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Enhancing Integration of Technology in Authentic Assessment for Education: A Structured Review

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ABSTRACT

In the ever-evolving landscape of education, the seamless integration of technology into authentic assessment practices has become a transformative force, reshaping how students are both evaluated and engaged. Authentic assessment, characterized by its emphasis on the real-world application of knowledge and skills, has gained prominence for its ability to gauge students' comprehension and foster deeper learning experiences. As technology continues to infiltrate the educational field, a pressing need arises to assess the effectiveness of these digital tools in promoting genuine understanding and critical thinking among students. This structured review of the PRISMA approach was applied to find the primary data based on keywords such as Technology, Science, and Authentic Assessment. Based on advanced searching on SCOPUS and Web of Science, we found (n=55). Expert scholar decided to develop 3 themes, which are (1) Online Assessment and Technology- Enhanced Learning, (2) Educational Practices and Student Engagement, and (3) Assessment and Curriculum Development. The findings underscore technology's immense potential in elevating authentic assessments for students, offering new avenues for engagement and skill development. It is evident that when wielded thoughtfully and integrated into pedagogy, technology can empower young learners to explore, inquire, and excel in the fascinating world of education. This study not only bridges existing gaps in the literature but also serves as a valuable resource for educators and policymakers alike, providing insights into harnessing technology's power to enhance authentic assessment practices and, consequently, the overall educational experience.

1. Introduction

In recent years, the integration of technology in education has become a topic of great interest and debate. Technology should no longer be new to us as we enter the fourth industrial revolution. With the rapid advancements in technology, educators have recognized the potential of utilizing digital tools to enhance teaching and learning experiences, a perspective supported by Baidoo *et al.,* [1]. This is particularly true in various fields of education, where technology can provide students with authentic assessment opportunities. Authentic assessment refers to the evaluation of a

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student's knowledge and skills in a real-world context, allowing them to demonstrate their understanding through practical application, as discussed in the works of Varioni *et al.,* [3] and Hains-Wesson *et al.,* [4]. Unlike traditional assessment forms, such as standardized tests and multiple-choice exams, authentic assessment promotes critical thinking, problem-solving, and creativity, as highlighted by Saher *et al.,* [4]. By incorporating technology into the assessment process, educators can design engaging and interactive activities that mirror the real-world applications of scientific concepts, a methodology supported by Lowell *et al.,* [6], and Yu *et al.,* [7]. This approach aligns with the 21st-century skills important in the digital era, such as critical thinking, problem-solving, communication, and collaboration, as emphasized by Fadhlilah *et al.,* [7].

Furthermore, the use of technology in assessment can provide immediate feedback to students, allowing them to track their progress and make necessary adjustments to their learning strategies, as observed by Pu *et al.,* [8]. However, educators need to possess the necessary digital literacy skills to effectively implement technology-based assessments, a necessity underscored by Alhejaili [9]. Additionally, technology integration in education can be hindered by factors such as the inaccessibility of computer-based technology tools and teachers' anxiety toward computers, as pointed out by Niaz *et al.,* [10]. Despite these challenges, the use of technology in authentic assessment holds significant advantages, offering a more comprehensive and accurate evaluation of a student's understanding and abilities, according to Jopp [12] and Sumardi *et al.,* [13]. Therefore, it is essential to explore how technology can be effectively utilized to enhance student assessment practices. This structured review focuses on enhancing the integration of technology into authentic assessment. Through the utilization of digital tools, educators can design tasks that necessitate students to apply their knowledge in solving real-world problems, conducting experiments, and analysing data, a method supported by Abdurrahman *et al.,* [14] and Kassymova *et al.,* [15].

In conclusion, the integration of technology in authentic assessment offers significant potential for enhancing students' learning experiences. By utilizing digital tools, educators can design assessments that simulate real-world applications, promote critical thinking, and foster collaboration among students. However, careful consideration of the challenges and limitations is necessary for successful implementation. This structured review aims to explore the various ways in which technology can be applied in authentic assessment, ultimately contributing to the advancement of education practices.

2. Literature Review

Previous studies by Gikandi [15] have reported incorporating online formative assessment into the Community of Inquiry framework, with a focus on teaching presence, exemplifies the core elements of formative assessment, including authentic tasks, distinct learning objectives, formative feedback, and systematic documentation of learning evidence. Rensburg *et al.,* [16] highlight digital creativity as a crucial skill for graduates. They outline an authentic assessment framework, evaluating outcomes and students' experiences, offering insights for other academic disciplines. Similarly, research findings by Romero-Ivanova *et al.,* [17] point toward the importance of digital storytelling in classrooms as a literacy practice, highlighting the voices and experiences of students. The approach allows educators to share diverse teaching experiences and perspectives while utilizing peer reviews as authentic assessments. This innovative approach fosters rapport and connection within the classroom. Another study by Sargent and Lynch [18] explores the use of democratic practices and video narratives in higher education and physical education to improve assessment authenticity. It demonstrates that these methods enhance self-awareness, elicit emotions, encourage performance, and create inclusive learning environments.

Recent research by Hashim *et al.,* [19], has explored the effectiveness of innovative instructional strategies in enhancing student learning and achievement across various disciplines. One notable study developed BioBoard-G, an educational board game aimed at secondary biology students, to improve their understanding of cell division topics. The findings revealed that the board game's superior efficacy in facilitating biology learning. Complementing these findings, another study by Giddens *et al.,* [20], and Elmi Sharlina *et al.,* [21] utilized a virtual community platform to offer an online course for nursing and health sciences students. This course, emphasizing narrative pedagogy, student-centred learning, and real-world application, aligns with the principles of authentic assessment. Similarly, Thompson *et al.,* [22], replaced traditional field excursions with a "virtual watershed," leveraging advanced technology to foster online innovation in water education. Their comprehensive approach, integrating course organization, content distribution, active learning, and authentic evaluation, further supports the utility of digital platforms in enhancing student engagement and participation. Collectively, these studies highlight the potential of gamified learning tools and virtual platforms in not only improving academic achievement but also in offering practical, real-world applications, thereby offering valuable insights for educational practice and the implementation of authentic assessment strategies.

These studies and perspectives highlight the evolving landscape of higher education assessment. As discussed by Mudau [23], E-portfolio assessment offers students a constructivist learning experience but presents challenges for instructors. In order to overcome these challenges, training workshops and a structured e-portfolio assessment framework are recommended to facilitate successful implementation and enhance student engagement. Ibarra-Saiz [24] emphasized the importance of aligning assessment with current trends and principles, advocating for a balance between technology and traditional methods. They suggest incorporating social justice, sustainability, and authentic tasks into assessment practices can promote feedback and active student participation while nurturing evaluative judgement for responsible educators. The impact of the COVID-19 pandemic on assessment is explored by Mate and Weidenhofer [25], who focused on the need to reconsider assessment purposes in higher education. They emphasize practical strategies for authentic online assessment while maintaining standards and accountability. Online multiple-choice assessments are noted for their rigor and efficiency in providing rapid feedback. In a different context, Fuentes-Nieto *et al.,* [26] investigated the use of authentic assessment and transformative assessment in high school physical education classes in Spain, finding that students valued self-assessment and peer-assessment processes in creating video tutorials. Similarly, Koretsky *et al.,* [27] reimagine assessment by integrating authentic computer-based assessment into large engineering classes to align with real-world practices, through the note that decision-making performances didn’t correlate with traditional assessment. Jopp [11] underscores the significant growth of authentic assessment in higher education, driven by industrial and regulatory needs, with the potential to enhance student's learning outcomes and employability skills while reducing plagiarism. However, designing and implementing authentic assessments present substantial challenges. In synthesis, these studies and perspectives collectively emphasize the evolving nature of assessment in higher education, with technology integration, authenticity, and adaptability as key themes, while acknowledging the persistent challenges and the potential for transformative changes in assessment practices.

