https://journal.ypidathu.or.id/index.php/jete/
P - ISSN: 3025-0668
E - ISSN: 3025-0676

Impact of Using Cognitive Technology in Increasing the Efficiency of the Learning Process

Baso Intang Sappaile[1]
[1]Universitas Negeri Makassar, Indonesia

ABSTRACT

Background. Utilizing cognitive technology has significantly improved educational outcomes, with a real impact on the effectiveness of the learning process.Cognitive technology allows teachers to present lesson content that is aligned with students' level of understanding and learning styles, resulting in more effective and efficient teaching. The use of cognitive technology not only increases the efficiency of the learning process but also creates a more thoughtful and focused learning environment for students.

Purpose. ObjectiveThis research aims to determine the impact of using cognitive technology in increasing the efficiency of the learning process. As well as knowing the effect of using cognitive technology which can increase efficiency in the learning process. So that the desired learning objectives are achieved.

Method. This research uses quantitative methods so that it can provide data in the form of accurate numbers. Data was obtained by distributing an online questionnaire via the Google Form application to respondents. The respondents' results will be managed using the SPSS application. After data management, researchers present the data in the form of graphs or diagrams.

Results. From the results of this research, it can be seen that cognitive technology has a significant impact in increasing the efficiency of the learning process. By using cognitive technology that can be accessed anytime and anywhere, it can make it easier for students to understand the material. So as to create an efficient learning process.

Conclusion. From this research, researchers can conclude that the impact of using cognitive technology can increase efficiency in the learning process. So as to create a safe and comfortable learning atmosphere. And achieving the desired learning goals.

KEYWORDS

Cognitive, Efficiency, Learning

Citation: Sappaile, I, B. (2024). Impact of Using Cognitive Technology in Increasing the Efficiency of the Learning Process. *Journal Emerging Technologies in Education*, *2*(2), 137–149.
https://doi.org/10.70177/jete.v2i2.1060

Correspondence:

Baso Intang Sappaile,
Baso.sappaile@unm.ac.id

Received: June 18, 2024

Accepted: June 29, 2024

Published: June 29, 2024

INTRODUCTION

In the current era of globalization, technological progress has developed so quickly that experts call it change or revolution(Kusumaputri et al., 2021). Because technology always develops in accordance with the times and science, technological development cannot be separated from various aspects of human life(Javed et al., 2024). For humans, technology is very important. The existence of technology has caused many changes in various aspects of human life. One of the benefits of technology is the ability to find out about various information and events that occur throughout the

world(Fotteler et al., 2023). Technology can also help people communicate with each other around the world.

Technological developments are currently also affecting the field of education. One of them is cognitive technology.Cognitive techniques use natural language processing, context understanding, and artificial intelligence to create systems that can understand, learn, and interact with humans(Akhmetova et al., 2024). Cognitive technology is a field of science that includes advances in mental function, memory, and cognitive development(Hawes & Arya, 2023). This includes technological developments related to cognition, such as information technology, artificial intelligence, and better computer capabilities(Benge et al., 2023). Technology also speeds up and improves thought processes and helps in learning and cognitive development

The development of cognitive technology can have a good or bad impact on a person's cognitive development, both children and adults, considering the role of social interaction in cognitive development(Aashiq et al., 2023).has a huge impact in the world of education, both negative and positive impacts. The negative impact of technology in the field of education is that it encourages students to feel lazy(Oleksiyenko et al., 2019). Because the easier access to information makes students lazy to think and read(Dove et al., 2020). So that makes students weak in terms of intellectuality. As well as training children to think briefly and be individualistic.

Behind this negative impact there are many positive impacts from the development of cognitive technology.This technique allows for personalization of learning, where the material is tailored to each student's needs and level of understanding(Broseghini et al., 2024). This increases the effectiveness of learning and makes the learning experience more interesting(Brown et al., 2024). Additionally, cognitive technology has the ability to provide rapid and in-depth feedback that helps students understand their strengths and weaknesses and helps them improve their performance(Maisyaroh et al., 2023).

By utilizing intelligent algorithms and data analysis, this technology is able to provide a more personalized learning experience that suits each individual's needs(Lee et al., 2024). Through collecting and analyzing learning data, teachers can easily identify the weaknesses and needs of individual students, so they can provide targeted and appropriate guidance.(Z. Wang, 2024). Thus, the use of cognitive technology can increase efficiency in the learning process, but also enrich the student's overall learning experience(Kalafatis et al., 2022).

The impact of using cognitive technology in increasing efficiency in the learning process is very influential. Using cognitive technology in the learning process can improve students' abilities and learning outcomes(Modarres et al., 2023). With the feedback provided by students in the learning process, it will increase student activity. So that students will easily understand the material provided by the teacher(Begde et al., 2024). And it will create an efficient, safe and comfortable learning process. An efficient learning process can increase students' enthusiasm for learning and motivation(Chang et al., 2024). So that there will be an increase in student quality and student learning outcomes.

