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Needs Analysis of HOTS-Based Digital Assessment in Physics Learning for Enhancing Critical Thinking Skills

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ABSTRACT

Purpose of the study: This study aims to analyze the need for implementing HOTS-based digital assessment in physics learning and to identify learning challenges, assessment practices, and opportunities for enhancing senior high school students' critical thinking skills through the integration of digital technologies.

Methodology: This study employed a descriptive qualitative research design using a needs analysis approach. Data were collected through semi-structured interviews involving five senior high school physics teachers. The research instrument was an interview guide consisting of ten questions. Data were analyzed using thematic analysis, including transcription, coding, categorization, and interpretation of emerging themes.

Main Findings: Physics learning remains predominantly teacher-centered, resulting in limited student participation and engagement. Students demonstrated difficulties in solving analytical and contextual problems requiring higher-order thinking skills. Critical thinking skills were not optimally developed due to conventional assessment practices. Teachers expressed a strong need for HOTS-based digital assessment and identified Quizizz and PhET as potential technologies to support student engagement, conceptual understanding, and critical thinking development.

Novelty/Originality of this study: This study contributes by focusing on the needs analysis of HOTS-based digital assessment in physics learning before intervention implementation. It integrates issues of student participation, critical thinking skills, assessment practices, and digital technology readiness within a single framework. The study also highlights the combined potential of Quizizz and PhET to support assessment innovation and critical thinking development in physics education.

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1. INTRODUCTION

Physics learning plays a strategic role in developing students' scientific reasoning and understanding of natural phenomena through logical and systematic thinking processes. Beyond mastering concepts and formulas, physics learning is expected to foster higher-order thinking skills that enable students to analyze, evaluate, and solve problems effectively [1]-[3]. Critical thinking has become one of the essential competencies required in the twenty-first century learning environment [4]-[6]. Therefore, physics instruction should provide opportunities for students to actively engage in constructing knowledge and interpreting scientific phenomena. Learning activities that encourage active participation are necessary to support the development of these cognitive competencies.

However, the implementation of physics learning in many senior high schools still faces various challenges [7]. Learning activities are often dominated by teacher-centered approaches, resulting in limited student participation during classroom instruction [8], [9]. Students tend to focus on memorizing formulas and procedural steps rather than understanding underlying concepts and their applications [10]-[12]. This condition affects their ability to solve problems that require analytical and evaluative thinking. As a result, students frequently experience difficulties when dealing with questions designed to measure higher-order thinking skills (HOTS).

Previous studies have reported that students generally perform well on routine questions but struggle when confronted with contextual and analytical problems that require deeper conceptual understanding [13]. Research has also shown that active learning strategies can improve students' conceptual understanding and critical thinking performance in science education. Furthermore, the integration of digital technology into assessment practices has been found to increase student engagement and provide immediate feedback on learning outcomes [14], [15]. Several studies have highlighted the effectiveness of digital platforms such as Quizizz in supporting interactive assessment processes. Similarly, interactive simulations such as PhET have demonstrated positive contributions to students' conceptual understanding in physics learning.

Although previous studies have examined digital assessment, HOTS-oriented learning, and technology integration separately, limited attention has been given to investigating the actual needs for implementing HOTS-based digital assessment in physics classrooms [16], [17]. Most existing research focuses on measuring the effectiveness of specific interventions after implementation rather than identifying the challenges and readiness factors that precede implementation. In addition, studies exploring teachers' perspectives regarding the necessity of HOTS-based digital assessment remain relatively limited. Consequently, there is still insufficient empirical information regarding the conditions that support or hinder the adoption of digital assessment practices in physics education [18]. This gap highlights the need for a comprehensive needs analysis before developing and implementing appropriate assessment innovations.

Conducting a needs analysis is important because it provides a foundation for designing assessment systems that align with classroom realities and students' learning needs. Understanding the challenges encountered by teachers and students can help identify suitable strategies for promoting critical thinking skills through assessment activities [19], [20]. HOTS-based digital assessment has the potential to create more interactive, flexible, and meaningful learning experiences compared with conventional assessment approaches. In addition, digital assessment can facilitate timely feedback and encourage students to reflect on their reasoning processes. Therefore, investigating the need for HOTS-based digital assessment is essential for supporting the improvement of physics learning quality and critical thinking development.