Figure 1 presents the holistic view extracted from the themes gathered through research conducted by McDermott *et al.,* [28] on authenticity in assessment. This view is grounded in the degree of alignment between the course contents and the assessment procedures used. The comments made by the respondents suggested that a baseline for authenticity was to have a strong match between the course contents and how students are assessed, which then makes the

assessment fair. Furthermore, the respondents suggest that the practical application of student skills and knowledge is possible when it is grounded in the module learning outcomes. At the same time, the application can also go beyond the course setting to increase correspondence with the real world.

The current study is important because few studies provide a comprehensive picture of how technology is incorporated into authentic assessment in education. Moreover, the existing systematic review literature on the topic refrains from delving deeply into the review methodologies' specifics. This addresses keyword research, article screening, and article eligibility. Furthermore, because of this situation, potential researchers were unable to approve the interpretation, evaluate the number of data, or renew the investigation. The significance of this study lies in its ability to provide researchers with peer assessments of the literature, which facilitates their understanding of the difficult integration of technology in authentic assessment issues that require governmental and scholarly attention. The primary research questions the current systematic analysis was created to explore is how using technology in authentic assessment could enhance students' learning. The inquiry's primary focus was on the feasibility of implementing authentic evaluation, including its benefits and challenges. This section also covers a comprehensive analysis of the role of technology in authentic assessment. However, the next part elaborates on the approach to address the research issue presented in this work. The necessary research on the integration of technology in authentic assessment scenarios is then found, selected, and assessed in the third segment, which undertakes a methodical examination and analysis of the scientific literature. Finally, the section highlights the awareness of potential researchers on the issues raised and discusses the essential activities to take.

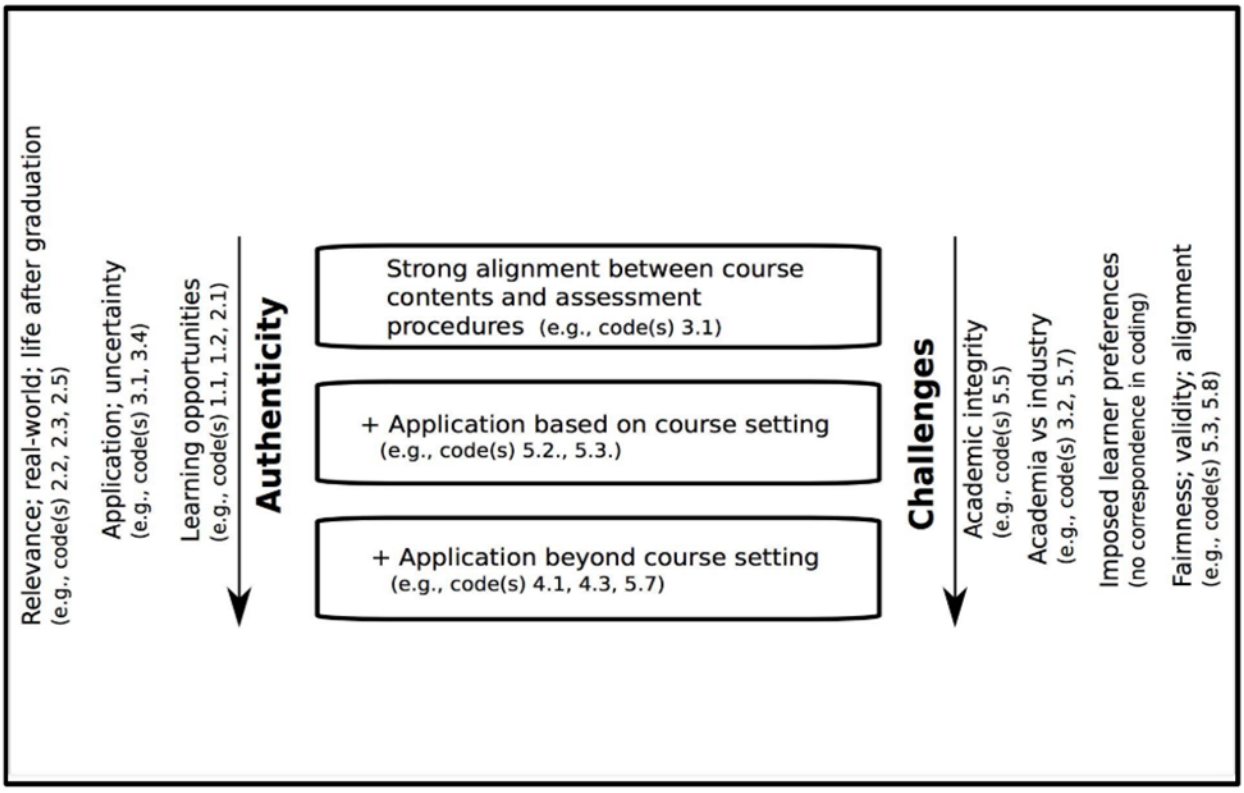

Fig. 1. Levels of Authenticity and Associated Challenges [28]

3. Material and Methods

Globally, much recent research on systematic assessments has been conducted. The necessity of a comprehensive study of technology integration in authentic assessment is covered in this section.

On the other hand, the methodology employed to address the research questions raised by the present study is presented in the ensuing section. There will be three components to this review:

i. Technology-Enhanced Learning and Online Assessment
ii. Curriculum Development and Assessment
iii. Curriculum Development and Assessment. Aside from the secondary goal, the difficulties and benefits.

The material is then methodically reviewed and synthesized in this section to identify, pick, and evaluate technology's crucial role in accurate assessment. In this investigation, the pre-recording systematic reviews and meta-analysis (PRISMA) approach a published method for carrying out a systematic literature review is employed. Publication rules are typically required to help writers evaluate and review the rigor and accuracy of a review with pertinent and essential facts. The Randomised Studies Evaluations Survey is another important tool that PRISMA emphasizes, and it can play a significant role in systematic analysis reports for various research types as shown in Figure 2 below [29].

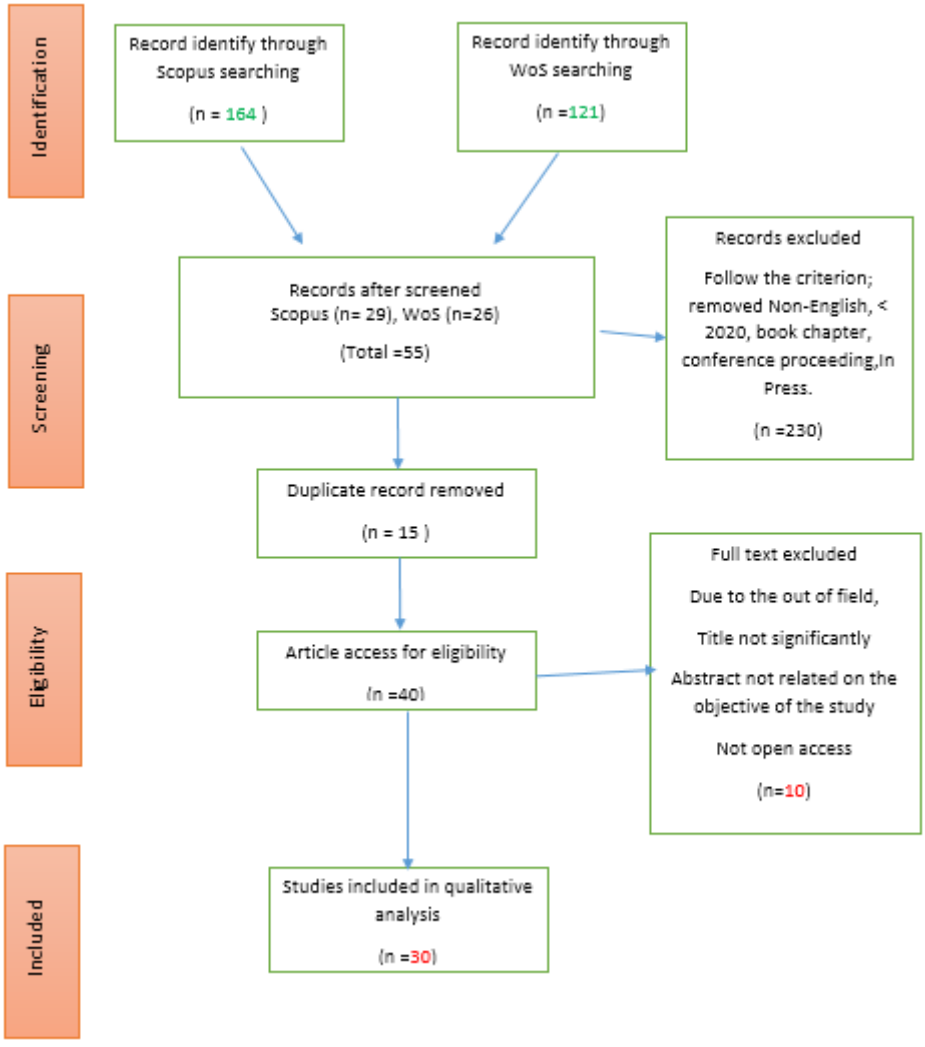

Fig. 2. Flow diagram of the proposed searching study [29]