The type of method used in this research is a quantitative method. This method is used so that the final results of the processed data can be known clearly and precisely regarding the impact of implementing game-based learning on student motivation and engagement. The data collection process was obtained by the researcher from the results of the respondents' answers that the researcher had carried out. Researchers created a questionnaire with 10 questions, then distributed it via Goggle from. After the data is collected, the data will be calculated into a percentage and presented in table form. In processing research data, researchers use SPSS software which aims to make it easier for researchers to process data, and the data results are more relevant.

From the results of the explanation above, researchers assume that the use of cognitive technology to increase the efficiency of the learning process can be a factor in improving student learning outcomes. This research also aims to determine the superiority of the impact of cognitive technology in increasing efficiency in the learning process so that there is feedback that students can give to the material explained by the teacher. Furthermore, the researcher really hopes that the next researchers will research and study more deeply the impact of implementing game-based learning on student motivation and engagement.

RESEARCH METHOD

Research design

This research uses a quantitative research design, which uses statistical processes to present data in the form of numbers. Researchers created twenty questions to collect information about the research to find out the results. Researchers will ask respondents to answer the questions asked, which will be presented in the form of tables and percentages. The purpose of processing this data with the SPSS application is to compare the results of respondents' answers. After this comparison, researchers can provide solutions for any information they obtain about the impact of using cognitive technology in increasing the efficiency of the learning process.

Research procedure

In this study, researchers investigated the impact of using cognitive technology in increasing the efficiency of the learning process. The aim of the researcher is to investigate this matter so that the researcher can collect, analyze and provide understanding of the data that has been collected. In creating questions, researchers use good language that is easy for teachers and students to understand. This aims to ensure that teachers and students who respond to questions asked by researchers can be answered quickly. That way, it will be easier for researchers to test the data being investigated regarding the impact of using cognitive technology in increasing the efficiency of the learning process

Research subject

In researchingthe impact of using cognitive technology in increasing the efficiency of the learning process,The researcher certainly determines the subject for his research. In this research, the subject of this research is aimed at students from various educational institutions. Before the questionnaire was distributed by the researcher, the researcher asked the respondents first to be willing to spend their time filling out the questionnaire that the researcher would distribute. The questionnaire each contains 10 questions aboutthe impact of using cognitive technology in increasing the efficiency of the learning process

Research Ethics

After the researcher carried out several stages as previously explained, in conducting research, the researcher also paid close attention to ethics and manners in research. Researchers believe that ethics needs to be considered whenever and wherever, including in the research being conducted. This aims to gain trust and readiness from the respondents or those who are the objects of this research. Furthermore, in this research, the researcher also explains information related to the research, one of which is information in filling out the questionnaire. This information was explained by the researcher so that the respondents were ready and willing to voluntarily provide responses and answers to the questions asked by the researcher.

Data Collection and Analysis

Data collected by researchers in researchingthe impact of using cognitive technology in increasing the efficiency of the learning processwill be processed into the SPSS application. Then

the data that has been obtained will be presented by researchers in the form of tables and diagrams. The purpose of presenting it in table and diagram form is to be able to see a comparison of the research results that have been carried out by researchers regardingthe impact of using cognitive technology in increasing the efficiency of the learning process. Next, the obtained data results are converted into percentages or averages. Then the data results will be tested again using the T-test

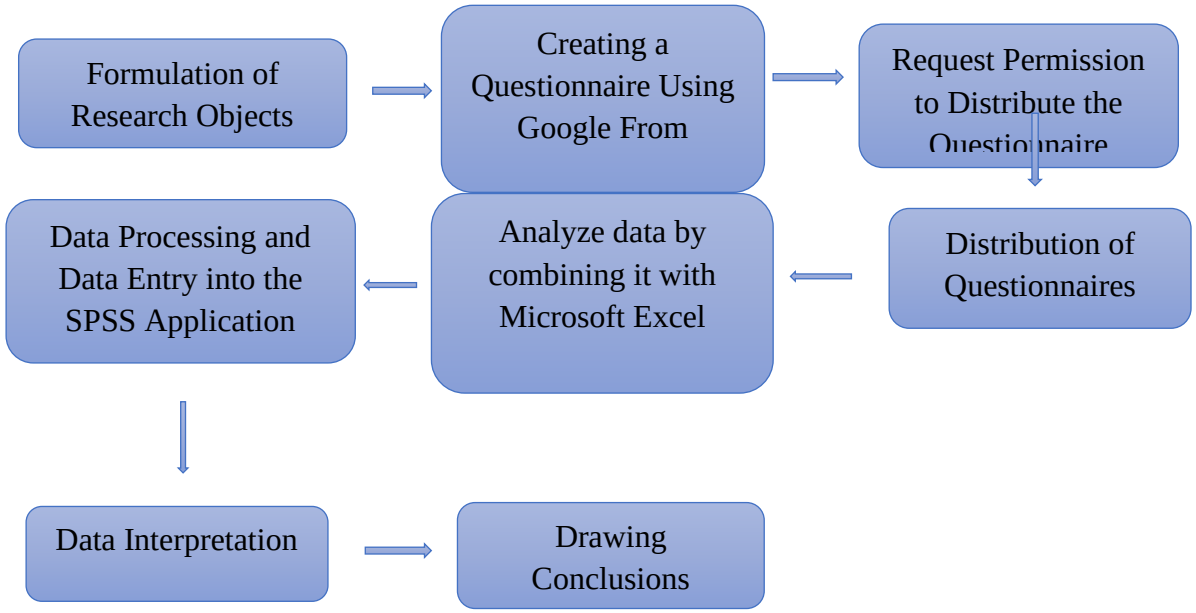
Table 1

Categories of the Impact of Game-Based Learning Integration on Student Motivation and Engagement