The novelty of this study lies in its focus on analyzing the need for implementing HOTS-based digital assessment in physics learning from the perspective of teachers and classroom learning conditions. Unlike previous studies that primarily emphasize intervention outcomes, this research explores the underlying educational needs that justify the integration of digital assessment technologies [21]. The study also connects issues of student participation, conceptual understanding, and critical thinking within a single analytical framework. Furthermore, it considers the potential utilization of digital platforms and interactive learning technologies as supporting tools for assessment innovation [22], [23]. Through this approach, the study is expected to provide a stronger empirical basis for developing effective HOTS-based digital assessment practices in physics education.

2. RESEARCH METHOD

2.1. Research Design

This study employed a qualitative descriptive approach to investigate the need for implementing HOTS-based digital assessment in physics learning. The research focused on identifying challenges encountered by teachers in developing students' critical thinking skills and exploring potential solutions through digital assessment. A qualitative approach was selected because it allows researchers to obtain in-depth information regarding classroom learning conditions and assessment practices [24]. The study emphasized understanding participants' experiences, perceptions, and educational needs in real learning contexts. The findings were used as a basis for identifying opportunities for integrating HOTS-based digital assessment into physics learning.

2.2. Participants and Data Collection

The participants consisted of five physics teachers from different senior high schools who were selected purposively based on their teaching experience and involvement in physics instruction [25]. Data were collected through semi-structured interviews that explored learning practices, students' critical thinking abilities, assessment strategies, and the use of educational technology. The interview protocol contained ten main questions related to classroom learning conditions and assessment implementation. Each interview was conducted individually and recorded to ensure data accuracy. The collected data provided comprehensive information regarding the need for HOTS-based digital assessment in physics education.

Table 1. Research Participants

Code	School Level	Participant
T1	Senior High School	Physics Teacher
T2	Senior High School	Physics Teacher
T3	Senior High School	Physics Teacher
T4	Senior High School	Physics Teacher
T5	Senior High School	Physics Teacher

2.3. Data Analysis

The collected interview data were analyzed using thematic analysis. The analysis began with data transcription, followed by data reduction, coding, categorization, and interpretation of emerging themes. Similar responses from participants were grouped to identify common patterns related to learning challenges, assessment practices, and critical thinking development [26]. The identified themes were then interpreted to explain the need for implementing HOTS-based digital assessment in physics learning. Finally, the results were presented descriptively to provide a comprehensive understanding of the research problem.

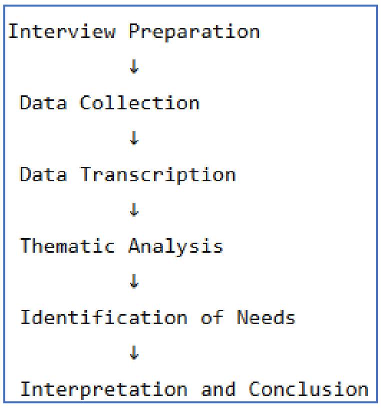

Figure 1. Research Procedure

3. RESULTS AND DISCUSSION

3.1. Physics Learning Practices in Senior High Schools

Based on interviews with five physics teachers from different senior high schools, physics learning generally begins with introductory activities, followed by concept explanation, worked examples, and problem-solving exercises [27], [28]. Several teachers also reported using discussions, question-and-answer sessions, and simple experiments to support student understanding [29], [30]. However, learning activities remain predominantly teacher-centered, with teachers serving as the primary source of information during classroom instruction. Student participation was reported to vary considerably across classrooms, with only a limited number of students actively engaging in discussions and learning activities. These findings indicate that active student involvement has not yet been fully achieved in physics learning.

Table 2. Summary of Physics Learning Practices

Aspect	Findings
Learning Process	Concept explanation, worked examples, exercises
Learning Activities	Discussion, question-and-answer, simple experiments
Learning Approach	Predominantly teacher-centered
Student Participation	Active participation limited to a small number of students

3.2. Students' Understanding and Critical Thinking Challenges

The interview results revealed that students' understanding of physics concepts varies considerably. Teachers reported that students generally perform well when solving routine problems involving direct formula application [31], [32]. However, many students experience difficulties when confronted with analytical and contextual problems that require deeper conceptual understanding [33], [34]. Students often struggle to identify relevant concepts and determine appropriate solution strategies. In addition, many students are unable to explain the reasoning behind their answers, indicating limited development of critical thinking skills.