Due to their robustness, two important databases Web of Science (WoS) and Scopus were utilized as instruments to assess the research's approach. It included a number of studies, including ones on e-learning. But no database is flawless and comprehensive, just as WoS and Scopus [30-32]. Furthermore, an outline of the four important subsections identification, screening, eligibility, and data abstraction is given in this section.

3.1 Identification

The systematic review process for this report involves three main phases: keyword recognition, searching for related terms, and creating search strings on Scopus and WoS as mentioned in Table 1 databases. After identifying relevant keywords, the research successfully retrieved 230 papers from both databases in the first step of the review process.

Table 1
The search strings

Scopus	TITLE-ABS-KEY((technology OR e-learning) AND "authentic assessment" AND education) AND PUBYEAR > 2019 AND PUBYEAR < 2024 AND (LIMIT-TO (DOCTYPE,"ar")) AND (LIMIT-TO (LANGUAGE,"English"))	29
WoS	(technology OR e-learning) AND "authentic assessment" AND education (Topic) and Preprint Citation Index (Exclude – Database) and 2023 or 2022 or 2021 or 2020 (Publication Years) and Article (Document Types) and English (Languages)	26

3.2 Screening

During the screening process, potentially pertinent research items are collected for content that aligns with the predetermined research topic or questions. Authentic evaluation is one of the content-related criteria often applied during the screening stage in selecting research items. This step will eliminate All duplicate papers from the list of searched papers. First, 230 articles were screened out; second, 55 papers were screened in accordance with the study's inclusion and exclusion criteria as mentioned in Table 2. Since research articles are the main source of useful recommendations, this criterion was applied before any other. Not included in the most current study are reviews, meta-synthesis, meta-analyses, books, book series, chapters, and conference proceedings. Moreover, the review was limited to English-language publications. It is imperative to bear in mind that the strategy was limited to the years 2020–2023. Due to duplication criteria, a total of fifteen publications were rejected.

Table 2
The selection criterion is searching

Criterion	Inclusion	Exclusion
Language	English	Non-English
Time line	2020-2023	< 2020
Literature type	Journal (only research articles)	Journal (book chapter, conference proceeding)
Publication Stage	Final	In Press

3.3 Eligibility

Forty papers have been created in all for the third level, which is called eligibility. At this point, every article's titles and important content were carefully examined to ensure that the inclusion criteria were met and that the papers fit within the current study and its goals. Consequently, five

reports (<2020, book chapter, conference proceeding, in press) were excluded since they were not in English. Lastly, Table 3 shows the thirty articles that are accessible for examination.

3.4 Data Abstraction and Analysis

One of the assessment procedures in this study was an integrative analysis, which looked at and synthesised a range of research designs (qualitative, mixed, and quantitative). The competent study's objective was to pinpoint pertinent subjects and subtopics. The initial phase of the theme's development was the data collection phase. The process by which the authors carefully examined a compilation of 55 publications for claims or information pertinent to the subjects of the current investigation is depicted in Figure 2. The authors then reviewed the important studies that are currently being conducted on authentic assessment technology. Investigations are being conducted into the research findings and the methods applied in all of the studies. The author then worked with other co-authors to create themes based on the data in the background of this study. Throughout the data analysis process, observations, opinions, puzzles, and other ideas pertinent to the interpretation of the data were recorded in a log. In order to determine whether the theme design process was inconsistent in any way, the writers finally compared the outcomes. It's important to note that the authors debate any opinion differences among the notions. Eventually, the generated themes were adjusted to guarantee coherence. Two experts, one in measurement and assessment (Bambang Sumintono, expert in measuring) and the other in assessment (Mohd Nazri, expert in indigenous assessment), conducted the analytical selection to ascertain the problem's validity. Through the establishment of the problem's domain validity, the expert review step guarantees the significance, appropriateness, and clarity of each subtheme. The expert review process guarantees each subtheme's significance, clarity, and applicability by establishing the domain validity.

4. Result and Finding

The integration of technology in authentic assessment in education has become increasingly important in addressing issues such as promoting more meaningful assessments by helping students develop early competency in adjusting to real-world work situations and complex responsibilities. Based on the searching technique, 30 articles were extracted and analysed. All articles were categorized based on three main themes (see Table 3), which are Online Assessment and Technology-Enhanced Learning (13 articles), Educational Practices and Student Engagement (9 articles), and Assessment and Curriculum Development (8 articles).

Table 3
The research article's findings are based on the proposed searching criterion

No.	Author	Journal	Title	Web of Science	Scopus	Remarks
1.	Gikandi [15]	International Journal of Online Pedagogy and Course Design	Enhancing e-learning through integration of online formative assessment and teaching presence		/	Online Assessment and Technology-Enhanced Learning
2.	Romero-Ivanova *et al.,* [17]	English Teaching	Digital stories, material transformations: reflections of education students in a pre-teacher program		/	Educational Practices and Student Engagement

3.	Giddens *et al.,* [20]	Journal of Professional Nursing	Enhancing learning in an online doctoral course through a virtual community platform		/	Online Assessment and Technology-Enhanced Learning
4.	Marcano *et al.,* [33]	Educacion XX1	Higher education teachers' and students' perceptions of open-book and proctored examinations in the COVID-19 pandemic	/	/	Online Assessment and Technology-Enhanced Learning
5.	Hains-Wesson *et al.,* [3]	Studies in Higher Education	STEM academic teachers' experiences of undertaking authentic assessment-led reform: a mixed method approach		/	Assessment and Curriculum Development
6.	Thompson *et al.,* [22]	Frontiers in Education	Prioritizing Engagement of a Diverse Student Cohort in Online Hydrology Learning at the University of Western Australia		/	Online Assessment and Technology-Enhanced Learning
7.	Balogun *et al.,* [34]	Journal of Engineering, Design and Technology	Investigating digital technological competencies amongst black Asian minority ethnic construction students in the UK		/	Assessment and Curriculum Development
8.	St. John-Matthews *et al.,* [35]	Radiography	Crowdsourcing: A novel tool to elicit the student voice in the curriculum design process for an undergraduate diagnostic radiography degree program		/	Assessment and Curriculum Development
9.	Linden and Gonzalez [36]	British Journal of Educational Technology	Zoom invigilated exams: A protocol for rapid adoption to remote examinations		/	Online Assessment and Technology-Enhanced Learning
10.	Ibarra-Saiz *et al.,* [24]	RELIEVE - Revista Electronica de Investigacion y Evaluacion Educativa	The future of assessment in Higher Education		/	Educational Practices and Student Engagement
11.	Mudau [37]	International Journal of Educational Methodology	Lecturers' Views on the Functionality of e-Portfolio as Alternative Assessment in an Open Distance e-Learning		/	Educational Practices and Student Engagement
12.	Roxburgh and Evans [38]	Anatomical Sciences Education	Assessing Anatomy Education: A Perspective from Design		/	Assessment and Curriculum Development
13.	Sargent [18]	Technology, Pedagogy, and Education	'None of my other teachers know my face/emotions/thoughts': digital technology and democratic assessment practices in higher education physical education	/	/	Online Assessment and Technology-Enhanced Learning
14.	Mate [25]	FASEB Bio Advances	Considerations and strategies for effective online assessment with a focus on the biomedical sciences		/	Educational Practices and Student Engagement

