



Technological Literacy and Epistemic Cognition: Relationships Affecting Student Learning Outcomes in Higher Education

Santy Dinar Permata^{1*}, Arda Purnama Putra², Shinta Aishnabila³, Maulidathul Hasanah⁴, Auliya Fitri⁵

^{1,2,3,4,5}Elementary and Preschool Education, State University of Malang, East Java, Indonesia

*Corresponding author, email: santy.permata.fip@um.ac.id

Keywords

literacy
technological
epistemic cognition

Abstract

The real challenge faced by students today is the low level of technological literacy in Indonesia. At the same time, the rapid flow of technological developments continues to occur and demands to have workforce competencies that are able to think critically, solve problems and provide solutions appropriately. This study aims to determine the correlation of technological literacy and epistemic cognition of elementary and preschool education, state university of Malang students. The type of research used is quantitative with the number of samples used as many as 120 students. Data were collected using tests and project assessments. Furthermore, the data were analyzed using the Spearman correlation test in a non-parametric method to measure the strength and direction of the relationship between two variables. The results showed that the correlation data was 0.860. The data explains that there is a relationship between technological literacy and epistemic cognition. Based on these data, it can be concluded that a significant correlation is observed in technological literacy and student epistemic cognition. Increasing technological literacy is the basis for improving the achievement of student learning outcomes, not only increases in numbers but also relates to the ability to think critically, solve problems and find solutions effectively.

1. Introduction

The real challenge faced by students today is the low level of technological literacy in Indonesia. The low level of literacy shows that in Indonesia a person's basic skills in using technology are still poor. The 2022 survey conducted by Kominfo stated that the technological skills of Indonesian people were at a score of 3.54 out of a score of 1-5. Although there was an increase from the survey in the previous year, in fact, having basic technology skills is part of technological literacy (Karitas, 2023; Pratama, 2022). How can one compete with the demands of today's global workforce if the technological skill base in Indonesia is still low.

The existence of these challenges is evident in students of the Elementary and PreSchool Education (PGSD) study program at the State University of Malang. It was found that during the lecture process, students experienced difficulties in using various existing technologies to have a skeptical attitude due to the misinformation they got from using a technology. This resulted in a lack of utilization of digital resources used to increase student knowledge related to lecture material. The use of technology is not only a tool to access information but can also play a role in developing one's epistemic cognition. Epistemic cognition discusses a person's understanding of how to obtain knowledge and how to use that knowledge (Xu, 2023; Quarderer et al, 2021). Through epistemic cognition, it allows a person to be able to critically evaluate information, develop argumentation skills and collaborate with colleagues during the lecture process. The development of epistemic cognition cannot be ignored with the competencies that need to be possessed in order to compete in the world of work both nationally and globally (Laar et al, 2017; McGunagle, D. and Zizka, L. (2020)).

Based on the previous explanation, it can be noted that there is an interaction between technological literacy and epistemic cognition in efforts to improve student learning outcomes. The results of this temporary research focus more on developing instruments to measure technological literacy and the impact on learning outcomes (Nuraeni et al, 2022; Putri, 2024) have not specifically explored the relationship between technological literacy and epistemic cognition. Both variables have a role in supporting the improvement of learning quality in higher education. Therefore, this research straightforwardly wants to know the relationship between technological literacy and students' epistemic cognition. Through this research, it can provide an overview of the level of digital literacy and also the epistemic cognition of elementary and preschool education students and analyze students' ability to build their knowledge and think critically.

2. Method

This study uses a quantitative approach with a focus on the correlation between variables. The purpose of this study was to identify the relationship between technological literacy and epistemic cognition of PGSD UM students. Data were collected through tests and also project assignment assessments. Through this data collection, a comprehensive assessment of student academic achievement can be made which has a relationship to technological literacy and epistemic cognition (Mawadah et al., 2022; Pobela, 2023).