Table 3. Students' Learning Difficulties Identified by Teachers

Indicator	Findings
Conceptual Understanding	Difficulties in abstract concepts
Problem Analysis	Challenges in contextual questions
Concept Integration	Difficulty connecting multiple concepts
Explanation Skills	Limited ability to justify answers

3.3. Student Participation and Learning Engagement

All participating teachers reported differences in student engagement during physics lessons. Only a small proportion of students consistently participate in discussions, ask questions, or respond to teacher prompts. Meanwhile, many students remain passive and tend to avoid expressing their opinions during classroom activities [35]. Teachers indicated that lack of confidence and fear of making mistakes are among the factors contributing to low participation [36]. As a result, students' learning processes are often difficult to observe comprehensively through classroom interaction alone.

3.4. Teachers' Perspectives on HOTS-Based Digital Assessment

The interviews revealed positive perceptions regarding the implementation of HOTS-based digital assessment in physics learning [37], [38]. Teachers emphasized the need for assessment approaches that not only evaluate final answers but also encourage analytical thinking and problem-solving skills. Several participants identified digital platforms such as Quizizz as potential tools for increasing student motivation and participation during assessment activities [39], [40]. Teachers also highlighted the potential contribution of interactive simulations such as PhET in supporting students' understanding of abstract physics concepts. These findings suggest a strong need for integrating digital technologies into assessment practices to support the development of students' critical thinking skills.

Table 4. Teachers' Recommendations for Improving Physics Learning

Recommendation	Purpose
HOTS-Based Assessment	Improve analytical thinking
Quizizz Integration	Increase motivation and participation
PhET Simulation	Enhance conceptual understanding
Interactive Learning	Promote student engagement

Physics learning in senior high schools is still largely characterized by teacher-centered instructional practices that limit students' active involvement in the learning process. Interview data revealed that concept explanation, worked examples, and routine exercises remain the dominant instructional approaches used by teachers. Although discussion activities and simple experiments are occasionally incorporated, participation among students is not equally distributed. Only a small proportion of students actively contribute to classroom interactions through questioning and discussion. Such conditions may reduce opportunities for students to develop higher-order thinking and critical thinking skills during learning activities.

Difficulties in solving analytical and contextual physics problems emerged as one of the most prominent issues reported by participating teachers. Routine questions involving direct formula substitution can generally be completed by students without significant obstacles. Greater challenges arise when students are required to interpret situations, connect multiple concepts, and justify their reasoning. Many students tend to focus on obtaining correct answers rather than understanding the conceptual basis of their solutions. Limited ability to explain reasoning processes indicates that critical thinking skills still require further development.

Similar patterns have been reported in previous studies examining the development of higher-order thinking skills in science education. Research has consistently shown that students often struggle with HOTS-oriented questions because of inadequate analytical and reasoning abilities. Conventional instructional approaches are frequently associated with limited opportunities for students to engage in meaningful problem-solving activities. Digital learning and assessment technologies have been suggested as potential solutions for improving engagement and cognitive performance. Nevertheless, most previous investigations have focused on intervention outcomes rather than examining classroom needs before implementation.

A distinctive contribution of this research lies in its focus on identifying educational needs prior to the implementation of HOTS-based digital assessment. Attention is directed not only toward learning outcomes but also toward understanding the challenges experienced by teachers and students during the learning process. Student participation, conceptual understanding, critical thinking skills, and digital assessment readiness are examined within a unified analytical framework. Integration of Quizizz and PhET is also highlighted as a potential strategy for supporting both assessment and learning activities. Such an approach offers a broader perspective for developing assessment innovations in physics education.

Important implications can be drawn from these findings for improving physics teaching and assessment practices. Greater emphasis should be placed on assessment activities that encourage students to analyze, evaluate, and justify their responses rather than simply produce correct answers. Digital assessment platforms may provide more engaging opportunities for students to participate actively in learning. Interactive simulations can further support conceptual understanding by visualizing abstract physics phenomena. Combining these approaches may contribute to the development of stronger critical thinking skills among senior high school students.

Several limitations should be acknowledged when interpreting the results of this study. Data were obtained from only five physics teachers, which may not fully represent conditions in other schools or regions. Perspectives from students were not included, even though they could provide valuable insights into learning and assessment experiences. Classroom observations were also not conducted, limiting the availability of direct evidence regarding instructional practices. Future research is therefore recommended to involve a larger sample, incorporate student perspectives, and evaluate the effectiveness of HOTS-based digital assessment through empirical implementation.