No	Earning Category	Level of education	Percentage (%)
1	Strongly agree	Student	>90%
2	Agree	Student	45-89%
3	Disagree	Student	16-45%
4	Don't agree	Student	5-15%

Figure 1

Data Collection and Analysis Flow



RESULTS

Impact of Cognitive Technology Use

Various aspects of life have been greatly influenced by the application of cognitive technology, both positively and negatively. Cognitive technology can increase productivity and work efficiency by enabling the automation of repetitive tasks. Additionally, cognitive technology provides valuable insights from big data, which helps people make more accurate and informed decisions. However, negative impacts that need to be considered also include job replacement due to automation and ethical issues related to data privacy and security. Additionally, relying on this technology can reduce humans' ability to think critically and make decisions independently. To overcome these negative effects, appropriate policies and regulations are needed to ensure the responsible use of cognitive technology.

Table 2

Summary of Percentage Results from Respondents' Answers

No.	Question	Strongly agree	Agree	Disagree	Don't agree
1	Cognitive technology can adapt learning to suit each student's needs and abilities	26%	60%	12%	0%
2	The use of cognitive technology can provide support to students	25%	30%	40%	5%
3	Adaptive learning algorithms enable more personalized and effective teaching	33%	53%	8%	6%
4	Cognitive technology can provide interactive and engaging learning materials, increasing student engagement	45%	50%	3%	2%
5	With cognitive technology, teachers can create automatic content which can save teachers' time in preparing teaching materials	65%	28%	7%	0%
6	The use of cognitive technology can provide learning guidance to students outside school hours	20%	35%	44%	1%
7	Cognitive technology helps in managing schedules and learning tasks efficiently	23%	60%	10%	7%
8	Cognitive technology can support students with disabilities in learning	30%	66%	2%	2%
9	Cognitive technology enables real-time analysis of student progress	30%	50%	10%	10%
10.	Learning using cognitive technology can make the learning process more enjoyable	60%	40%	0%	0%

Table 2 above shows the distribution of questionnaires that have been carried out by researchers. This questionnaire contains ten questions about the impact of using cognitive technology in increasing the efficiency of the learning process. In addition, during the distribution of the questionnaire, the researcher presented a percentage of each response from the respondents. Therefore, respondents can choose to answer the researcher's questions by providing options such as strongly agree, agree, disagree, or disagree. And it can also be seen from the first question asked by researchers regarding Cognitive technology can adapt learning according to the needs and abilities of each student, getting the highest score of 60% with the agree option.

The second question is aboutThe use of cognitive technology can provide support to students, getting a percentage result of 40% disagreeing. The third question about Adaptive learning algorithms enabling more personalized and effective teaching, scored 53% agree. The fourth question about cognitive technology can provide interactive and interesting learning materials, increase student engagement, getting a percentage of 50% agree. Next, the fifth question was regarding With the existence of cognitive technology, teachers can create automatic content which can save teachers' time in preparing teaching materials. There were 65% of the options that strongly agreed. Furthermore, the sixth is regarding the use of cognitive technology to provide learning guidance to students outside school hours, as many as 44% disagree.

The seventh question is thatCognitive technology helps in managing schedules and learning tasks efficiently, resulting in a percentage of 60% choosing the agree option. In the eighth question regarding cognitive technology can support students with disabilities in participating in learning, can influence the development of students' social skills, there was also an agree option of 66%. The ninth question on Cognitive technology allows real-time analysis of student progress, resulting in a percentage of 50% agreeing. For the last question regarding learning using cognitive technology can make the learning process more enjoyable, the percentage gain was 60% for the strongly agree option.

Table 3

Summary of Percentage Results from Respondents' Answers

No.	Question	Strongly agree	Agree	Disagree	Don't agree
1	Cognitive technology can optimize teaching by identifying the most effective learning strategies	33%	59%	3%	5 %
2	An intelligent information search system makes it easier for students to find relevant learning materials	50%	50%	0%	0%
3	Cognitive technology helps in detecting plagiarism and ensuring the authenticity of students' work	80%	20%	0%	0%
4	The use of interactive simulations supported by technology can improve understanding of difficult concepts	45%	52%	3%	1%
5	Cognitive technology can facilitate collaborative learning by connecting students from diverse backgrounds	67%	33%	0%	0%
6	The use of cognitive technology can provide automatic feedback helping teachers provide fast and accurate responses to students	50%	50%	0%	0%
7	Online learning powered by cognitive technology can provide access to high-quality materials anywhere	72%	28%	0%	0%
8	Cognitive technology can help students manage their own study time more effectively	44%	39%	15%	1%
9	Facial recognition can be used to ensure student attendance in online classes	85%	5%	10 %	0%
10	Cognitive technology can support the development of critical thinking skills through data analysis and problem solving	70%	30%	0%	0%

In the statement in table 3 above, the researcher has also created ten questions. Which can be seen from the first question regarding cognitive technology can optimize teaching by identifying the most effective learning strategies, getting a percentage result of 59% of agree options. Next, question number two is about an intelligent information search system that makes it easier for

students to find relevant learning materials, getting the same percentage score for the strongly agree and agree options of 50%. The third question that cognitive technology helps in detecting plagiarism and ensuring the authenticity of students' work, received a percentage score of 80% strongly agree.