15.	Van Rensburg *et al.,* [16]	Assessment and Evaluation in Higher Education	Developing digital creativity through authentic assessment		/	Assessment and Curriculum Development
16.	Djihadah *et al.,* [39]	Theory and Practice in Language Studies	Literary Teaching Based on Information and Communication Technology (ICT): An Inquiry Approach		/	Educational Practices and Student Engagement
17.	Leeder *et al.,* [40]	International Sport Coaching Journal	Understanding the Impact of an Online Level 1 Coach Education Award on Dodgeball Coaches' Learning and Practice	/	/	Online Assessment and Technology-Enhanced Learning
18.	Wang *et al.,* [41]	Education and Information Technologies	Automated and interactive game-based assessment of critical thinking		/	Online Assessment and Technology-Enhanced Learning
19.	Fuentes-Nieto *et al.,* [26]	Retos	A combination of transformative and authentic assessment through ICT in Physical Education	/	/	Online Assessment and Technology-Enhanced Learning
20.	Koretsky *et al.,* [27]	Journal of Engineering Education	Aligning classroom assessment with engineering practice: A design-based research study of a two-stage exam with authentic assessment		/	Assessment and Curriculum Development
21.	Spanjaard *et al.,* [42]	Journal of Marketing Education	Tell Me a Story! Blending Digital Storytelling Into Marketing Higher Education for Student Engagement		/	Online Assessment and Technology-Enhanced Learning
22.	Jopp [11]	Teaching in Higher Education	A case study of a technology-enhanced learning initiative that supports authentic assessment		/	Online Assessment and Technology-Enhanced Learning
23.	Sarmiento *et al.,* [43]	Journal of University Teaching and Learning Practice	Assessment Practices in Philippine higher steam education		/	Educational Practices and Student Engagement
24.	Szabo *et al.,* [44]	Education Sciences	Development of Spatial Abilities of Preadolescents: What Works?		/	Assessment and Curriculum Development
25.	So [45]	Philippine Journal of Nursing	Nurturing Responsive Learning Environment in the Nursing Academe Amid COVID-19		/	Educational Practices and Student Engagement
26.	Orsini *et al.,* [46]	European Journal of Dental Education	The development of a reporting form for peer observation of online learning courses: An e-Delphi consensus study of educators working in health professions education		/	Assessment and Curriculum Development

27.	Tortajada-Genaro [47]	REMIE-Multidisciplinary Journal of Educational Research	Mini-Cases of Professional-Inspired Activities in E-Learning Platforms: An Experience for the Formative Assessment	/	Educational Practices and Student Engagement
28.	Nieminen *et al.,* [48]	Assessment & Evaluation in Higher Education	Designing the digital in authentic assessment: is it fit for purpose?	/	Online Assessment and Technology-Enhanced Learning
29.	Lim *et al.,* [49]	Education and Information Technologies	Analytics-enabled authentic assessment design approach for digital education	/	Online Assessment and Technology-Enhanced Learning
30.	Petrovic and Pale [50]	IEEE Transactions on Education	Achieving Scalability and Interactivity in a Communication Skills Course for Undergraduate Engineering Students	/	Educational Practices and Student Engagement

4.1 Online Assessment and Technology- Enhanced Learning

Technology-enhanced learning and online assessment have completely transformed the educational landscape by utilizing the potential of digital tools and platforms. Online assessments give teachers immediate feedback and customization possibilities while assessing students' knowledge and skills through digital exams, quizzes, and assignments. Table 4 provides the summary findings of the theme Online Assessment and Technology-Enhanced Learning. Conversely, technology-enhanced learning combines technologies like virtual classrooms, adaptive learning systems, and interactive multimedia to produce a dynamic and captivating learning environment. The digital era's future of teaching and learning is shaped by the collective breakthroughs that have increased access to education, personalized learning, and data-driven insights.

Table 4
Summary results of theme Online *Assessment and Technology- Enhanced Learning*

Author	Title	Methodology	Finding and advantages
Gikandi [15]	Enhancing e-learning through integration of online formative assessment and teaching presence	The study was carried out in an online graduate course. The case study research approach was used.	The study improved engagement in crucial learning moments by coordinating formative assessment components with teaching presence functions.
Giddens *et al.,* [20]	Enhancing learning in an online doctoral course through a virtual community platform	The study utilized a qualitative research approach to explore developing and implementing a virtual community platform in an online doctoral-level course for nurses and healthcare clinicians transitioning to a faculty role.	The virtual community platform was developed to support story pedagogy, facilitate highly engaging, student-centred learning, and require students to apply their learning to real-world situations.

Marcano *et al.,* [33]	Higher education teachers' and students' perceptions of open-book and proctored examinations in the COVID-19 pandemic	The study uses a quantitative, empirical methodology based on the replies of 301 students and 66 educators to a sufficiently reliable questionnaire.	Open-book exams with or without proctoring are suitable for authentic online assessment in higher education, with no significant differences between educators and students, and should be compared to other online courses.
Thompson *et al.,* [22]	Prioritizing Engagement of a Diverse Student Cohort in Online Hydrology Learning at the University of Western Australia	The research project used a comprehensive strategy to move hydrological classes at UWA to online learning. The strategy used a number of tactics, such as reorganizing the course structure, utilizing existing learning management systems, and integrating active learning activities and authentic assessment.	The outcomes of the study indicated positive student engagement and satisfaction, with the potential for future reintroduction of face-to-face activities.
Linden and Gonzalez [36]	Zoom invigilated exams: A protocol for rapid adoption to remote examinations	The research study utilized a trial methodology to evaluate the effectiveness and student experience of exams invigilated with an online meeting platform. The trial involved a large number of subjects and students.	In the context of higher education, the study emphasizes the potential of online meeting platforms as a reliable and affordable instrument for exam invigilation.
Sargent and Lynch [18]	'None of my other teachers know my face/emotions/thoughts': digital technology and democratic assessment practices in higher education physical education	This study used a digital ethnographic approach, allowing researchers to practice ethnography differently.	Video narratives elevated students' self-awareness and allowed them to provide emotive responses. Students perceived the video narratives as an authentic learning experience different from their normal assessments.
Leeder *et al.,* [40]	Understanding the Impact of an Online Level 1 Coach Education Award on Dodgeball Coaches' Learning and Practice	The study used an online qualitative survey and virtual semi-structured interviews with 57 dodgeball coaches who completed the Level 1 coach education award. The analysis focused on understanding coaches' experiences, identifying barriers to online coach education, and exploring ways to enhance the impact of online coach education through authentic assessment methods and post-award support mechanisms.	The impact of the Level 1 coach education award varies among coaches due to cognitive differences but overall positive experiences. Enhancements include authentic assessments and mentoring opportunities.
Wang *et al.,* [41]	Automated and interactive game-based assessment of critical thinking	The research study used a mixed-methods approach, integrating the development and validation of game-based assessment to evaluate students' performance.	Although unrelated to academic performance, the game's validity mirrored earlier studies, proving student interest and engagement for a favourable user experience.