4. CONCLUSION

The findings of this study indicate that physics learning in senior high schools is still characterized by limited student participation, difficulties in solving HOTS-oriented problems, and insufficient development of critical thinking skills. Interview results further revealed that conventional assessment practices have not fully facilitated students' analytical reasoning and problem-solving abilities, highlighting the need for more innovative assessment approaches. HOTS-based digital assessment emerged as a promising alternative because it has the potential to support active learning, provide immediate feedback, and encourage deeper cognitive engagement. The integration of digital platforms such as Quizizz and interactive simulations such as PhET can create learning environments that promote both conceptual understanding and critical thinking development. These findings provide an important foundation for educators and stakeholders in designing assessment strategies that are more responsive to the demands of twenty-first-century learning. Future research is recommended to implement and evaluate HOTS-based digital assessment in broader educational settings to examine its effectiveness in improving students' critical thinking skills and overall learning outcomes.

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REFERENCES

[1] W. Nuraini, F. S. Widyaningtyas, R. Perdana, and K. Kunci, "Development of scratch learning media based on problem-based learning model on fluid dynamics topic to improve hots of high school students," *Ilmu Pendidik. J. Kaji. Teor. dan Prakt. Kependidikan*, vol. 11, no. 1, pp. 43–52, 2026, doi: 10.17977/um027v11i12026p43-52.

[2] T. Tanti, W. Utami, D. Deliza, and M. Jahanifar, "Investigation in vocation high school for attitude and motivation students in learning physics subject," *J. Eval. Educ.*, vol. 6, no. 2, pp. 479–490, 2025, doi: 10.37251/jee.v6i2.1452.

[3] D. Darmaji, A. Astalini, K. Kamid, and E. Triani, "The influence of generic skills on gender differences in scientific processing and critical thinking in physics motion dynamics," *J. Ilm. Ilmu Terap. Univ. Jambi*, vol. 8, no. 2, pp. 524–537, Oct. 2024, doi: 10.22437/jiituj.v8i2.37237.

[4] T. Tanti, D. A. Kurniawan, K. Kuswanto, W. Utami, and I. Wardhana, "Science process skills and critical thinking in science: Urban and rural disparity," *J. Pendidik. IPA Indones.*, vol. 9, no. 4, 2020, doi: 10.15294/jpii.v9i4.24139.

[5] S. Ahzari and A. Akmam, "Analyzing students' critical thinking as a basis for developing interactive physics multimedia with generative learning and cognitive conflict strategies," *J. Pendidik. Fis.*, vol. 13, no. 2, pp. 163–176, Apr. 2025, doi: 10.26618/jpf.v13i2.17702.

[6] P. Sari Dewi and H. Kuswanto, "The effectiveness of the use of augmented reality-assisted physics e-module based on pedicab to improve mathematical communication and critical thinking abilities," *J. Technol. Sci. Educ.*, vol. 13, no. 1, pp. 53–64, 2023, doi: 10.3926/jotse.1714.

[7] S. H. U. Salsabila Arwa Naila, Salamah Izati Winda, Daulay Hasanuddin Ahmad, Badri Nurul Lalu, "Utilizing technology to improve higher order thinking skills (HOTS) in the digital era," *J. Ilmu Pendidik. dan Psikol.*, vol. 2, no. 2, pp. 115–125, 2025, doi: 10.66952/jippsi.v3i2.246.

[8] I. W. Gunartha, D. A. Widiasri, I. Ayu, and A. Ekasriadi, "Hots-based Indonesian language assessment and learning:

Efforts to improve students' critical thinking skills in the 21st century digital era," *SANDIBASA II (Seminar Nas. Pendidik. Bhs. dan Sastra Indones.*, vol. 2, no. 1, pp. 109–125, 2024.

[9] T. Tanti, D. Deliza, and S. Hartina, "The effectiveness of using smartphones as mobile-mini labs in improving students' beliefs in physics," *JIPF (Jurnal Ilmu Pendidik. Fis. Vol 9, No 3 Sept. 2024*, vol. 9, no. 3, pp. 387–394, 2024, doi: 10.26737/jipf.v9i3.5185.

[10] A. Hidayati, A. Bentri, F. Yeni, Zuwirna, and Eldarni, "The development of instructional multimedia based on science, environment, technology, and society (SETS)," *J. Phys. Conf. Ser.*, vol. 1594, no. 1, p. 12016, 2020, doi: 10.1088/1742-6596/1594/1/012016.

[11] S. Soeharto and B. Csapó, "Exploring Indonesian student misconceptions in science concepts," *Heliyon*, vol. 8, no. 9, pp. 1–10, Sep. 2022, doi: 10.1016/j.heliyon.2022.e10720.