The fourth question is aboutThe use of interactive simulations supported by technology can improve understanding of difficult concepts, getting as much as 52% of the percentage score on the agree option. The fifth question about cognitive technology can facilitate collaborative learning by connecting students from various backgrounds, received 65% of strongly agree options. The sixth question regarding the use of cognitive technology can provide automatic feedback to help teachers provide fast and accurate responses to students, getting the same percentage gain of 50% for the strongly agree and agree options.

Next the seventh hitsOnline learning supported by cognitive technology can provide access to high-quality materials anywhere, getting a percentage score of 72% strongly agree. The eighth question about cognitive technology can help students manage their own study time more effectively, obtained a percentage gain of 44% strongly agree. In question number nine, that facial recognition can be used to ensure student attendance in online classes, the highest number of options were strongly agreed with 85%. The last question about cognitive technology can support the development of critical thinking skills through data analysis and problem solving, got as many as 70% of the strongly agree options.

Diagram 1

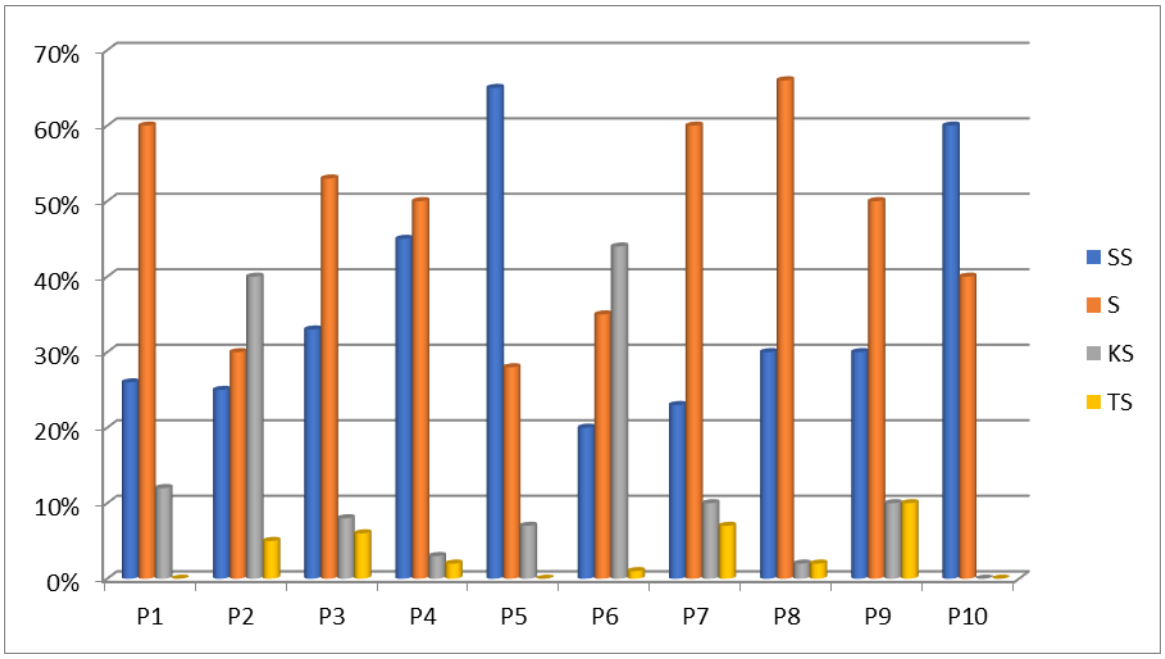


Diagram 2

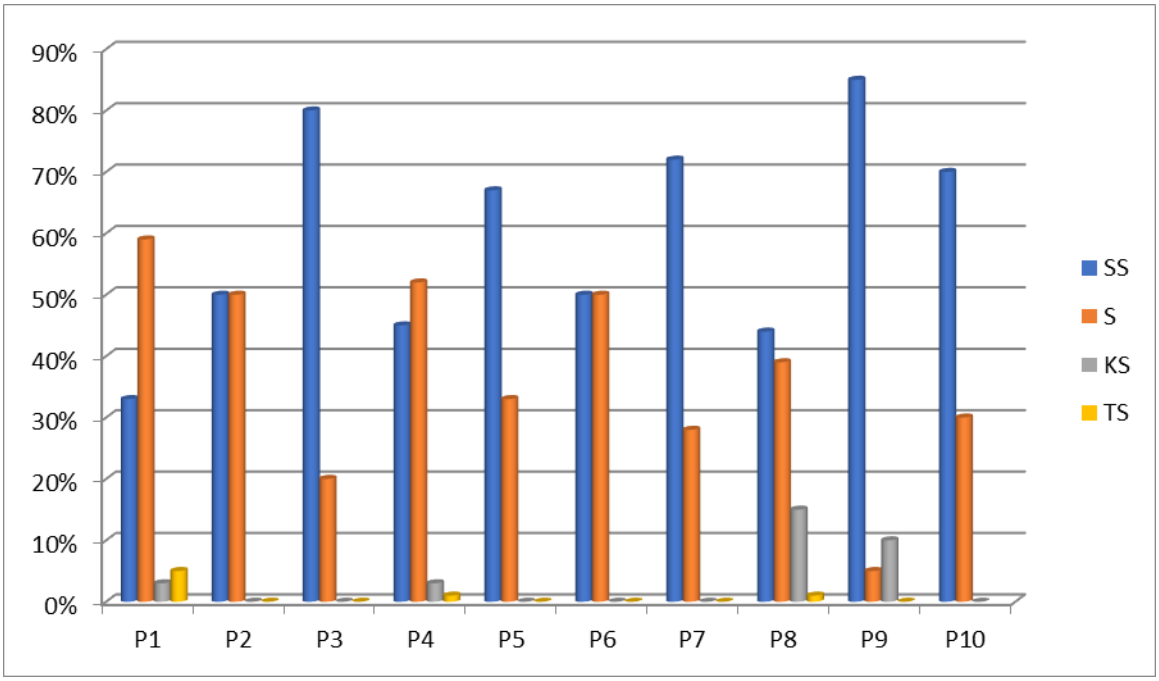


Table 3

T-test ConcerningThe Impact of Implementing Game-Based Learning on Student Motivation and Engagement

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	PRE TEST	47.6500	20	20.26995	4.53250
	POST TEST	41,9000	20	15.67062	3.50406

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	PRE TEST & POST TEST	20	-.743	,000

Paired Samples Test

		Paired Differences				
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of th Difference Lower	Upper
Pair 1	PRE TEST - POST TEST	5.75000	33.59648	7.51240	-9.97364	21.47364

Based on the results of table 3 above, it is a T-test using the SPSS application. From the research results, the researcher can conclude that the T-test in the first output section explains the

mean as the average. In the Pre Test the average number produced was 47.6500,while in the Post Test section the result was 41,9000. Based on these results, it can be formulated that there are differences in the results of the respondents' answers. Next, in the Paired Samples Correlations section, you get a correlation of -743, and the sign size is 000. Next, in the Paired Samples Test section, you get a result of 33.59648 in the Std section. Deviation, while in the Std. Mean Error obtained a result of 7.51240. Based on these results, the impact of using cognitive technology can really increase the efficiency of the learning process.

Table 4

T-test ConcerningThe Impact of Implementing Game-Based Learning on Student Motivation and Engagement

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	PRE TEST	8,3500	20	12.47007	2.78839