Fuentes-Nieto *et al.,* [26]	A combination of transformative and authentic assessment through ICT in Physical Education	38 Spanish high school students used Plickers for authentic and transformational assessment in a dancing unit. They created salsa video tutorials and evaluated their own and others' videos. The study assessed the effectiveness of AA, TA, and ICT in PE lessons.	Students viewed video tutorials positively as learning and assessment methods, valuing peer-assessment and self-assessment processes, Plickers, and integrating AA, TA, and ICT in PE.
Spanjaard *et al.,* [42]	Tell Me a Story! Blending Digital Storytelling into Marketing Higher Education for Student Engagement	The study uses canonical correlation analysis to examine the effectiveness of digital storytelling in enhancing student engagement in a postgraduate marketing subject, examining the relationships between two variables.	According to a study, digital storytelling offers a social and interactive learning method, enhancing student engagement and potentially promoting learning and satisfaction.
Jopp [11]	A case study of a technology-enhanced learning initiative that supports authentic assessment	The study uses a case study on implementing Assessment-Based Learning (AA) in a digital walking tour assessment, highlighting its impact on student engagement, understanding, creativity, and plagiarism reduction. Data collection methods are not explicitly mentioned.	Based on case study evidence, the study highlights the potential benefits of AA, including increased student engagement, deeper understanding, increased creativity, and reduced plagiarism.
Nieminen *et al.,* [48]	Designing the digital in authentic assessment: is it fit for purpose?	A critical scoping review of existing literature examines the integration of digital elements into authentic assessment in higher education, analysing relevant studies for conclusions and recommendations.	The study found that digital tools were primarily used to improve assessment design and develop students' digital skills, with only eight studies addressing students' digital literacies. Authentic assessment should incorporate digital elements meaningfully to prepare students for the digital world.
Lim *et al.,* [49]	Analytics-enabled authentic assessment design approach for digital education	The research collects data to validate the GHMA assessment model and assess learner satisfaction. It uses an experimental design with an experimental group and a control group. Pre- and post-treatment data measure changes in satisfaction. Statistical analysis evaluates significant differences between groups.	The data analysis findings show that all crucial components of the GHMA assessment model have been positively validated. It reports that the GHMA technique positively impacted learner satisfaction with assessment delivery.

4.2 Educational Practices and Student Engagement

Many strategies have been used in the field of education to improve student involvement. The aforementioned practices are designed to establish a favourable learning atmosphere that encourages students to actively engage in their educational journey. Utilizing technology, such as interactive whiteboards and online learning platforms, is one such approach that gives students the chance to engage more deeply with the material they are studying and exploring. Including practical exercises and group projects is another technique that promotes cooperation and critical thinking

abilities. Table 5 presents the results of the theme Educational Practices and Student Engagement. When taken as a whole, these strategies raise student involvement and eventually improve academic achievement.

Table 5
Summary results of the theme Educational Practices and Student Engagement

Author	Title	Methodology	Finding and advantages
Romero-Ivanova, *et al.,* [17]	Digital stories, material transformations: reflections of education students in a pre-teacher program	This research study uses grounded theory to examine how high school pre-teacher education program candidates engage in reflective peer reviews of their classmates' digital stories. The authors collected digital stories, storytelling guides, and reflections from two cohorts, identifying emerging themes and conducting narrative analysis to understand the findings.	The study found that pre-teacher education candidates effectively used seven elements of digital storytelling to assess and provide feedback on their peers' digital stories. Integrating these elements into peer review enhances students' ability to critically evaluate and offer suggestions for improvement. Digital storytelling promotes differentiated teaching and learning, fostering deeper conversations and valuing students' authentic voices.
Ibarra-Saiz *et at.,* [24]	The future of assessment in Higher Education	This research paper utilizes a collaborative methodology among multiple authors to create a reflective text on the future of assessment in higher education.	With a focus on strategic learning, technological integration, and modern educational objectives like social justice and sustainability, the paper promotes a change in how higher education assessments are conducted.
Mudau [37]	Lecturers' Views on the Functionality of e-Portfolio as Alternative Assessment in an Open Distance e-Learning	The study uses a qualitative research design to understand lecturers' perspectives on e-portfolios. Data was collected through interviews with four ODeL lecturers. Thematic analysis was used to identify recurring themes and patterns in the interview data, utilizing a purposive sampling approach.	The research highlights the advantages of e-portfolios in ODeL assessment, enabling student-centred learning and authentic assessment practices while highlighting the challenges lecturers face.
Djihadah *et al.,* [39]	Literary Teaching Based on Information and Communication Technology (ICT): An Inquiry Approach	The research uses a qualitative method to investigate issues in ICT-based literary teaching. Data was collected through interviews, direct observation, and visual documentation. The study involved participants from the Indonesian Language and Literature Education Study Programs at two universities. The data was analysed using qualitative interactive model techniques.	The study provides the management of ICT-based literary teaching using an inquiry approach, focusing on lesson planning, learning organization, implementation, and assessment stages.

Sarmiento *et al.,* [43]	Assessment Practices in Philippine higher steam education	The study involved 106 STEAM teachers from 14 Philippine institutions, sourced from a state-funded research project database. Data was collected using a Classroom Observation Protocol and analysed through systematic methods.	The findings provided several crucial insights into how STEAM educators assess students, including how they employ both conventional and real-world assessment techniques. The recognized best assessment practices were divided into three primary categories: communal and reflective assessment processes, establishing assessment systems to support instruction and assessment for career or industry readiness.
Petrovic and Pale [50]	Achieving Scalability and Interactivity in a Communication Skills Course for Undergraduate Engineering Students	The course design focuses on improving communication skills through interactive lectures and authentic assessment activities. Data was collected through surveys and final course percentages. Course components include live lectures, practical assignments, and authentic activities. Interactivity is facilitated using AuResS, and peer review assesses assignments. Data analysis determines course impact on student perceptions and learning outcomes.	The research shows that first-semester engineering students value communication skills and authentic course activities, with a small correlation between opinions and course achievements. The study also highlights the effectiveness of audience response systems and peer review in learning and assessment.
So [45]	Nurturing Responsive Learning Environment in the Nursing Academe Amid COVID-19	Researchers select analytical techniques based on the data nature and research questions, whether qualitative or quantitative, and the research's objectives, such as description, comparison, prediction, or relationship testing.	The nursing academe must adapt to the COVID-19 pandemic by addressing online learning challenges, supporting students' well-being, providing resources, and revising the curriculum. Nurse educators play a crucial role in preparing students for the future.
Mate and Weidenhofer [25]	8. Considerations and strategies for effective online assessment with a focus on the biomedical sciences	The case study presented demonstrates that an online multiple-choice assessment provides similar rigor in assessment to the invigilated examination of the same concepts in human physiology.	The key elements for the implementation of online assessments include consideration of the role of assessment in teaching and learning, the rationale for online delivery, accessibility of the assessment from both a technical and equity perspective, academic integrity, and the authenticity and structure of the assessment.
Tortajada-Genaro [47]	14. Mini-Cases of Professional-Inspired Activities in E-Learning Platforms: An Experience for the Formative Assessment	The formative assessment aimed at deep learning and continuous evaluation, using short extension cases from professional situations and self-learning tasks. An e-learning platform, Sakai software, was used for data collection. The assessment impact analysis was conducted on student documents, interviews, and surveys.	The findings suggest that participants positively received the formative assessment initiative and could be applicable in various educational contexts, including online learning and large classes.

4.3 Assessment and Curriculum Development

In the realm of education, assessment and curriculum development play crucial roles in ensuring effective teaching and learning. Assessment refers to the process of gathering evidence of students' knowledge, skills, and understanding to evaluate their progress and inform instructional decisions. It helps educators identify areas of strength and weakness, tailor instruction to meet individual needs and provide timely feedback to students. On the other hand, curriculum development involves designing and organizing a course or program's content, objectives, and instructional strategies. Table 6 provides the results of the theme Assessment and Curriculum Development. It aims to align educational goals with the needs and interests of students, ensuring a coherent and meaningful learning experience. Both assessment and curriculum development are essential components of educational practice, as they contribute to the overall improvement of teaching and learning outcomes.

