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Editorial note:

Faculty of Humanities Teaching and Learning Colloquium 2025 (T&L Colloquium 25) hosted by the Faculty of Humanities, North-West University, South Africa took place in Rustenburg, South Africa, from September 9-11, 2025, with a rich and stimulating programme filled with inspiring keynotes, contributed papers, workshops and panels. This bi-annual colloquium brings together educators, researchers, students, policymakers, and community practitioners. The main theme of T&L Colloquium 25 was “Reimagining the Future of Humanities Knowledge and Pedagogy: Decoloniality, Technology and the Social Justice Imperative.” This special issue of the *Journal of Contemporary Society And Education (JCSE)* contains Thirteen (13) selected papers presented at T&L Colloquium 2025. Selected contributions come from within and outside of South Africa and address a wide range of issues in humanities, decoloniality, technology and the social justice.

The introductory contribution by Tshifhiwa Ignatia Mashau provides an overview of research findings and trends related to the colloquium’s focus on the role of digital humanities and technology in supporting decolonial scholarship. The author’s article which titled “Decolonising digital health promotion in African higher education institutions: A justice-oriented literature review” develops a Digital Health Justice Framework to guide equitable and culturally responsive digital health promotion in African HEIs. A research article by Eyitayo Francis Adanlawo and Mpho Chaka follows with a discussion of emerging career pathways that foreground wellbeing and sustainable development, positioning humanities graduates as key contributors to sustainable and ethical futures. The authors identify novel professional opportunities in sectors including community engagement, policy development, and social innovation. They advocate for an expanded employability paradigm that integrates humanistic knowledge with sustainable development goals, underscoring the vital role of humanities disciplines in shaping resilient, inclusive societies.

The article by Nurain Aboo Mohammed evaluating the use of QR codes as a form of assessment in teaching and learning. The author confirms the potential of QR codes as both a useful and effective medium for assessment in educational settings. Samuel Chukwudi Agunyai and Victor Ojakorotu article “Analyzing the effect of the disconnection between the curriculum and Africa’s indigenous Knowledge on effective learning” argues that Africans’ realities still encompass indigenous knowledge on various levels that can be incorporated into the continent’s school curricula.

Other articles include: Examining the Impact of Digitalization and Inequality Post Covid - 19 In Africa by *Phuti Ignatius Moloto and Rosinah Pillay*; The Omitted Conversation: Incorporating Teacher Union Scholarship for A Transformative Educational Agenda Within the Educational Landscape. Thembinkosi Zwane, Trevor, David Matsepe; Examining factors behind an achieving institution: A scenario of secondary schools in Limpopo Province by Ngwako Solomon Modiba; Assessing the role of the COVID-19 catch-up recovery programme on learner performance in EFAL by Vele RJ, Tshikota and TM Badugela; Entrepreneurial Education and Sustainable Entrepreneurship Advancing Sustainable Development Goals in South Africa Through Small Businesses by Lazarus, M. and Beharry-Ramraj, A; Mitigating Grammatical Ambiguity In English Prepositional Phrases At Dzindi Circuit Secondary School, South Africa by Farisani Thomas Nephawe;

Exploring the Usage of Metadiscourse in Research Proposals Written by Honours Students by Mzamani Steven Khosa and Ernest Kwesi Klu; and Population Ethics and its implication for Developing Countries by Onwe Peter S. and Kelechi Johnmary Ani. Policy Windows and Missed Opportunities: An Institutional Analysis of How Teacher Unions Influence (or fail to influence) National Educational Policy Formulation by Zwane Theminkosi Trevor, Matsepe David.

Editor,

Prof. Mpho Chaka

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EVALUATING THE USE OF QR CODES AS A TOOL OF ASSESSMENT IN TEACHING AND LEARNING WITHIN HIGHER EDUCATION BLENDED LEARNING

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Abstract

This paper explores the use of QR (Quick Response) codes as an innovative tool for assessment in educational environments. The research was guided by the following key questions: (1) What are the advantages of using QR codes as an assessment method in teaching and learning? (2) How effective are QR codes in supporting assessment practices? The study was carried out with third-year education students enrolled in the Literacies in Education module. From a group of 1,500 students, a purposive sample of 29 participants completed an online questionnaire consisting of nine items aimed at exploring students' perceptions of mobile learning and the use of QR codes for assessment. This paper employed a qualitative research approach and adopted an interpretivist paradigm. The results reveal a range of student perceptions. While descriptions of mobile learning varied, the majority of participants recognised the potential of QR codes as an assessment tool. Approximately 48.3% indicated that they would likely incorporate QR codes into their future teaching practices. Participants noted that QR codes increase engagement, are easy to use, offer instant feedback, and support the development of digital skills. Furthermore, they were seen to improve time efficiency and encourage blended learning environments. The research confirms the potential of QR codes as both a useful and effective medium for assessment in educational settings. The study's aims were achieved, and the research questions were addressed through empirical feedback from students, which supports the integration of QR codes into teaching and learning practices.