[12] D. Saepuzaman, H. Retnawati, E. Istiyono, and H. Haryanto, "Developing HOTS instruments: Is it difficult for physics teachers?," *J. Pendidik. MIPA*, vol. 23, no. 4, pp. 1802–1826, 2022, doi: 10.23960/jpmipa/v23i4.pp1802-1826.

[13] D. A. U. Hariyanti Nur Syafria, Hikmawati Usfin, Ali Yunanto Bugar, Rahmawati Fitria, Fadly Wirawan, Julianto, "Bibliometric analysis of hots based physics e-module development to improve high school students' critical thinking," *Epistemic Sci. Think. Lit.*, vol. 1, no. 1, pp. 40–55, 2025.

[14] Y. B. Bhakti, R. Arthur, and Y. Supriyati, "Development and validation of a complex true-false multiple-choice test for assessing critical thinking skills in physics," *Cogent Educ.*, vol. 12, no. 1, pp. 1–13, 2025, doi: 10.1080/2331186X.2025.2553008.

[15] T. Tanti, D. Darmaji, A. Astalini, D. A. Kurniawan, and M. Iqbal, "Analysis of user responses to the application of web-based assessment on character assessment," *J. Educ. Technol.*, vol. 5, no. 3, pp. 356–364, Oct. 2021, doi: 10.23887/jet.v5i3.33590.

[16] A. I. Journal *et al.*, "Physics informed machine learning in geotechnical engineering: A direction paper," *Geomech. Geoengin.*, vol. 20, no. 5, pp. 1128–1159, 2025, doi: 10.1080/17486025.2025.2502029.

[17] P. J. A. C. Van Der Zanden *et al.*, "Fostering critical thinking skills in secondary education to prepare students for university: Teacher perceptions and practices," *Res. Post-Compulsory Educ.*, vol. 25, no. 4, pp. 394–419, 2020, doi: 10.1080/13596748.2020.1846313.

[18] D. C. Selvam *et al.*, "Mechanics Physics Informed machine learning for turbulent combustion in aerospace propulsion: Bridging physical rigour and data intelligence," *Eng. Appl. Comput. Fluid Mech.*, vol. 20, no. 1, pp. 1–23, 2026, doi: 10.1080/19942060.2026.2678066.

[19] D. Champion, F. Solomon, and M. Lammey, "Embodying physics assessment: Reimagining formative assessment as a creative, multimodal, and culturally sustaining dialogic practice," *J. Learn. Sci.*, vol. 34, no. 4, pp. 474–525, 2025, doi: 10.1080/10508406.2025.2569583.

[20] J. Bates *et al.*, "Cultivating critical thinking skills: A pedagogical study in a business statistics course," *J. Stat. Data Sci. Educ.*, vol. 33, no. 2, pp. 166–176, 2025, doi: 10.1080/26939169.2024.2394534.

[21] A. Nyström, A. Johansson, A. T. Danielsson, J. Allison, and A. Johansson, "Resonating with physics: Physics students' stories about existential and affective relations to science in and beyond formal learning spaces," *Int. J. Sci. Educ. Part B*, vol. 15, no. 4, pp. 581–596, 2025, doi: 10.1080/21548455.2024.2439140.

[22] P. Pečiuliauskienė, "Instructional clarity in physics lessons: Students' motivation and self-confidence," *Cogent Educ.*, vol. 10, no. 2, 2023, doi: 10.1080/2331186X.2023.2236463.

[23] L. Tuyishimire, W. Mlaga, and P. Ntawigira, "Teaching critical thinking skills in Rwandan secondary schools: Challenge and practical solutions," *Cogent Educ.*, vol. 12, no. 1, pp. 1–12, 2025, doi: 10.1080/2331186X.2025.2562349.

[24] H. H. Lotriet and P. M. Gouws, "Educational robotics in physics education: A systematic review," *Stud. Sci. Educ.*, vol. 62, no. 1, pp. 107–136, 2026, doi: 10.1080/03057267.2025.2455334.

[25] J. Heymann, A. Sprague, A. Raub, J. Heymann, A. Sprague, and A. M. Y. Raub, "National action to reduce barriers to and bias against women's leadership: A comparative analysis of laws and policies in 193 countries," *J. Comp. Policy Anal. Res. Pract.*, vol. 27, no. 3, pp. 360–381, 2025, doi: 10.1080/13876988.2025.2490160.