	POST TEST	2,0000	20	2.95581	.66094

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	PRE TEST & POST TEST	20	,244	,300

Paired Samples Test

		Paired Differences				
					95% Confidence Interval of th Difference	
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper
Pair 1	PRE TEST - POST TEST	6.35000	12.09295	2.70407	.69032	12.00968

Furthermore, in table 4, there are also the results of research using the T-test. It can be seen in the first output section that the Pre Test results were 8.3500, and the Post Test results were 2.0000. In the Paired Samples Correlations section, we obtained a Correlation of 244, with a Sign result of 300. Meanwhile, in the Paired Samples Test section, we obtained a result of 12.09295 in the Std section. Diviation, and Std. The mean error is 2.70407. Based on the results of this research, it can be seen between each question asked by researchers regarding the impactthe use of cognitive technology can increase the efficiency of the learning process.

DISCUSSION

Cognitive technology refers to the use of technology to understand human behavior and improve cognitive abilities such as memory, attention, and thinking(Heimann-Steinert et al., 2021).

Cognitive technology has developed rapidly in recent years, influencing various aspects of life, including education(Mingaleva & Vukovic, 2020). Cognitive technology can improve students' cognitive abilities in education through the use of gadgets and internet technology(Krakenberg et al., 2019). These gadgets can encourage children to think creatively and become more mature in handling problems.

In addition, information technology can help improve students' cognitive abilities in education. Studies have shown that the use of information technology benefits students' cognitive abilities, such as analytical and critical thinking skills(Blok et al., 2020). Cognitive technology can help in artificial intelligence solving cognitive problems such as voice recognition and facial recognition(Fotteler et al., 2023). Although cognitive technology has great potential to improve cognitive abilities and influence various aspects of life. One of the influences is increasing the efficiency of the learning process(Hong et al., 2022).

To increase the efficiency of the learning process, the use of technology in the education sector has a big influence(Colmenar-Santos et al., 2018). The use of cognitive technology is present as one of the innovations that attracts students' interest in learning during the learning process. Using the benefits of cognitive technology can increase the efficiency of the learning process and make students active in discussions(He et al., 2021). With cognitive technology, education can become dynamic and relevant to current developments. And the learning style is not monotonous, helping to increase students' enthusiasm for learning and creativity in the classroom(Micek et al., 2021).