Keywords: QR codes, Assessment tools, Mobile learning, Educational technology, Student engagement, Blended learning

1. Introduction

Education is advancing at a rapid pace, largely driven by continuous technological developments that require educators to adapt their practices to meet the evolving needs of contemporary society (ECAR, 2022). Within this context, the present study investigates the integration of technology in assessment, with a particular focus on the use of Quick Response (QR) codes as an innovative tool for evaluating student learning (Masih et al., 2022). The study

explores whether technology can serve as a viable and effective form of assessment, examines the specific benefits of employing QR codes within teaching and learning environments (Karia & Hughes, 2019), and considers the likelihood that future educators will incorporate QR codes into their classrooms as both assessment tools and broader pedagogical supports (Rikala & Kankaanranta, 2014). Accordingly, this inquiry is guided by two central research questions: what benefits do QR codes provide as a form

of assessment in teaching and learning, and how effective are they in enhancing the assessment process? Addressing these questions will contribute to the growing body of scholarship on technology-enhanced assessment, offering critical insights into innovative approaches that align with the demands of 21st-century education (Minard, 2024).

Quick Response (QR) codes were originally developed by the Japanese company Denso in 1994 and have since been released into the public domain, making them freely accessible for widespread use (Soon, 2008). QR codes are two-dimensional barcodes capable of storing a range of embedded information such as text, URLs, automated SMS messages, and other forms of digital data (Law & So, 2010; Shezi et al., 2025). Their adaptability and accessibility have contributed to their increasing application in educational contexts, although much of the early literature primarily focused on the technical structure and functioning of QR codes rather than their pedagogical implications (Soon, 2008).

The use of QR codes in education aligns with broader developments in mobile learning, often referred to as “m-learning.” Mobile learning involves the use of handheld devices such as smartphones, tablets, and personal digital assistants (PDAs) to facilitate access to learning resources and support collaborative engagement among students and educators (Al-Emran, Elsherif, & Shaalan, 2016; McConatha, Praul, & Lynch, 2008). According to Compton and Burke (2018), m-learning emphasizes flexibility, accessibility, and learner autonomy, providing opportunities for collaboration, peer-to-

peer engagement, and interactive teaching strategies. Within this framework, QR codes represent a valuable extension of mobile learning by enabling educators to link learners directly to assessment tools, resources, or multimedia content efficiently and interactively. Such integration highlights the potential of mobile devices to enhance communication, collaboration, and participation in both formal and informal learning environments (McConatha et al., 2008).

The growing interest in QR codes for educational purposes is also closely connected to the evolving role of technology in assessment. The term “technology assessment” first emerged in the 1960s in the United States (Banta, 2009), primarily in relation to evaluating the impact of technological innovations. Within higher education, the integration of technology into assessment practices has often been viewed as resource-intensive; however, the rapid growth and increasing accessibility of digital tools have encouraged their adoption in teaching and learning contexts (Adanlawo & Nkomo-Asare, 2025; Banta, 2009). Despite this, research exploring the application of technology as a form of educational assessment remains limited, with much of the existing scholarship concentrated in the medical and health sciences. This gap highlights the importance of studies that investigate innovative tools such as QR codes for assessment purposes, offering insights into how they can support both formative and summative evaluation in broader educational settings. This paper is guided by the following research questions: (1) What are the advantages of using QR codes as an assessment method

in teaching and learning? (2) How effective are QR codes in supporting assessment practices?

The problem statement of this paper is encapsulated by the fact that technology is still in transformation within higher education, and assessment practices frequently fall behind, due to the digital divide within South Africa. Assessments can be made more interactive and linked to real-world digital tools with Quick Response (QR) codes, which are an easy and accessible method. The purpose of this study is to examine the advantages, difficulties, and potential for enhancing student engagement and feedback in higher education by examining how QR codes can be utilised as an efficient assessment tool in blended learning environments.