[26] S. B. Nicholls *et al.*, "Performance analysis practice within olympic and paralympic sports: A comparison of coach and analyst experiences," *Int. J. Perform. Anal. Sport*, vol. 22, no. 3, pp. 343–351, 2022, doi: 10.1080/24748668.2022.2054623.

[27] B. Kılıç, E. Ünal, C. Pörücü, M. Öveç, and D. Asarkaya, "The impact of unmet needs on fear of cancer recurrence in cancer survivors: A cros sectional and multivariate analysis," *Cancer Manag. Res.*, vol. 13, no. 17, pp. 1788–1800, 2025, doi: 10.2147/CMAR.S542283.

[28] M. Wessel *et al.*, "Generative ai and its transformative value for digital platforms generative ai and its transformative value for digital platforms," *J. Manag. Inf. Syst.*, vol. 42, no. 2, pp. 346–369, 2025, doi: 10.1080/07421222.2025.2487315.

[29] N. N. Ndou-chikwena, "Bibliometric analysis of studies in inclusive psychosocial support of adolescents with special needs in schools," *Emot. Behav. Difficulties*, vol. 30, no. 4, pp. 291–303, 2025, doi: 10.1080/13632752.2025.2536985.

[30] A. Yang, N. A. Sulaiman, N. S. Yaccob, and A. Yang, "Enhancing critical thinking skills for higher education students through English reading modules: A systematic review," *Cogent Educ.*, vol. 12, no. 1, pp. 1–15, 2025, doi: 10.1080/2331186X.2025.2587466.

[31] C. Zhou *et al.*, "Needs analysis of supportive care for postoperative wound rehabilitation in anal fistula patients based on the kano model," *J. Multidiscip. Healthc.*, vol. 23, no. 90, pp. 5289–5298, 2025, doi: 10.2147/JMDH.S535960.

[32] B. A. Jantausch *et al.*, "Assessing trainee critical thinking skills using a novel interactive online learning tool learning tool," *Med. Educ. Online*, vol. 28, no. 1, pp. 1–6, 2023, doi: 10.1080/10872981.2023.2178871.

[33] S. Paul, H. M. Isaacs, and R. J. Cote, "Expert review of molecular diagnostics ai and the digital pathology revolution: Clinical applications in cancer diagnosis and assessment," *Expert Rev. Mol. Diagn.*, vol. 26, no. 4, pp. 277–292, 2026,

doi: 10.1080/14737159.2026.2665801.

[34] S. M. Al-bahlani, P. Ecke, and S. M. Al-, “Assessment competence and practices including digital assessment literacy of postsecondary english language teachers in Oman,” *Cogent Educ.*, vol. 10, no. 2, pp. 1–18, 2023, doi: 10.1080/2331186X.2023.2239535.

[35] S. Li, N. M. Nasri, and H. Norman, “Needs analysis of virtual reality (VR) application in art appreciation for Chinese middle school students,” *Cogent Educ.*, vol. 12, no. 1, pp. 1–18, 2025, doi: 10.1080/2331186X.2025.2474287.

[36] E. Y. Yeh, “Testing the canon: Digital scholarship and early cinema in Hong Kong,” *J. Chinese Cinemas*, vol. 18, no. 2–3, pp. 375–396, 2025, doi: 10.1080/17508061.2025.2518014.

[37] M. K. Merga and M. K. Merga, “Needs analysis for resource development to fuel school library advocacy for writer visits,” *J. Libr. Adm.*, vol. 65, no. 3, pp. 267–287, 2025, doi: 10.1080/01930826.2025.2468131.

[38] M. Zhu, C. Calderon, A. Ford, C. Robson, and J. Jin, “Digital Twin for resilience and sustainability assessment of port facility,” *Sustain. Resilient Infrastruct.*, vol. 11, no. 3, pp. 267–300, 2026, doi: 10.1080/23789689.2025.2526928.

[39] N. Katajavuori *et al.*, “Assessment futures through teachers’ eyes: A qualitative case study in higher education,” *Eur. J. High. Educ.*, vol. 8235, pp. 1–27, 2026, doi: 10.1080/21568235.2026.2658139.

[40] E. Grammatikopoulou, S. Johansson, and M. Rosén, “Paper based and digital reading in 14 countries: Exploring cross country variation in mode effects,” *Educ. Rev.*, vol. 78, no. 1, pp. 61–79, 2026, doi: 10.1080/00131911.2025.2452236.