In learning using cognitive technology, students not only gain new knowledge but also improve their ability to think critically, work together, and overcome obstacles through the challenges and simulations offered.(Inaba et al., 2020). However, it is also important to remember that learning based on cognitive technology is not always effective. Not all students respond in the same way to the use of cognitive technology, so it is very important for a teacher to pay attention to the diversity of his students in learning(El Abed & Castro-Lopez, 2024). How students respond to technology-based learning can be influenced by elements such as environment, culture, and personality, and the student's daily life.

The use of cognitive technology can have a big impact on the efficiency of the learning process(K. Wang et al., 2021). Learning using cognitive technology is able to create an active, innovative, fun, interesting and efficient learning environment(Geerts et al., 2018). Learning using cognitive technology is an effective tool used to prepare students to face educational challenges in the future, taking into account increasingly rapid technological advances and an increasingly competitive world.(Balatsas-Lekkas et al., 2020). The existence of cognitive technology can also improve the quality of education and student achievement if used appropriately.

However, apart from its positive impacts, the use of cognitive technology also has negative impacts that can endanger students' education. The impact is that there will be a dependency between students and this cognitive technology(Liljaniemi & Paavilainen, 2020). Because if students don't use it properly, students will experience various conveniences and will make them forget to think. And students will be lazy in reading from other literacies and always rely on technology that is fast and practical(Rockinson-Szapkiw & Wendt, 2021). By understanding this problem, as educators, you must be able to provide cognitive technology-based learning solutions that are focused and inclusive.

To ensure that cognitive technology-based learning can have positive benefits and can increase the efficiency of the learning process(Lohan et al., 2018). Even though the impact of cognitive technology-based learning has many benefits, it is important to remember that

technology-based learning should not be used as a substitute for traditional learning as a whole(Maurer-Grubinger et al., 2021). Therefore, technology-based learning can be an effective tool to support students' academic performance and at the same time bridge the differences between each student's learning styles.

CONCLUSION

The use of cognitive technology in the learning process greatly influences learning efficiency. Cognitive technology has developed rapidly in recent years and has influenced various aspects of life, including education. In education, the use of cognitive technology can improve students' academic performance and enhance their cognitive abilities. Information technology has greatly influenced the development of human cognitive aspects, including education. The use of cognitive technology in education can have a positive impact on students' academic performance and improve their cognitive abilities. Information technology has greatly influenced the development of a person's cognitive aspects, including in education. The use of information technology in the classroom can improve the learning process, improve student performance, and improve their cognitive abilities.

Cognitive technology can also help students become more mature in solving problems and thinking creatively. This can be seen if children use electronic devices to play games, download content and share information with friends. In this way, children become more mature in understanding events that occur around them and become smarter in handling problems. However, side effects such as addiction and sleep disorders can also arise from the use of cognitive technology. Therefore, parents and teachers should have guidelines for dealing with technology issues and supervising their children's use of devices. Director General of Primary and Secondary Education, Ministry

Education and Culture said in an online seminar that technology such as knives can help with many things if used correctly. However, if used incorrectly, it will backfire. The use of cognitive technology in learning has great potential to improve academic performance and increase learning effectiveness. However, the use of cognitive technology also needs to be anticipated by providing strategies to overcome technology problems and control children's gadget use.

REFERENCES

Aashiq, Zeb, I., Zhang, Y., & Tahir. (2023). Impact of emerging technologies on cognitive development: The mediating role of digital social support among higher education students. IJERI: International Journal of Educational Research and Innovation, 20, 1–15.https://doi.org/10.46661/ijeri.8362

Akhmetova, A., Karmanova, Z., Demissenova, S., Sadvakassova, N., & Koshkumbaev, K. (2024). Pedagogical Technologies and Cognitive Development in Secondary Education. Open Education Studies, 6(1), 20220214.https://doi.org/10.1515/edu-2022-0214

Balatsas-Lekkas, A., Arvola, A., Kotilainen, H., Meneses, N., & Pennanen, K. (2020). Effect of labeling fresh cultivated blueberry products with information about irradiation technologies and related benefits on Finnish, German, and Spanish consumers' product acceptance. Food Control, 118, 107387.https://doi.org/10.1016/j.foodcont.2020.107387

Begde, A., Jain, M., Goodwin, M., Brayne, C., Barnes, L., Brooks, R., Green, E., Richardson, C., Dening, T., Wilcockson, T., & Hogervorst, E. (2024). Exploring factors influencing the willingness of older adults to use assistive technologies: Evidence from the cognitive function and aging study II. Information, Communication & Society, 27(2), 368–385.https://doi.org/10.1080/1369118X.2023.2205915

Benge, J.F., Kiselica, A.M., Aguirre, A., Hilsabeck, R.C., Douglas, M., Paydarfar, D., & Scullin, M.K. (2023). Technology use and subjective cognitive concerns in older adults. Archives of Gerontology and Geriatrics, 106, 104877.https://doi.org/10.1016/j.archger.2022.104877