This paper presents a comprehensive scholarly discussion, structured to provide a coherent and rigorous examination of the research topic. This section will end by outlining the conceptual framework that underpins the study, situating the investigation within relevant theoretical and pedagogical perspectives. The paper will then detail the research design, including the methodological approach, data collection instruments, and analytical procedures employed to ensure the validity and reliability of findings. Following this, the study's empirical results will be presented and critically analysed, highlighting key patterns, relationships, and insights derived from the data. The discussion will integrate these findings with the conceptual framework and existing literature, providing a nuanced interpretation of the implications for theory and practice. Finally, the paper

will conclude with a synthesis of the major findings, reflections on the study's contributions to the field, and recommendations for future research and practical application. This structured approach ensures a systematic and scholarly exploration of the research problem, demonstrating the study's rigour, relevance, and contribution to educational knowledge

2. Literature Review

The integration of technology into education has led to innovative assessment methods that enhance student engagement and learning outcomes. One such innovation is the use of Quick Response (QR) codes, which are two-dimensional barcodes that can store information accessible via mobile devices. This literature review examines scholarly research on the application of QR codes as an assessment tool in teaching and learning, focusing on their effectiveness, benefits, challenges, and implications for educational practice.

2.1. QR Codes in Educational Assessment

QR codes have been utilised in various educational contexts to facilitate assessment processes. For instance, they have been employed to link students to resources, quizzes, and feedback mechanisms, thereby enabling timely and interactive assessments. Studies indicate that QR codes can enhance formative assessment by providing immediate feedback and promoting active learning (Che Abdul Rani et al.). Additionally, QR codes can support diverse assessment formats, including peer assessments and self-assessments, by linking to digital

platforms that collect and analyze student responses.

2.2. Benefits of Using QR Codes in Assessment

QR codes offer several notable benefits in educational assessment. They can enhance student engagement by making assessments more interactive and encouraging active participation in the learning process (Rikala & Kankaanranta, 2014). Additionally, by linking to digital platforms, QR codes provide immediate feedback on student performance, facilitating timely interventions and support (Che Abdul Rani et al.). The accessibility and convenience of QR codes allow them to be scanned using mobile devices, making assessments available anytime and anywhere, which is particularly advantageous in remote or blended learning environments (Law & So, 2010). Furthermore, QR codes can support diverse learning styles by linking to various multimedia resources, catering to different learning preferences, and promoting inclusive education (Xaba et al., 2025; Karahan & Canbazoglu Bilici, 2019).

2.3. Challenges and Considerations

Despite their potential benefits, the use of QR codes in assessment presents several challenges:

Despite their benefits, the use of QR codes in assessment also presents several challenges. The effectiveness of QR codes is dependent on the availability and functionality of mobile devices and internet connectivity, which may not be consistent across all students (Brodie et al., 2020). Additionally, using QR codes to collect student data raises privacy and security concerns, requiring careful

consideration of ethical and legal implications (Che Abdul Rani et al.). Resistance to change can also hinder adoption, as some educators and students may be unfamiliar with the technology or perceive it as complex (Ali & Areepattamannil, 2017). Moreover, disparities in access to technology can exacerbate educational inequalities, highlighting the need to ensure that all students have the necessary resources to benefit from QR code-based assessments (Brodie et al., 2020).

2.4. Implications for Educational Practice

The integration of QR codes into assessment practices requires careful planning and implementation. Educators should consider the following:

Effective implementation of QR codes in educational assessment requires careful planning and support. Providing training for both educators and students on how to use QR codes can facilitate their adoption and maximise their benefits (Ali & Areepattamannil, 2017). Additionally, ensuring that all students have access to the necessary technology, including mobile devices and reliable internet connections, is crucial for equitable implementation (Brodie et al., 2020). Establishing clear policies regarding data privacy and security can address concerns related to the collection and use of student information (Che Abdul Rani et al.). Furthermore, continuously evaluating the effectiveness of QR code-based assessments can help identify areas for improvement and ensure that they meet educational objectives (Che Abdul Rani et al.).

QR codes offer a promising tool for enhancing assessment practices in education by providing interactive, accessible, and timely feedback to students. While challenges such as technical issues, privacy concerns, and resistance to change exist, these can be mitigated through careful planning, training, and infrastructure development. By addressing these challenges, educators can leverage QR codes to create more engaging and effective assessment experiences that support diverse learning needs.