Data analysis with the Spearman correlation technique is used in non-parametric statistical methods to measure the strength and direction of the relationship between two variables. This analysis technique is used on data that is not normally distributed. Determination of hypotheses is if the Significance Value / (sig.) / (ρ) / (Asymp. Sig.) < 0.05 , then H_0 is rejected and H_a is accepted, which means there is a relationship between the variables tested, and vice versa: If the Significance Value / (sig.) / (ρ) / (Asymp. Sig.) > 0.05 , then H_0 is accepted and H_a is rejected, which means there is no relationship between the variables tested. The assessment indicators used in the data collection technique are as follows:

Table 1. Indicator of Variables

Technological Literacy	Epistemic Cognition
Basic understanding of technology	Ability to generalize and make analogies
Analyzing data	Finding innovative solutions to problems
Problem solving using technology	Ability to think critically
<i>(Adaptation of Saman, et al, 2019. Lestari, et al, 2019).</i>	<i>(Adaptation of Ulyshen et al, 2015; Greene et al, 2018)</i>

3. Results and Discussion

3.1. Results and Discussion 2

The goal of this study is to examine the relationship between technological literacy and epistemic cognition of students. Technological literacy is defined as a person's ability to use information and communication technology effectively, while epistemic cognition in this study leads to the mastery of one's knowledge through the process of critical thinking. Data collected by test is used to measure students' technological literacy, while measurements for epistemic cognition are carried out using project assessments. Because the data obtained were not normally distributed and homogeneous, a non-parametric analysis test was applied using the Spearman correlation technique. The following are the results of the correlation between technological literacy and epistemic cognition of students.

Correlations

		literasi	kognisi
Spearman's rho	literasi	Correlation Coefficient	1.000
		Sig. (2-tailed)	.
		N	120
kognisi		Correlation Coefficient	.860**
		Sig. (2-tailed)	<,001
		N	120

** . Correlation is significant at the 0.01 level (2-tailed).

Figure 1. Result of Correlation Data

Referring to the table of correlation results of technological literacy and epistemic cognition shows that there is a very significant positive correlation between technological literacy and student epistemic cognition. This is evidenced by the correlation coefficient showing a number of 0.86 which clearly shows that there is a correlation or close relationship between increasing technological literacy and students' epistemic cognition.

Furthermore, it is clear that the significance value (p-value) obtained is less than 0.001. This value indicates that the results obtained are very significant so it is very unlikely that these results are observed by chance. And the number of samples used as many as 120 students indicates that the existing data is strong enough to draw conclusions.

3.1.1. Results and Discussion 3

The results of this study show strongly that there is a correlation between the technological literacy of students and their epistemic cognition. This is evidenced by the correlation data of 0.860 which explains the hypothesis that there is a relationship between the two variables. Furthermore, Greene et al (2018) stated that a person's epistemic cognition has a role in academic achievement through accessing information carried out by having basic skills in operating technology.

This research is targeted at 2nd semester students with an age range of 19-20 years. The age of this research subject is included in generation Z where it is known that generation Z is often also known as digital natives. Students in this age range were born along with the rapid development of technology so it is not surprising that technological literacy at this age is certainly more qualified than the millennial generation or before. Research conducted by Hastini et al (2020) found that generation Z has a good level of technological literacy and contributes to students' learning abilities. This statement provides a direct view that this generation has good epistemic cognition development where they have the ability to think critically and analyze well the information obtained through technological assistance.

During lectures, lecturers provide facilities to support easy access to information to students. Students can access e-learning, powtoon, prezi, Kahoot! or nearpod which makes it easy for them to learn. Mentioned by Trisnawati et al (2022) shows that the variety of technological facilities provided to students can bridge them to increase knowledge. This opinion means that the types of platforms used can add students to obtain information so that there are efforts to analyze, criticize and also generalize data so that the process of increasing epistemic cognition continues.

As has been stated that the indicators of this research do not only include a person's basic ability in technology but are able to critically analyze data and solve problems using technology (Nuraeni et al, 2022; Haliq, 2019). The relationship between epistemic cognition and technological literacy has actually appeared in the indicators in this research variable. Someone with a good level of epistemic cognition will tend to be better able to think critically, generalize problems through the solutions provided (Nikat, 2020; Eybers, 2022). It is clear that if a student has a good level of technological literacy, they will find it easier to find solutions to complex problems using technology (Faber and Benson, 2017). Likewise, epistemic cognition is able to help students to utilize technology effectively because they are more likely to be critical in selecting and analyzing information obtained on technological sophistication (Eastwood et al, 2017).

The data collection technique used to measure technological literacy is a test. Test measurement is appropriate for measuring students' knowledge related to technology. Tests are used as a measuring tool to identify the distribution of students' abilities in technology. In research conducted by Ferdiana & Aina (2020) found that someone who is able to access technology is not always able to utilize technology effectively. Based on these results, tests to measure technological literacy need to be carried out so that they can also be used to identify the need to develop more meaningful and effective lecture programs in technology courses (Pakpahan, 2023). Through assessments carried out in this way, it can improve the institution in preparing its graduates to face the challenges of the global workforce.