Block, M., Van Ingen, E., De Boer, A.H., & Slootman, M. (2020). The use of information and communication technologies by older people with cognitive impairments: From barriers to benefits. Computers in Human Behavior, 104, 106173.https://doi.org/10.1016/j.chb.2019.106173

Broseghini, A., Lõoke, M., Brscic, M., Raffaghelli, J., Cardazzo, B., Lotti, A., Cavicchioli, L., & Marinelli, L. (2024). Exploring the Effectiveness of Problem-Based Learning in an International Undergraduate Program in Veterinary Sciences: Students' Satisfaction, Experience and Learning. Veterinary Sciences, 11(3), 104.https://doi.org/10.3390/vetsci11030104

Brown, A., Lawrence, J., Axelsen, M., Redmond, P., Turner, J., Maloney, S., & Galligan, L. (2024). The effectiveness of nudging key learning resources to support online engagement in higher education courses. Distance Education, 45(1), 83–102.https://doi.org/10.1080/01587919.2024.2303491

Chang, I.-S., Byun, S.-W., Lim, T.-B., & Park, G.-M. (2024). A Study on E-Nose Systems in Terms of the Learning Efficiency and Accuracy of Boosting Approaches. Censorship, 24(1), 302.https://doi.org/10.3390/s24010302

Colmenar-Santos, A., Gómez-Camazón, D., Rosales-Asensio, E., & Blanes-Peiró, J.-J. (2018). Technological improvements in energetic efficiency and sustainability in existing combined-cycle gas turbine (CCGT) power plants. Applied Energy, 223, 30–51.https://doi.org/10.1016/j.apenergy.2018.03.191

Dove, E., Wang, R., Zabjek, K., & Astell, A. (2020). Impacts of Motion-Based Technology on Balance, Movement Confidence, and Cognitive Function Among People With Dementia or Mild Cognitive Impairment: Protocol for a Quasi-Experimental Pre- and Posttest Study. JMIR Research Protocols, 9(9), e18209.https://doi.org/10.2196/18209

El Abed, M., & Castro-Lopez, A. (2024). The impact of AI-powered technologies on aesthetic, cognitive and affective experience dimensions: A connected store experiment. Asia Pacific Journal of Marketing and Logistics, 36(3), 715–735.https://doi.org/10.1108/APJML-02-2023-0109

Fotteler, M.L., Kocar, T.D., Dallmeier, D., Kohn, B., Mayer, S., Waibel, A.-K., Swoboda, W., & Denkinger, M. (2023). Use and benefits of information, communication, and assistive technology among community-dwelling older adults – a cross-sectional study. BMC Public Health, 23(1), 2004.https://doi.org/10.1186/s12889-023-16926-8

Geerts, A., Leten, B., Belderbos, R., & Van Looy, B. (2018). Does Spatial Ambidexterity Pay Off? On the Benefits of Geographic Proximity Between Technology Exploitation and Exploration. Journal of Product Innovation Management, 35(2), 151–163.https://doi.org/10.1111/jpim.12380

Hawes, D., & Arya, A. (2023). Technology Solutions to Reduce Anxiety and Increase Cognitive Availability in Students. IEEE Transactions on Learning Technologies, 16(2), 278–291.https://doi.org/10.1109/TLT.2023.3239985

He, A., Xue, Q., Zhao, R., & Wang, D. (2021). Renewable energy technological innovation, market forces, and carbon emission efficiency. Science of The Total Environment, 796, 148908.https://doi.org/10.1016/j.scitotenv.2021.148908

Heimann-Steinert, A., Latendorf, A., Prange, A., Sonntag, D., & Müller-Werdan, U. (2021). Digital pen technology for conducting cognitive assessments: A cross-over study with older adults. Psychological Research, 85(8), 3075–3083.https://doi.org/10.1007/s00426-020-01452-8

Hong, S., Lee, J., Cho, H., Kim, M., Moon, I., & Kim, J. (2022). Multi-objective optimization of CO2 emission and thermal efficiency for on-site steam methane reforming hydrogen production process using machine learning. Journal of Cleaner Production, 359, 132133.https://doi.org/10.1016/j.jclepro.2022.132133

Inaba, A., Hori, K., Yoda, Y., Ikematsu, H., Takano, H., Matsuzaki, H., Watanabe, Y., Takeshita, N., Tomioka, T., Ishii, G., Fujii, S., Hayashi, R., & Yano, T. (2020). Artificial intelligence system for detecting superficial laryngopharyngeal cancer with high efficiency of deep learning. Head & Neck, 42(9), 2581–2592.https://doi.org/10.1002/hed.26313

Javed, A., Basit, A., Ejaz, F., Hameed, A., Fodor, Z. J., & Hossain, M. B. (2024). The role of advanced technologies and supply chain collaboration: During COVID-19 on sustainable supply chain performance. Discover Sustainability, 5(1), 46.https://doi.org/10.1007/s43621-024-00228-z