2.5. Embedding the study into theory

The conceptual reference model for this study draws upon three key frameworks: TPACK, Connectivism, and Mobile Learning Theory, each providing a unique lens for understanding the use of QR codes as a form of assessment. TPACK, or Technological Pedagogical Content Knowledge, is a framework that identifies the essential knowledge teachers need to effectively integrate technology into their teaching. It encompasses three core domains: Content Knowledge (CK), which involves understanding the subject matter; Pedagogical Knowledge (PK), which involves understanding effective teaching strategies and learning management; and Technological Knowledge (TK), which involves understanding how to use technology tools effectively. Beyond these individual domains, TPACK emphasises the intersections among them. Pedagogical Content Knowledge (PCK) focuses on the effective teaching of specific content, Technological Content Knowledge (TCK) highlights how technology can transform content understanding, and Technological Pedagogical Knowledge

(TPK) explores how teaching strategies can evolve through technology use. The full TPACK framework, where all three domains intersect, enables teachers to design learning experiences that integrate content, pedagogy, and technology to enhance student outcomes (Mishra & Koehler, 2006). Within the context of QR codes, TPACK guides teachers in designing assessments that strategically combine subject knowledge, pedagogical approaches, and digital tools.

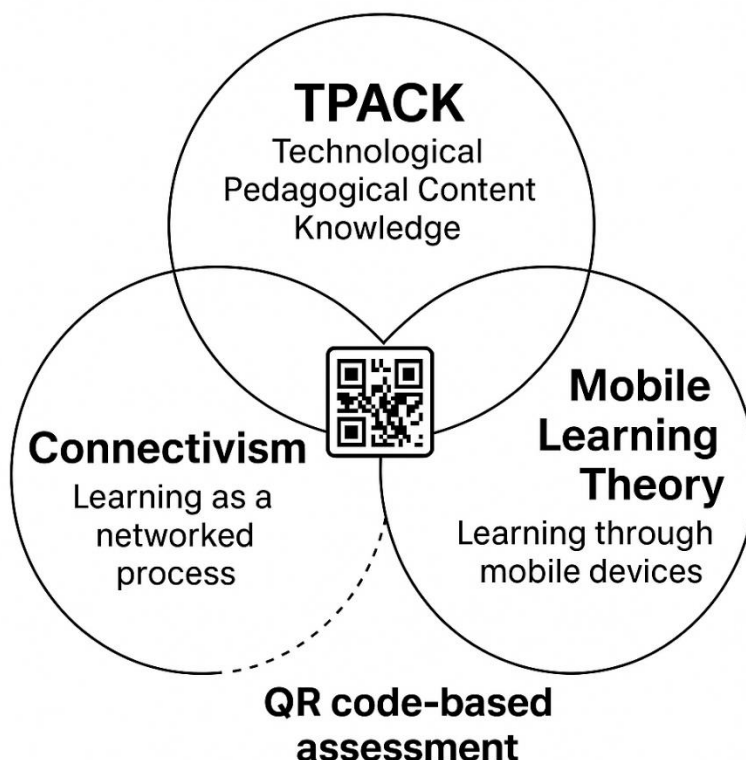
Connectivism provides a complementary perspective, framing learning as a networked and distributed process suited to the digital age. According to this theory, knowledge resides across networks rather than solely within an individual, and learning occurs through forming connections between nodes of information. Key principles include access to real-time information from multiple sources, the importance of digital tools for sharing and evaluating knowledge, and the facilitation of collaborative learning (Nkomo & Adanlawo, 2024; Siemens, 2005). QR codes exemplify Connectivism principles by linking students to diverse digital resources and assessments, enabling them to engage with information anytime and anywhere, while fostering critical skills in collaboration, information navigation, and independent inquiry.

Mobile Learning Theory further enriches this conceptual model by emphasising learning that occurs through mobile devices, such as smartphones and tablets. The theory highlights principles of ubiquity, allowing learning to occur in any location; personalisation, which enables learners to engage with content at their own pace; and interactive,

contextualised learning, which leverages multimedia resources and real-world applications (Crompton, 2013). QR codes serve as an effective mobile learning tool by granting immediate access to assessments and learning resources, thereby supporting flexible, self-directed, and contextually relevant learning experiences.