Table 6
Summary results of theme Assessment and Curriculum Development

Author	Title	Methodology	Finding and advantages
Hains-Wesson *et al.,* [3]	STEM academic teachers' experiences of undertaking authentic assessment-led reform: a mixed method approach	The study involved 106 STEAM teachers from 14 Philippine institutions, sourced from a state-funded research project database. Data was collected using a Classroom Observation Protocol and analysed through systematic methods.	The research provided several crucial insights into how STEAM educators assess students, including how they employ conventional and real-world assessment techniques. The recognized best assessment practices were divided into three primary categories: communal and reflective assessment processes, establishing assessment systems to support instruction and assessment for career or industry readiness.
Balogun *et al.,* [34]	Investigating digital technological competencies amongst black Asian minority ethnic construction students in the UK	The study involved STEM teachers participating in an online survey and recorded interviews. A mixed methods approach was used, combining quantitative and qualitative data.	The paper explores the results' ramifications, especially in relation to helping teachers reform STEM education. Key themes emerged, emphasizing the importance of shared understanding among stakeholders for effective assessment-led reform and the need for additional support options when collaborating with industry partners.
Roxburgh and Evans [38]	Assessing Anatomy Education: A Perspective from Design	The research compares learning and assessment practices in anatomical sciences and design learning, likely through literature review and comparative analysis. It analyses methods, pedagogical approaches, and authentic assessment in both fields.	The study's Insights and conclusions were intended to illuminate how anatomical sciences instruction may change to address present-day difficulties and be consistent with design learning best practices.

Orsini *et al.,* [46]	The development of a reporting form for peer observation of online learning courses: An e-Delphi consensus study of educators working in health professions education	The study used the e-Delphi technique to gather consensus from 21 international online educators in Health Professions Education. The process involved three rounds of feedback, with a minimum agreement level of 75%. The consensus was then analysed, and criteria for successful online course design and delivery were identified. The study aimed to develop a peer observation form for online Teaching, incorporating the identified criteria.	The study revealed the Delphi process's outcomes, including the agreed-upon levels and the resulting form, which had 81 items in 13 broad categories. The conclusion emphasized the importance of the created form and the stated criteria for creating and delivering top-notch online courses in the context of health professions education.
St. John-Matthews *et al.,* [35]	Crowdsourcing: A novel tool to elicit the student voice in the curriculum design process for an undergraduate diagnostic radiography degree program	This research study uses a three-stage action research spiral to involve students in healthcare curriculum design. The first phase involves evaluating anonymous crowdsourcing as a tool for curriculum design. The researchers used an eight-point crowdsourcing verification tool to assess the ideas' quality, relevance, and feasibility.	The study found that anonymized crowdsourcing in healthcare curriculum design yielded valuable contributions from students. Participants generated 23 unique ideas and actively engaged with 40 comments and 173 votes. Five prominent themes emerged: technology-enhanced learning, simulation activities, patient-focused curriculum, mental well-being, and authentic assessment approaches. Improvement opportunities were identified by evaluating participants who engaged in the crowdsourcing process.
Van Rensburg *et al.,* [16]	Developing digital creativity through authentic assessment	The research study used a mixed-methods approach, integrating the creation of an authentic evaluation, examining students' digital creative outputs, and exploring their personal experiences.	The study's findings showed that although many of the students' digital creative outputs were at a lesser level, most had a positive learning experience and gained an understanding of the course subject and the requirement for digital creativity in accounting.
Szabo *et al.,* [44]	Development of Spatial Abilities of Preadolescents: What Works?	The study used a database of state-funded research on Philippine STEAM education involving 106 teachers from 14 regions. Data was collected using a Classroom Observation Protocol, and systematic analysis involved data condensation, display, and conclusion verification.	STEAM educators utilized traditional and authentic assessment tools, integrating technology into their practices. They identified three best practices: career readiness assessment, system support for instruction, and collective and reflective assessment processes.
Koretsky *et al.,* [27]	Aligning classroom assessment with engineering practice: A design-based research study of a two-stage exam with authentic assessment	The research utilized a design-based framework and collected data from 117 student teams through two iterations: performance, reflection, and comparison of authentic tasks and traditional assessments.	Teams chose multiple solution paths in an authentic task, mirroring engineering practice. Technology tools evaluated procedural accuracy and decision-making performances aligned with desired competencies. Computer-based assessments provided holistic assessment, reshaping classroom perceptions.

5. Discussion

The study emphasizes the importance of integrating technology components with teaching presence functions to improve student engagement and foster a supportive learning environment. It also highlights the development of a virtual community platform for story pedagogy and student-centred learning, aligning with modern pedagogical approaches. The endorsement of open-book exams for online assessment in higher education challenges traditional methods and encourages innovative approaches. The study's positive outcomes suggest that online learning can be effective when executed thoughtfully, and the potential for reintroducing face-to-face activities emphasizes the need for a balanced approach as reported by Lim *et al.,* [48], and Pham *et al.,* [49]. Online meeting platforms are recognized as reliable and affordable tools for exam invigilation in higher education. These results underscore the significance of bringing education up to date via creative teaching strategies, evaluation techniques, and technological incorporation. They emphasize how important it is to get students involved in the learning process, to encourage the application of information in the real world, and to embrace technology as a tool for evaluation and learning. They also emphasize how designing education to be more real and student-centred can lead to higher levels of engagement, creativity, and student happiness. These observations can direct educators and educational institutions toward improving education as a whole in the digital age.

The research also highlights the evolving landscape of education and assessment methods, emphasizing the importance of integrating modern multimedia techniques into evaluation processes, strategic learning, technological integration, and contemporary educational goals like social justice and sustainability. E-portfolios in Open and Distance e-Learning (ODeL) assessments offer a student-centred and authentic approach, but addressing challenges faced by instructors is crucial. The management of ICT-based literary teaching through an inquiry approach emphasizes the role of technology in modern classrooms. STEAM education assessments showcase diverse strategies educators employ to assess students' skills and readiness. Communication skills and authentic learning experiences are crucial for first-semester engineering students. The adaptation of nursing academia to the COVID-19 pandemic demonstrates educators' resilience and adaptability. Key elements for implementing online assessments include the assessment's role, rationale, accessibility, academic integrity, and authenticity. The positive reception of formative assessment initiatives in various educational contexts as evidenced by the findings of McCallum *et al.,* [50],and Choi *et al.,* [51] suggests their adaptability and potential benefits in diverse settings. All of these research results point to the necessity of adaptable, creative assessment practices that align with modern educational objectives. They emphasize how important it is to use technology, student-centred learning strategies, and genuine assessment techniques to help students get ready for the opportunities and challenges of the contemporary world. They also emphasize how important it is for educators to adjust to shifting conditions and keep refining their methods of evaluation in order to improve student performance.

Our finding in the third theme revealed that STEAM education assessment practices reveal a diverse range of techniques, including conventional and real-world methods. It categorizes assessment into three primary categories: community and reflective assessment processes, establishing instructional support systems, and assessing career or industry readiness. These insights can guide educators in tailoring their assessment strategies to evaluate students' skills and readiness for future careers. The research underscores the importance of collaboration and shared understanding among stakeholders in STEM education reform. The study on anatomical sciences instruction emphasizes the need for instructional practices that align with design learning best practices. The Delphi process provides a comprehensive framework for creating high-quality online

courses in health professions education. The study on anonymized crowdsourcing in healthcare curriculum design highlights the value of student input and engagement in curriculum development. The study on digital creative outputs in accounting education emphasizes the importance of fostering a positive learning experience. The recognition of three best practices in STEAM education assessment career readiness assessment, system support for instruction, and collective and reflective assessment processes provides valuable guidance for educators. Together, these research results highlight the significance of varied, authentic, and student-centred assessment methods in education, especially in STEAM subjects. They emphasize the necessity of teamwork, assistance, and creative methods of evaluation in order to guarantee that students are adequately equipped to face the opportunities and problems of the contemporary world.

6. Conclusions

The research emphasizes the importance of modernizing education by integrating innovative teaching strategies, evaluation techniques, and technology. It emphasizes the need for active student engagement, real-world application of knowledge, and the use of technology for assessment and learning. Designing education to be authentic and student-centred can lead to higher engagement, creativity, and satisfaction. The research also highlights the evolving landscape of education and assessment methods, emphasizing the need for adapting practices to align with contemporary goals and student needs. The research on STEAM education assessment practices highlights the diversity of assessment techniques and the importance of evaluating students' readiness for future careers. Collaboration among stakeholders and shared understanding are crucial for educational reform in STEM fields. Recognizing best practices in STEAM education assessment provides practical guidance. In conclusion, these themes emphasize the need for adaptability, creativity, and alignment with contemporary educational objectives to be more authentic in assessment practices.