Kalafatis, C., Modarres, M.H., Apostolou, P., Tabet, N., & Khaligh-Razavi, S.-M. (2022). The Use of a Computerized Cognitive Assessment to Improve the Efficiency of Primary Care Referrals to Memory Services: Protocol for the Accelerating Dementia Pathway Technologies (ADePT) Study. JMIR Research Protocols, 11(1), e34475.https://doi.org/10.2196/34475

Krakenberg, V., Woigk, I., Garcia Rodriguez, L., Kästner, N., Kaiser, S., Sachser, N., & Richter, S. H. (2019). Technology or ecology? New tools to assess cognitive judgment bias in mice. Behavioral Brain Research, 362, 279–287.https://doi.org/10.1016/j.bbr.2019.01.021

Kusumaputri, ES, Muslimah, HL, Ahmad, A., & Nurwardani, M. (2021). POSITIONING INDONESIAN ISLAMIC HIGHER-EDUCATION VIS-A-VIS GLOBALIZATION: ORGANIZATIONAL–RESILIENCE DYNAMICS. Journal of Educational Horizons, 40(2), 413–427.https://doi.org/10.21831/cp.v40i2.39357

Lee, Y., Kim, I., Lee, S., & Yu, S. (2024). Information and Communication Technology-Based Application for Cognitive Behavioral Therapy among Community-Dwelling Older Adults with Insomnia: Development and Validation Study. Healthcare, 12(1), 106.https://doi.org/10.3390/healthcare12010106

Liljaniemi, A., & Paavilainen, H. (2020). Using Digital Twin Technology in Engineering Education – Course Concept to Explore Benefits and Barriers. Open Engineering, 10(1), 377–385.https://doi.org/10.1515/eng-2020-0040

Lohan, E.S., Koivisto, M., Galinina, O., Andreev, S., Tolli, A., Destino, G., Costa, M., Leppanen, K., Koucheryavy, Y., & Valkama, M. (2018). Benefits of Positioning-Aided Communication Technology in High-Frequency Industrial IoT. IEEE Communications Magazine, 56(12), 142–148.https://doi.org/10.1109/MCOM.2018.1701057

Maisyaroh, A., Widianto, EP, & Kurnianto, S. (2023). The effectiveness of project-based learning on students' academic achievement in emergency nursing study. Healthcare in Low-Resource Settings.https://doi.org/10.4081/hls.2023.11757

Maurer-Grubinger, C., Holzgreve, F., Fraeulin, L., Betz, W., Erbe, C., Brueggmann, D., Wanke, E.M., Nienhaus, A., Groneberg, D.A., & Ohlendorf, D. (2021). Combining Ergonomic Risk Assessment (RULA) with Inertial Motion Capture Technology in Dentistry—Using the Benefits from Two Worlds. Sensors, 21(12), 4077.https://doi.org/10.3390/s21124077

Micek, A., Jóźwiakowski, K., Marzec, M., Listosz, A., & Grabowski, T. (2021). Efficiency and Technological Reliability of Contaminant Removal in Household WWTPs with Activated Sludge. Applied Sciences, 11(4), 1889.https://doi.org/10.3390/app11041889

Mingaleva, Z., & Vukovic, N. (2020). Development of Engineering Students Competencies Based on Cognitive Technologies in Conditions of Industry 4.0. International Journal of Cognitive Research in Science Engineering and Education, 8(Special issue), 93–101.https://doi.org/10.23947/2334-8496-2020-8-SI-93-101

Modarres, M.H., Kalafatis, C., Apostolou, P., Tabet, N., & Khaligh-Razavi, S.-M. (2023). The use of the integrated cognitive assessment to improve the efficiency of primary care referrals to memory services in the accelerating dementia pathway technologies study. Frontiers in Aging Neuroscience, 15, 1243316.https://doi.org/10.3389/fnagi.2023.1243316

Oleksiyenko, OH, Martsyniak-Dorosh, OM, Mishyn, SV, Buryanovatiy, OM, & Yakymchuk, BA (2019). Impact of Convergence of Smart-Technology as Compared to Traditional Methodological Tools on Fostering Cognitive Aspects of Leadership Competencies in the

Process of Vocational Training of Students. Journal of Intellectual Disability - Diagnosis and Treatment, 7(1), 1–8.https://doi.org/10.6000/2292-2598.2019.07.01.1

Rockinson-Szapkiw, A., & Wendt, J. L. (2021). The benefits and challenges of a blended peer mentoring program for women peer mentors in science, technology, engineering and mathematics (STEM). International Journal of Mentoring and Coaching in Education, 10(1), 1–16.https://doi.org/10.1108/IJMCE-03-2020-0011

Wang, K., Barr, C., Norman, R., George, S., Whitehead, C., & Ratcliffe, J. (2021). Using Eye-Tracking Technology with Older People in Memory Clinics to Investigate the Impact of Mild Cognitive Impairment on Choices for EQ-5D-5L Health States Preferences. Applied Health Economics and Health Policy, 19(1), 111–121.https://doi.org/10.1007/s40258-020-00588-3

Wang, Z. (2024). Exploring the teaching mode of college students' psychological education under artificial intelligence technology guided by cognitive-behavioral theory. Applied Mathematics and Nonlinear Sciences, 9(1), 20240597.https://doi.org/10.2478/amns-2024-0597