Integrating these three frameworks, the conceptual model demonstrates the multifaceted role of QR codes in assessment. Through TPACK, teachers design QR code-based assessments that combine technological proficiency, pedagogical strategies, and content knowledge. Mobile Learning Theory emphasises how students access these

assessments via mobile devices, facilitating flexible and personalised engagement. Connectivism highlights how students interact with networked learning resources, collaborate with peers and educators, and apply knowledge in meaningful ways. The flow of learning, therefore, begins with teacher-designed QR code assessments, continues with mobile access and personalised engagement by students, and culminates in networked interactions that enhance knowledge construction and learning outcomes. This integrated approach underscores how the combination of content knowledge, pedagogical strategies, and technology-enabled assessment practices can create dynamic and effective learning experiences.



The Figure 1 Theories were combined to analyse the data created by ChatGPT

3. Research Tools and Methods

The research design adopted for this study is exploratory, aiming to gain an in-depth understanding of using Quick Response (QR) codes as a form of assessment within teaching and learning contexts. Exploratory research is particularly valuable when few prior studies exist in a field, as it allows researchers to explore emerging practices and generate insights that may inform future empirical work (Maree, 2015). This study is based on a qualitative methodological approach. In this study, I will explain and describe the findings of the study. This approach is both descriptive and exploratory, enabling a meticulous examination of QR codes as an assessment tool in higher education.

The selection of participants used a non-probability sampling method, in line with qualitative research approaches that aim to produce rich, contextually detailed descriptions rather than statistical generalisations (De Vos, Strydom, Fouché, & Delpont, 2011). Specifically, purposive sampling was chosen, as this method lets researchers select participants based on a specific purpose (Maree, 2016). I also used convenience sampling, as I used to be a lecturer for Literacies in Education. I was able to upload the link to the questionnaire via Blackboard, and the students were able to answer the questionnaire. For this study, students enrolled in the Literacies in Education module (JLZ 300) were invited to take part, as their direct experience with QR code-based assessments made them well-qualified to offer meaningful insights into the advantages and difficulties of this approach.

Data collection was conducted through the use of questionnaires, which remain one of the most widely used instruments for gathering information from participants. The questionnaires were designed to elicit students' perceptions of QR codes in assessment, including their usability, effectiveness, and overall learning value. The use of questionnaires offers several advantages, including ease of administration, objectivity in data collection, and the ability to reach larger groups of participants (Lindemann). However, limitations were also acknowledged, including the potential for misinterpretation of questions, variability in the quality of responses, and the possibility of collecting large volumes of data that require extensive analysis (Lindemann).

The data analysis engages with a qualitative data approach, which emphasises the non-numerical examination and interpretation of observations to uncover underlying meanings, patterns, and relationships (Maphela & Adanlawo, 2025; De Vos, Strydom, Fouché, & Delpont, 2011). Consistent with an interpretivist epistemological stance, data analysis will follow an inductive approach. Inductive reasoning progresses from specific observations to broader generalisations and theoretical insights, allowing patterns and themes to emerge from the data (Bertram & Christiansen, 2017). I looked at each question and underlined information that was repetitive. By using this approach, I was able to identify themes and subthemes. This approach is particularly suited to the study, as it facilitates the connection of empirical findings to the theoretical framework

underpinning the investigation, specifically, to TPACK, Mobile theory and Connectivism.

Data interpretation was conducted through a systematic process of noticing, collecting, and reflecting on the information obtained. This iterative process allows for the identification of gaps in the dataset, enabling me to gather additional information if necessary.

Ultimately, the analytical procedure supports the development of conclusions grounded in the participants' perspectives, ensuring that findings are both contextually relevant and theoretically informed. By employing qualitative, inductive analysis within an interpretivist paradigm, the study sought to generate specific insights into educational practices within technology education.

Questions asked as per the questionnaire

Table 1 Questions asked through Google Form Questionnaire

No.	Questions
1.	What is Mobile Learning?
2.	Can you use QR codes as a form of assessment? Explain your answer.
3.	Have you used a QR code creator/marker before?
4.	Do you think including technology as a form of assessment as QR codes useful? Please elaborate on your answer.
5.	Will you use QR codes in your assessments or teaching as a teacher? Explain your answer and provide an example if you say yes
6.	Were the instructions to create a QR code sufficient, or did you need to conduct additional research?
7.	Did you enjoy creating a QR code? Please elaborate
8.	Is it beneficial to use QR codes as a form of assessment in teaching and learning? Explain
9.	Was using QR codes effective as a form of assessment? Explain your answer.