Measurement of epistemic cognition using project assessment. The project given to students is to create a learning media for elementary school students. The creation of this learning media is based on the needs or problems faced by students at school. The stage begins with observation and determining the problems and needs of the school. At this stage students need to analyze and define the problems that occur in students so that they can determine the right solution. This solution is then realized in the form of learning media. Project assessment to measure epistemic cognition provides valuable longitudinal data. Through this assessment, changes in students' epistemic cognition over time can be recognized (DeGlopper, 2024; Lee&Chan, 2014). The project assignment also provides an opportunity for students to apply their knowledge in a practical way, stimulating their critical thinking skills (Iordanou, 2022). It is clear that epistemic cognition does not only contribute to knowledge acquisition but much more than that.

The implications of these findings can be developed in higher education curriculum innovation. Technology integration in fact makes a real contribution to student academic achievement. In line with the opinion of Nwosu et al (2018) which explains that students who have good technological literacy skills will tend to have better academic performance outcomes as well. With the increasing integration of technology in curriculum development, the prospect of improving learning outcomes among students can also increase.

3.2. Conclusion

This study aims to determine the relationship between technological literacy and epistemic cognition in PGSD UM students. Overall, the results of the study confirmed that there was a significant relationship between the two variables. The results indicate that a high level of technological literacy has a correlation with a better understanding of student epistemic cognition.

The positive correlation found confirms the importance of technology integration in the higher education curriculum. Improving technological literacy is the basis for improving the achievement of student learning outcomes, not only numerically but also with regard to the ability to think critically, solve problems and find solutions effectively. This is important because through these abilities, global competition is no longer a dream. Therefore, educational institutions need to develop a curriculum that integrates technological literacy as a whole to face future challenges.

Author Contributions

All authors have equal contributions to the paper. All the authors have read and approved the final manuscript.

Funding

No funding support was received.

Declaration of Conflicting Interests

The author declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

References

- DeGlopper, K. (2024). Modeling students' epistemic cognition in undergraduate chemistry courses: a review. *Chemistry Education Research and Practice*, 25(3), 594-612. <https://doi.org/10.1039/d3rp00348e>
- Eastwood et al. "Epistemic cognition in medical education: a literature review." *International journal of medical education* (2017) doi:10.5116/ijme.5849.bfce.
- Eybers, O. (2022). Sociocultural theory for academic literacy research involving argumentation in institutions of higher learning. *South African Journal of Higher Education*, 36(2). <https://doi.org/10.20853/36-2-4683>
- Faber and Benson "Engineering Students' Epistemic Cognition in the Context of Problem Solving." *Journal of engineering education* (2017) doi:10.1002/jee.20183.