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References
[1] Baidoo-Anu, David, and Leticia Owusu Ansah. "Education in the era of generative artificial intelligence (AI): Understanding the potential benefits of ChatGPT in promoting teaching and learning." *Journal of AI* 7, no. 1 (2023): 52-62. https://doi.org/10.61969/jai.1337500

[2] Vrioni, Andri, Anna Mavroudi, and Ioannis Ioannou. "Promoting Authentic Student Assessment for STEM Project-Based Learning Activities." In *Internet of Things, Infrastructures and Mobile Applications: Proceedings of the 13th IMCL Conference 13*, pp. 117-126. Springer International Publishing, 2021. https://doi.org/10.1007/978-3-030-49932-7_12

[3] Hains-Wesson, Rachael, Vikki Pollard, Friederika Kaider, and Karen Young. "STEM academic teachers' experiences of undertaking authentic assessment-led reform: A mixed method approach." *Studies in Higher Education* 45, no. 9 (2020): 1797-1808. https://doi.org/10.1080/03075079.2019.1593350

[4] Saher, Al-Sabbah, Al Momani Jehad Ali, Darwish Amani, and Fares Najwan. "Traditional Versus Authentic Assessments in Higher Education." *Pegem Journal of Education and Instruction* 12, no. 1 (2022): 283-291. https://doi.org/10.47750/pegegog.12.01.29

[5] Lowell, Victoria L., and Robert L. Moore. "Developing practical knowledge and skills of online instructional design students through authentic learning and real-world activities." *TechTrends* 64, no. 4 (2020): 581-590. https://doi.org/10.1007/s11528-020-00518-z

[6] Yu, Wang, Wang Hui, Huang Wei, and Jiao Yongge. "Implementing a web-based personalized learning and assessment system." In *2010 5th International Conference on Computer Science & Education*, pp. 1629-1632. IEEE, 2010. https://doi.org/10.1109/ICCSE.2010.5593590

[7] Fadhlilah, Ahmad, Rochmiyati Rochmiyati, and Lilik Sabdaningtyas. "STEAM class-based creative thinking ability instruments for elementary school." (2021). https://doi.org/10.53402/ijesss.v1i3.23

[8] Pu, Ying-Hung, Ting-Ting Wu, Po-Sheng Chiu, and Yueh-Min Huang. "The design and implementation of authentic learning with mobile technology in vocational nursing practice course." *British Journal of Educational Technology* 47, no. 3 (2016): 494-509. https://doi.org/10.1111/bjet.12443

[9] Alhejaili, Anwar Safar. "A Critical Appraisal of Using Digital Literacy as A Transformational Leadership Style in An Educational Context."

[10] Niaz, Syeda Fatima, Muzammila Akram, and Rabia Bahoo. "Integrating Computer-Based Technology In Higher Education Programs: Availability, Utility, Opinions, And Anxiety Of University Teachers." *Pakistan Journal of Humanities and Social Sciences* 9, no. 3 (2021): 386-391. https://doi.org/10.52131/pjhss.2021.0903.0144

[11] Jopp, Ryan. "A case study of a technology enhanced learning initiative that supports authentic assessment." *Teaching in Higher Education* 25, no. 8 (2020): 942-958. https://doi.org/10.1080/13562517.2019.1613637

[12] Wijaya, Andik Nur. "Digital video project: An authentic assessment to assess students' speaking skills." *Indonesian Journal of EFL and Linguistics* 5, no. 1 (2020): 57. https://doi.org/10.21462/ijefl.v5i1.217

[13] Abdurrahman, Abdurrahman, Novinta Nurulsari, Hervin Maulina, and Farida Ariyani. "Design and validation of inquiry-based STEM learning strategy as a powerful alternative solution to facilitate gift students facing 21st century challenging." *Journal for the Education of Gifted Young Scientists* 7, no. 1 (2019): 33-56. https://doi.org/10.17478/jegys.513308

[14] Kassymova, G., A. Akhmetova, M. Baibekova, A. Kalniyazova, B. Mazhinov, and S. Mussina. "E-Learning environments and problem-based learning." *International Journal of Advanced Science and Technology* 29, no. 7 (2020): 346-356.

[15] Gikandi, Joyce Wangui. "Enhancing e-learning through integration of online formative assessment and teaching presence." *International Journal of Online Pedagogy and Course Design (IJOPCD)* 11, no. 2 (2021): 48-61. https://doi.org/10.4018/IJOPCD.2021040104

[16] Janse van Rensburg, Cecile, Stephen A. Coetzee, and Astrid Schmulian. "Developing digital creativity through authentic assessment." *Assessment & Evaluation in Higher Education* 47, no. 6 (2022): 857-877. https://doi.org/10.1080/02602938.2021.1968791

[17] Romero-Ivanova, Christina Louise, Paul Cook, and Greta Faurote. "Digital stories, material transformations: reflections of education students in a pre-teacher program." *English Teaching: Practice & Critique* 20, no. 2 (2021): 245-260. https://doi.org/10.1108/ETPC-07-2020-0066

[18] Sargent, Julia, and Shrehan Lynch. "'None of my other teachers know my face/emotions/thoughts': digital technology and democratic assessment practices in higher education physical education." *Technology, Pedagogy and Education* 30, no. 5 (2021): 693-705. https://doi.org/10.1080/1475939X.2021.1942972

[19] Hashim, Najiah Hanim, Nur Asma Ariffin, Nurul Ain Chua Abdullah, and Nor Omaima Harun. "Using BioBoard-G: A Board Game for Enhancing Understanding of Cell Division for Secondary School." *Journal of Advanced Research in Applied Sciences and Engineering Technology* 38, no. 2 (2024): 83-94. https://doi.org/10.37934/araset.38.2.8394

[20] Giddens, Jean, Kim Curry-Lourenco, Elizabeth Miles, and Elaine Reeder. "Enhancing learning in an online doctoral course through a virtual community platform." *Journal of Professional Nursing* 37, no. 1 (2021): 184-189. https://doi.org/10.1016/j.profnurs.2020.05.007

[21] Suhaimi, Elmi Sharlina Md, Zuhaizi Abdullah, Norazreen Muhamad, Nik Khadijah Nik Salleh, and Ahmad Affendy Abdullah. "FIGEE CARD: Pembelajaran Interaktif Kumpulan Berfungsi Kimia Organik: FIGEE CARD: Interactive Learning of Organic Chemistry Functional Groups." *International Journal of Advanced Research in Future Ready Learning and Education* 30, no. 1 (2023): 13-24.

[22] Thompson, Sally E., Sarah A. Bourke, J. Nikolaus Callow, and Matthew R. Hipsey. "Prioritizing engagement of a diverse student cohort in online hydrology learning at the University of Western Australia." In *Frontiers in Education*, vol. 7, p. 907801. Frontiers, 2022. https://doi.org/10.3389/feduc.2022.907801

[23] Mudau, Patience Kelebogile. "Lecturers' Views on the Functionality of e-Portfolio as Alternative Assessment in an Open Distance e-Learning." *International Journal of Educational Methodology* 8, no. 1 (2021): 81-90. https://doi.org/10.12973/ijem.8.1.81

[24] Ibarra Sáiz, María Soledad, Gregorio Rodríguez Gómez, David Boud, Tijs Rotsaert, Sally Brown, M. L. Salinas Salazar, and H. M. Rodríguez Gómez. "The future of assessment in Higher Education." (2020).