The study employed a qualitative, interpretivist paradigm, recognising that knowledge is socially constructed and that meaning is best understood from the perspectives of participants. In line with this epistemological stance, data analysis was inductive, moving from specific observations to the identification of broader patterns and themes (Bertram & Christiansen, 2017). As De Vos, Strydom, Fouché, and Delport (2011) note, qualitative analysis involves the systematic, non-numerical examination of data to uncover underlying meanings and relationships. My analytic process

followed the stages of noticing, collecting, and reflecting, which facilitated the identification of recurring themes, the recognition of gaps in the data, and the development of interpretations grounded in participants' experiences. This approach ultimately allowed for a specific understanding of the role of QR codes in assessment and informed the study's conclusions.

4. Findings and Discussion of the Findings

The study revealed that QR codes provide multiple benefits as a form of

assessment in teaching and learning. Participants frequently noted that QR codes enhance student engagement by making learning interactive and more appealing. They emphasised that assessments could be linked to multimedia resources, including videos, quizzes, and online documents, which encourages learners to interact actively with content (Participant A, Participant B, Participant C). Several respondents highlighted that QR codes support digital literacy and help both students and teachers develop technological competence, providing an effective avenue for integrating technology into the classroom (Participant A, Participant D). Additionally, participants observed that QR codes save time by streamlining assessment processes, reducing reliance on paper-based methods, and allowing quicker submission and grading of assignments (Participant E, Participant F, Participant C).

Accessibility and convenience emerged as key advantages. Participants reported that QR codes can be used on mobile devices such as smartphones, tablets, and laptops, enabling learning and assessment to take place in multiple environments, including remote or mobile contexts (Participant B, Participant G, Participant H). QR codes also facilitate immediate feedback, as students can complete linked online quizzes and receive instant results, allowing teachers to quickly identify areas of strength and weakness (Participant F, Participant I). Moreover, QR codes support diverse learning styles, linking to a variety of multimedia resources that cater to different student preferences, thereby promoting inclusive education (Participant J, ; participant D,).

Despite these advantages, the study identified challenges that may affect the effectiveness of QR codes as an assessment tool. Technical issues were commonly reported, including problems with device availability, internet connectivity, and QR code functionality, which can hinder access and completion of assessments (Participant K, Participant L). Participants also noted equity concerns, pointing out that students in schools with limited technological resources may be disadvantaged (Participant H, Participant M). Some respondents expressed caution regarding the use of QR codes for younger learners or in contexts where students might be distracted by mobile devices (Participant N). Additionally, privacy and security considerations were mentioned, with participants emphasising the importance of safeguarding student data when using QR codes linked to digital platforms (Participant I).

Overall, the findings indicate that QR codes are an effective tool for enhancing engagement, improving accessibility, and facilitating timely feedback in assessment practices. When implemented with adequate infrastructure, training, and clear instructions, QR codes can enrich teaching and learning experiences and foster the development of 21st-century digital skills among both teachers and students. However, their effectiveness depends on factors such as technological resources, student age, and school context, highlighting the need for careful planning and support to maximise the benefits of QR code-based assessments.

Table 1 below summarises the findings from the responses received for 29 students only.
Table 2 Summary of the findings

Theme	Benefits (with supporting quotes)	Limitations (with supporting quotes)
Accessibility & Convenience	Quick and easy access to assessments – 'it is a quick and easy-to-use tool to access tasks'	
Time-Saving & Efficiency	Saves time and reduces paperwork – 'it saves time', 'easier for the marker to access videos or documents'	
Engagement & Motivation	More fun and interactive – 'it made learning and assessment more fun than paper-based assessments'	
Digital Literacy Development	Learners gain technological skills, so that my learners will become digitally literate.	
Perceived Redundancy		Some felt QR codes were unnecessary – 'we can just copy and paste the link'

The findings of this study highlight several benefits of using Quick Response (QR) codes as a form of assessment in teaching and learning. One of the most significant advantages identified was accessibility and convenience. QR codes provide immediate access to assessments and resources, reducing the need for learners to type lengthy URLs or navigate complex systems. Teachers can efficiently distribute assignments, quizzes, videos, and supplementary materials through simple code scans (Rikala & Kankaanranta 2014). This level of accessibility not only supports inclusive learning but also aligns with the growing emphasis on mobile learning, which promotes learning opportunities across different contexts (Al-Emran, Elsherif, & Shaalan 2016). Recent research also indicates that QR codes enable rapid linkage between physical

and digital materials, facilitating “anytime/anywhere” access to learning resources (Noah 2022).

