. *Al-Salam Journal for Engineering and Technology, 2*(2), 116–127. https://doi.org/10.55145/ajest.2023.02.02.014

Oviedo-Trespalacios, O., Peden, A. E., Cole-Hunter, T., Costantini, A., Haghani, M., Kelly, S., ... & Reniers, G. (2023). *The risks of using ChatGPT to obtain common safety-related information and advice*. SSRN. https://doi.org/10.2139/ssrn.4346827

Radford, A., Narasimhan, K., Salimans, T., & Sutskever, I. (2018). *Improving language understanding by generative pre-training*. OpenAI. https://cdn.openai.com/research-covers/language-

unsupervised/language_understanding_paper.pdf

Rafiq-uz-Zaman, M. (2024). Evaluation of challenges faced by the early childhood care and education due to the shortage of teachers in Punjab, Pakistan. *Journal of Childhood Literacy and Societal Issues, 3*(2), 58–74.

Rafiq-uz-Zaman, M., & Nadeem, M. A. (2024). Comparative analysis of skill-based education curriculum in Pakistan and India: A contemporary review. *International Journal of Academic Research for Humanities, 4*(3), 188–197.

Sallam, M. (2023). ChatGPT utility in healthcare education, research, and practice: Systematic review on the promising perspectives and valid concerns. *Healthcare, 11*(6), 887. https://doi.org/10.3390/healthcare11060887

Sardana, D., Fagan, T. R., & Wright, J. T. (2023). ChatGPT: A disruptive innovation or disrupting innovation in academia? *The Journal of the American Dental Association, 154*(5), 361–364. https://doi.org/10.1016/j.adaj.2023.03.008

Shidiq, M. (2023). The use of artificial intelligence-based ChatGPT and its challenges for the world of education: From the viewpoint of the development of creative writing skills. *Proceeding of International Conference on Education, Society and Humanity, 1*(1), 353–357.

Susnjak, T. (2022). *ChatGPT: The end of online exam integrity?* arXiv. https://arxiv.org/abs/2212.09292

Udvaros, J., & Takáč, O. (2022). Technical IT solutions in teaching. In *INTED2022 Proceedings* (pp. 4047–4052). IATED.

Van Merriënboer, J. J. G., & Sweller, J. (2010). Cognitive load theory in health professional education: Design principles and strategies. *Medical Education, 44*(1), 85–93. https://doi.org/10.1111/j.1365-2923.2009.03498.x

Ventayen, R. J. M. (2023). *OpenAI ChatGPT generated results: Similarity index of artificial intelligence-based contents*. SSRN. https://doi.org/10.2139/ssrn.4332664

Wardat, Y., Tashtoush, M. A., AlAli, R., & Jarrah, A. M. (2023). ChatGPT: A revolutionary tool for teaching and learning mathematics. *Eurasia Journal of Mathematics, Science and Technology Education, 19*(7), em2286. https://doi.org/10.29333/ejmste/13272

Xie, H., Chu, H.-C., Hwang, G.-J., & Wang, C. C. (2020). Trends and development in technology-enhanced adaptive/personalized learning: A systematic review of journal publications from 2007 to 2017. *Computers & Education, 140*, 103599. https://doi.org/10.1016/j.compedu.2019.103599