[25] Mate, Karen, and Judith Weidenhofer. "Considerations and strategies for effective online assessment with a focus on the biomedical sciences." *Faseb Bioadvances* 4, no. 1 (2022): 9. https://doi.org/10.1096/fba.2021-00075

[26] Nieto, Teresa Fuentes, Víctor Manuel López Pastor, and Andrés Palacios Picos. "A combination of transformative and authentic assessment through ICT in Physical Education." *Retos: nuevas tendencias en educación física, deporte y recreación* 44 (2022): 728-738. https://doi.org/10.47197/retos.v44i0.91459

[27] Koretsky, Milo D., Campbell J. McColley, James L. Gugel, and Thomas W. Ekstedt. "Aligning classroom assessment with engineering practice: A design-based research study of a two-stage exam with authentic assessment." *Journal of Engineering Education* 111, no. 1 (2022): 185-213. https://doi.org/10.1002/jee.20436
[28] McDermott, Roger, Mark Zarb, Mats Daniels, Aletta Nylén, Arnold Pears, Ville Isomöttönen, and Michael Caspersen. "The authenticity of 'authentic'assessment some faculty perceptions." In *2017 IEEE frontiers in education conference (FIE)*, pp. 1-9. IEEE, 2017. https://doi.org/10.1109/FIE.2017.8190604
[29] Moher, David, Alessandro Liberati, Jennifer Tetzlaff, Douglas G. Altman, and T. PRISMA Group*. "Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement." *Annals of internal medicine* 151, no. 4 (2009): 264-269. https://doi.org/10.7326/0003-4819-151-4-200908180-00135
[30] Pech, Gerson, and Catarina Delgado. "Percentile and stochastic-based approach to the comparison of the number of citations of articles indexed in different bibliographic databases." *Scientometrics* 123, no. 1 (2020): 223-252. https://doi.org/10.1007/s11192-020-03386-9
[31] Stahlschmidt, Stephan, and Dimity Stephen. "Comparison of web of science, scopus and dimensions databases." *KB forschungspoolprojekt* (2020): 1-37.
[32] Pranckutė, Raminta. "Web of Science (WoS) and Scopus: The titans of bibliographic information in today's academic world." *Publications* 9, no. 1 (2021): 12. https://doi.org/10.3390/publications9010012
[33] Marcano, Beatriz, Beatriz Ortega-Ruipérez, and Almudena Castellanos Sánchez. "Percepción de docentes y estudiantes de educación superior de los exámenes a libro abierto y supervisados en la pandemia por COVID-19." (2023).
[34] Balogun, Teslim Bamidele, Olukayode Olusola Awonuga, and Rukaya Abowen-Dake. "Investigating digital technological competencies amongst black Asian minority ethnic construction students in the UK." *Journal of Engineering, Design and Technology* 21, no. 6 (2023): 1857-1882. https://doi.org/10.1108/JEDT-08-2021-0449
[35] John-Matthews, J. St, L. Robinson, F. Martin, P. M. Newton, and A. J. Grant. "Crowdsourcing: A novel tool to elicit the student voice in the curriculum design process for an undergraduate diagnostic radiography degree programme." *Radiography* 26 (2020): S54-S61. https://doi.org/10.1016/j.radi.2020.04.019
[36] Linden, Kelly, and Prue Gonzalez. "Zoom invigilated exams: A protocol for rapid adoption to remote examinations." *British Journal of Educational Technology* 52, no. 4 (2021): 1323-1337. https://doi.org/10.1111/bjet.13109
[37] Mudau, Patience Kelebogile. "Lecturers' Views on the Functionality of e-Portfolio as Alternative Assessment in an Open Distance e-Learning." *International Journal of Educational Methodology* 8, no. 1 (2021): 81-90. https://doi.org/10.12973/ijem.8.1.81
[38] Roxburgh, Mark, and Darrell JR Evans. "Assessing anatomy education: A perspective from design." *Anatomical Sciences Education* 14, no. 3 (2021): 277-286. https://doi.org/10.1002/ase.2060
[39] Djihadah, Nuryati, Iim Wasliman, Agus Mulyanto, and Faiz Karim Fatkhullah. "Literary Teaching Based on Information and Communication Technology (ICT): An Inquiry Approach." *Theory and Practice in Language Studies* 13, no. 6 (2023): 1556-1563. https://doi.org/10.17507/tpls.1306.25
[40] Leeder, Thomas M., Lee C. Beaumont, and Ciaran MC Maloney. "Understanding the Impact of an Online Level 1 Coach Education Award on Dodgeball Coaches' Learning and Practice." *International Sport Coaching Journal* 10, no. 3 (2023): 373-386. https://doi.org/10.1123/iscj.2022-0072
[41] Wang, Dang, Hongyun Liu, and Kit-Tai Hau. "Automated and interactive game-based assessment of critical thinking." *Education and Information Technologies* 27, no. 4 (2022): 4553-4575. https://doi.org/10.1007/s10639-021-10777-9
[42] Spanjaard, Daniela, Francine Garlin, and Hossain Mohammed. "Tell me a story! Blending digital storytelling into marketing higher education for student engagement." *Journal of Marketing Education* 45, no. 2 (2023): 167-182. https://doi.org/10.1177/02734753221090419
[43] Sarmiento, Celina P., Marie Paz E. Morales, Levi E. Elipane, and Brando C. Palomar. "Assessment practices in Philippine higher STEAM education." *Journal of University Teaching & Learning Practice* 17, no. 5 (2020): 18. https://doi.org/10.53761/1.17.5.18
[44] Szabó, Tibor, Bernadett Babály, Helena Pataiová, and Andrea Kárpáti. "Development of spatial abilities of preadolescents: What works?." *Education Sciences* 13, no. 3 (2023): 312. https://doi.org/10.3390/educsci13030312
[45] So, Iris C. "Nurturing Responsive Learning Environment in the Nursing Academe Amid COVID-19." *Philippine Journal of Nursing* 91, no. 2 (2021).
[46] Orsini, Cesar, Barbara Jennings, Veena Rodrigues, and Jorge Tricio. "The development of a reporting form for peer observation of online learning courses: An e-Delphi consensus study of educators working in health professions education." *European Journal of Dental Education* 27, no. 4 (2023): 1088-1097. https://doi.org/10.1111/eje.12902

[47] Tortajada-Genaro, Luis Antonio. "Mini-cases of professional-inspired activities in e-learning platforms: An experience for the formative assessment." *Multidisciplinary Journal of Educational Research* 12, no. 1 (2022): 38-59. https://doi.org/10.17583/remie.6070

[48] Nieminen, Juuso Henrik, Margaret Bearman, and Rola Ajjawi. "Designing the digital in authentic assessment: is it fit for purpose?." *Assessment & Evaluation in Higher Education* 48, no. 4 (2023): 529-543. https://doi.org/10.1080/02602938.2022.2089627

[49] Lim, Tristan, Swapna Gottipati, Michelle Cheong, Jun Wei Ng, and Christopher Pang. "Analytics-enabled authentic assessment design approach for digital education." *Education and Information Technologies* 28, no. 7 (2023): 9025-9048. https://doi.org/10.1007/s10639-022-11525-3

[50] Petrović, Juraj, and Predrag Pale. "Achieving scalability and interactivity in a communication skills course for undergraduate engineering students." *IEEE transactions on education* 64, no. 4 (2021): 413-422. https://doi.org/10.1109/TE.2021.3067098

[51] Orikana, Marcelyn Budi, Hanita Yulia, and Krismiyati Krismiyati. "Effectiveness of Online Learning viewed from Students' Online Interaction." *Jurnal Teknologi Informasi dan Pendidikan* 15, no. 1 (2022): 105-119. https://doi.org/10.24036/jtip.v15i1.576

[52] Pham, Thi Tinh Thuong, Hoang Anh Le, and Doan Trang Do. "The factors affecting students' online learning outcomes during the COVID-19 pandemic: a Bayesian exploratory factor analysis." *Education Research International* 2021 (2021): 1-13. https://doi.org/10.1155/2021/2669098

[53] McCallum, Suzanne, and Margaret M. Milner. "The effectiveness of formative assessment: student views and staff reflections." *Assessment & Evaluation in Higher Education* 46, no. 1 (2021): 1-16. https://doi.org/10.1080/02602938.2020.1754761

[54] Choi, Younyoung, and Cayce McClenen. "Development of adaptive formative assessment system using computerized adaptive testing and dynamic bayesian networks." *Applied Sciences* 10, no. 22 (2020): 8196. https://doi.org/10.3390/app10228196