Another prominent benefit relates to time efficiency and reduced administrative demands. Participants emphasised that QR codes streamline the processes of submission and marking by reducing paperwork, saving time for both educators and students. For example, the feasibility study by Masih et al. (2022) found that QR-code-based registration and evaluation shortened the time for learners to complete evaluations and enhanced submission rates. By moving away from hard copies, QR codes contribute to environmentally sustainable practices while allowing educators to manage assessments more effectively. Furthermore, a systematic review published in 2024 found that QR codes

embedded in textbooks or worksheets reduced teacher preparation overhead and promoted quicker student access to linked materials.

The study also demonstrated that QR codes enhance student engagement and motivation. Students described QR-code-based assessments as fun, creative, and exciting—qualities that support active learning. This aligns with research suggesting that digital tools foster learner curiosity and participation by offering novel and interactive experiences (Karia & Hughes 2019). In more recent work, Sögüt (2024) found that QR-code-enriched writing and speaking activities in language classrooms significantly increased student willingness to engage, enhancing both participation and scaffolding of tasks. In this sense, QR codes are not simply a means of accessing resources but also a pedagogical tool that sparks enthusiasm for learning.

Furthermore, the integration of QR codes into teaching and learning environments supports digital literacy development. Both teachers and learners develop essential technological skills when using QR codes, thereby preparing students for a digitally mediated world (ECAR 2022). Beyond digital skills, QR codes allow educators to integrate multimodal resources, including videos, simulations, and interactive quizzes, which enhances the richness of learning experiences (Minard 2024). Importantly, the potential for instant feedback was also identified as a key advantage, particularly when QR codes link directly to online quizzes or automated assessments. Immediate feedback enables learners to identify strengths and weaknesses in real-time,

which is consistent with best practices in formative assessment (Shute 2008). A study in 2025 further observed that QR-code-enhanced sessions in anatomy education led to significantly higher student satisfaction and improved comprehension, indicating effective just-in-time feedback affordances (Al-Khalifa & Alshahrani 2025).

Regarding effectiveness, QR codes were seen as practical and efficient tools for assessment. Participants emphasised their simplicity, flexibility, and capacity to enrich the learning experience. These findings align with existing literature that presents QR codes as versatile educational tools capable of supporting anywhere-anytime, anywhere, creativity, and worldwide adoption (Law & So 2010; Rikala & Kankaanranta 2014). However, several challenges were identified. One major limitation concerns the digital divide, with participants noting that QR codes are less effective in under-resourced schools where access to smartphones, mobile data, or reliable internet is limited. This concern reflects broader critiques of digital technologies in education, warning that innovations might worsen inequalities if not implemented with equity in mind (Selwyn 2016). A 2024 systematic review found infrastructure issues, such as lack of WiFi and mobile device capability, to be common barriers to QR-code adoption in many contexts (Sağit 2024). According to Masih et al. (2022), technical problems like malfunctioning codes and broken links were also observed, highlighting concerns that technological reliability influences adoption and effectiveness. This may also

affect marks if submissions include broken links.

Overall, QR codes were found to provide numerous benefits, including accessibility, efficiency, engagement, and the promotion of digital literacy. They are largely effective in contexts where technology and resources are available. Still, equity-related barriers such as the digital divide, infrastructure challenges, and policy restrictions (e.g., bans on mobile devices in schools) limit universal applicability. As such, while QR codes offer considerable potential to enhance assessment practices, their effectiveness remains highly context-dependent.

5. Relating the findings to the theory

The findings of this study underscore the multifaceted benefits of using QR codes as an assessment tool within educational contexts. Participants highlighted accessibility and convenience as key strengths, noting that QR codes provide quick and seamless access to assessments and learning materials across multiple devices. This flexibility supports mobile learning by enabling students to engage with content in diverse environments beyond the traditional classroom (Rikala & Kankaanranta 2014).

Time efficiency emerged as another significant advantage, with QR codes streamlining administrative processes such as marking and feedback. By reducing paper-based tasks, QR codes not only save time but also contribute to sustainable teaching practices (SAğit, Uçak, & Savran-Gencer 2024). Participants further observed that engagement and motivation were notably enhanced, as QR code-based tasks

transformed learning into a more interactive, enjoyable, and student-centered process that fostered active participation (McCabe & Tedesco 2012). In addition, QR codes were found to promote digital literacy development, allowing both teachers and learners to strengthen their technological competence and acquire essential digital skills necessary for navigating modern educational environments. The provision of instant feedback through automated QR-linked assessments further supported formative assessment practices, enabling learners to identify their strengths and areas for improvement in real time (SAğit et al. 2024).