- Ferdiana, S. and Aina, Q. (2020). Profil literasi sains digital mahasiswa di era pandemi. *Indonesian Journal of Science Learning (Ijsl)*, 1(2), 37-43. <https://doi.org/10.15642/ijsl.v1i2.954>
- Greene et al. "A meta-analytic review of the relationship between epistemic cognition and academic achievement." *Journal of educational psychology* (2018) doi:10.1037/edu0000263.
- Haliq, A. (2019, February 1). Pembelajaran Mandiri melalui Literasi Digital. <https://doi.org/10.31227/osf.io/8vyqz>
- Hastini, L., Fahmi, R., & Lukito, H. (2020). Apakah pembelajaran menggunakan teknologi dapat meningkatkan literasi manusia pada generasi z di indonesia?. *Jurnal Manajemen Informatika (Jamika)*, 10(1), 12-28. <https://doi.org/10.34010/jamika.v10i1.2678>
- Iordanou, K. (2022). Supporting strategic and meta-strategic development of argument skill: the role of reflection. *Metacognition and Learning*, 17(2), 399-425. <https://doi.org/10.1007/s11409-021-09289-1>
- Laar, E., Deursen, A., Dijk, J., & Haan, J. (2017). The relation between 21st-century skills and digital skills: a systematic literature review. *Computers in Human Behavior*, 72, 577-588. <https://doi.org/10.1016/j.chb.2017.03.010>
- Lee, W. and Chan, C. (2014). Identifying and examining epistemic beliefs among college students in hong kong. *The Asia-Pacific Education Researcher*, 24(4), 603-612. <https://doi.org/10.1007/s40299-014-0206-1>
- Lestari, f., Andriani, D., & Indrayany, E. (2019). Analisis Implementasi Gerakan Literasi Sekolah SMA Wahidiyah Kediri Tahun Pelajaran 2018/2019. *Jurnal Pendidikan : Riset Dan Konseptual*, 3(1), 01-07. doi:10.28926/riset_konseptual.v3i1.92
- Mawadah, S., Kasiyun, S., Ghufron, S., & Rahayu, D. (2022). Pengaruh minat baca terhadap hasil belajar ips siswa kelas v sekolah dasar. *PTK Jurnal Tindakan Kelas*, 3(1), 33-38. <https://doi.org/10.53624/ptk.v3i1.113>
- McGunagle, D. and Zizka, L. (2020), "Employability skills for 21st-century STEM students: the employers' perspective", *Higher Education, Skills and Work-Based Learning*, Vol. 10 No. 3, pp. 591-606. <https://doi.org/10.1108/HESWBL-10-2019-0148>
- Nikat, R., Supriyadi, S., & Algiranto, A. (2019). Pengembangan dan Evaluasi Soal Kemampuan Berfikir Kritis Siswa Pada Materi Usaha dan Energi. *Musamus Journal of Science Education*, 2(1), 9-21. <https://doi.org/10.35724/mjose.v2i1.2232>
- Nuraeni, R., Pattiasina, P., & Ulfah, A. (2022). Peran literasi teknologi dalam dunia pendidikan. *Al-Madrasah Jurnal Pendidikan Madrasah Ibtidaiyah*, 6(3), 659. <https://doi.org/10.35931/am.v6i3.1045>
- Nuraeni, R., Pattiasina, P., & Ulfah, A. (2022). Peran literasi teknologi dalam dunia pendidikan. *Al-Madrasah Jurnal Pendidikan Madrasah Ibtidaiyah*, 6(3), 659. <https://doi.org/10.35931/am.v6i3.1045>
- Nwosu, J., John, H., Izang, A., & Akorede, O. (2018). Assessment of information and communication technology (ict) competence and literacy skills among undergraduates as a determinant factor of academic achievement. *Educational Research and Reviews*, 13(15), 582-589. <https://doi.org/10.5897/err2018.3539>
- Pakpahan, S. (2023). Kesiapan kerja mahasiswa akuntansi di era disrupsi teknologi digital: peran keahlian akuntansi, literasi digital, literasi manusia, dan adaptabilitas karir. *Al-Kharaj Jurnal Ekonomi Keuangan & Bisnis Syariah*, 6(3), 3796-3811. <https://doi.org/10.47467/alkharaj.v6i3.5592>

- Pobela, F. (2023). Assessment pembelajaran berbasis proyek pada siswa kelas iv sd. *Edukatif Jurnal Ilmu Pendidikan*, 5(2), 1174-1183. <https://doi.org/10.31004/edukatif.v5i2.4985>
- Putri, N. (2024). Pengaruh literasi digital terhadap pemberdayaan masyarakat dalam konteks sdgs 2030. *Jurnal Penelitian Pendidikan Indonesia (JPPI)*, 1(3), 349-360. <https://doi.org/10.62017/jppi.v1i3.1208>
- Quarderer, N., Fulmer, G., Hand, B., & Neal, T. (2021). Unpacking the connections between 8th graders' climate literacy and epistemic cognition. *Journal of Research in Science Teaching*, 58(10), 1527-1556. <https://doi.org/10.1002/tea.21717>
- Saman, M., Handayanto, S., & Sunaryono, S. (2019). Eksplorasi literasi teknologi informasi dan komunikasi siswa melalui blended learning fisika. *Jurnal Pendidikan Teori Penelitian Dan Pengembangan*, 4(1), 79. <https://doi.org/10.17977/jptpp.v4i1.11863>
- Trisnawati, T., Manalu, M., & Amini, M. (2022). Hubungan kinerja dan keterampilan tik guru terhadap hasil belajar dan literasi digital siswa kelas tinggi sekolah dasar. *Jurnal Basicedu*, 6(6), 9440-9449. <https://doi.org/10.31004/basicedu.v6i6.4089>
- Ulyshen, T., Koehler, M., & Gao, F. (2015). Understanding the connection between epistemic beliefs and internet searching. *Journal of Educational Computing Research*, 53(3), 345-383. <https://doi.org/10.1177/0735633115599604>
- Xu, T. (2023). Structural relationship on factors influencing digital literacy of college students. *International Journal of Emerging Technologies in Learning (Ijet)*, 18(19), 147-159. <https://doi.org/10.3991/ijet.v18i19.38319>