However, several challenges were identified that may influence the effectiveness of QR codes in educational assessment. These included technical difficulties, issues of digital inequity, privacy and security concerns, and questions surrounding the suitability of QR-based assessments for younger learners. Such limitations suggest that while QR codes hold significant pedagogical potential, their successful implementation requires adequate infrastructure, equitable access to digital tools, and clear guidelines for ethical use (Rikala & Kankaanranta 2014; SAğit et al. 2024).

5.1. Implications for Conceptual Frameworks

TPACK (Technological Pedagogical Content Knowledge)

The findings reinforce the TPACK framework by illustrating how QR codes can effectively integrate technology with pedagogy and content knowledge. Teachers were able to align learning objectives with digital tools,

demonstrating the synergy between technological and pedagogical dimensions that TPACK advocates (Mishra & Koehler 2006; Koehler & Mishra 2009). The challenges reported, particularly those related to teachers' digital confidence and design skills, highlight the ongoing need for professional development in digital assessment. This study extends TPACK by showing how simple, low-cost tools such as QR codes can operationalize technology integration within authentic classroom settings, bridging theory and practice.

Mobile Learning Theory

The study's emphasis on accessibility, convenience, and ubiquitous learning aligns closely with the principles of mobile learning. QR codes facilitate contextual and flexible learning experiences, allowing education to extend beyond the confines of the classroom and into real-world environments (MacCallum & Parsons 2016; Mohtar et al. 2022). They support learner autonomy and situated learning, key tenets of mobile learning. This research expands the theory by demonstrating that QR codes can serve as micro-learning portals—accessible, engaging, and inclusive even in settings with limited resources.

Connectivism

The results also align with Connectivist perspectives, which view learning as a process of building and navigating networks through digital interactivity. By linking students to diverse multimedia and online resources, QR codes foster knowledge construction across connected digital environments (Herlo 2017; 360Learning Team 2021). Their collaborative and interactive potential

supports the notion of distributed knowledge, where learning occurs across multiple contexts and platforms. This study extends Connectivism by showing that even simple technologies can effectively enable networked learning and immediate access to information without reliance on complex infrastructures.

Support, Challenge, and Extension of Existing Theories

The findings collectively support the TPACK model's emphasis on integrated digital pedagogy, the flexibility promoted by Mobile Learning Theory, and the connectivity central to Connectivism. However, they also challenge the universal applicability of these frameworks by exposing persistent barriers such as inequitable access to devices and reliable internet. At the same time, the study extends these theories by demonstrating that QR codes can serve as accessible, low-barrier tools that democratize technology integration, offering practical avenues for educators to apply theoretical constructs within everyday teaching and assessment.

Implications for Future Research and Practice

The results suggest several directions for future inquiry and practical application. Teacher-training initiatives should focus on enhancing educators' TPACK competencies, equipping them to design and implement effective QR-based assessments. Further research is warranted to address issues of equity and access, ensuring that digital innovations do not widen existing educational divides. Studies examining the scalability of QR code integration across disciplines and over time could offer insights into sustainable implementation practices.

Lastly, the study underscores the need to explore policy and ethical considerations, particularly regarding data privacy, digital citizenship, and responsible use of mobile learning technologies.

6. Conclusion

This study demonstrates that QR codes hold significant promise as innovative tools for assessment in teaching and learning. Their ability to enhance accessibility, streamline administrative processes, promote engagement, and foster digital literacy underscores their relevance within contemporary, technology-mediated education. The integration of multimodal resources and the potential for immediate feedback further position QR codes as valuable assets in supporting active and formative learning practices. However, the findings also highlight the contextual limitations of QR code implementation. While

effective in technologically resourced environments, their utility is diminished in under-resourced schools due to the digital divide, unreliable infrastructure, and institutional restrictions on mobile device use. These challenges emphasise that the adoption of QR codes should not be viewed as a universal solution but rather as a context-dependent practice requiring careful consideration of equity and access. Overall, QR codes represent a practical and engaging assessment approach that aligns with global shifts toward mobile and digital learning. Yet, for their benefits to be fully realised, policymakers and educators must address infrastructural inequalities and ensure that the integration of such tools is inclusive and sustainable. Future research should explore long-term impacts on student learning outcomes, as well as strategies for equitable implementation across diverse educational contexts.

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