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The Effectiveness of Using Quick Response (QR) Code Technology in University Learning Management via a Local Network

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Abstract:

This study aimed to evaluate the effectiveness of using Quick Response (QR) Code technology in university learning management via a local network among university students, focusing on three main academic areas: recording student attendance and absence, providing and downloading educational materials, and administering achievement tests and psychological assessments electronically. The study sample consisted of 70 male and female students majoring in Clinical and School Psychology at Hassiba Ben Bouali University of Chlef. The descriptive-analytical method was used, and a questionnaire was designed based on scientific frameworks to determine the effectiveness of this technology. The study relied on employing QR Code technology as a digital tool supporting the educational process. The results showed that there is effectiveness in using QR Code technology in managing university learning via a local network among students at Hassiba Ben Bouali University of Chlef, compared to traditional methods.

The results also indicated that using QR Code technology is a simple, cost-effective technical solution, easy to integrate with existing educational systems within a local network. This contributes to achieving a flexible and secure digital transformation within educational institutions and enhances the quality of university learning management.

Keywords: Quick Response (QR) Code technology, university learning management, local network

1. Introduction

The 21st century has witnessed rapid scientific and technological development encompassing various areas of life, which has imposed on world nations the necessity of keeping pace with this progress, especially in the field of information and communication technology and the accompanying emergence of the digital revolution. This has necessitated working towards building an integrated knowledge society and improving the quality of education by preparing a renewed and innovative teacher capable of adapting to the requirements of this changing era, developing students' knowledge, enhancing their attitudes and values, and equipping them with the necessary skills to achieve a society based on

lifelong learning. Consequently, it has become necessary to rely on modern and effective assessment methods to measure student performance inside and outside educational situations, in line with the requirements of education in the digital age.

Technological developments have become an integral part of our daily lives and have led to significant changes in our social lives, values, and attitudes due to the significant services this technology provides. It has been employed in various life domains, especially educational institutions, to facilitate the role of teachers and professors, motivate students, and increase their motivation, which positively reflects on the entire educational process, increasing its efficiency and effectiveness, improving its quality, and contributing to achieving its goals (Mansour, Al-Duwairi, & Muhaisen, 2023, p. 79).

In light of the rapid development of global digital technologies in various institutions, especially educational ones, university education has become heavily reliant on fast, easy, and flexible technological tools aimed at improving the quality of higher education and facilitating pedagogical and administrative processes. Among these tools is Quick Response (QR) Code technology (Yahya, 2018, p. 79), which provides a fast, effective, flexible, and scalable means for exchanging information and executing educational, pedagogical, and administrative procedures within a secure environment, especially when connected to a local network. This technology contributes to a set of procedures, including recording student attendance, downloading lectures, and conducting achievement tests and psychological assessments in an effective, easy, flexible, and fast manner, reducing reliance on paper and increasing data accuracy and speed of access.

Its advantages include high efficiency, simplification of processes, reduction of time and effort, cost savings, reduced reliance on expensive systems, high flexibility, easy integration with existing systems, enhanced security and data privacy via the local network, and an enjoyable user experience with a simple, cognitive interface for students and professors.

However, there are challenges that this method may face, including the lack of availability of smart devices (tablets, phones, etc.). The good side is that these can be easily overcome without additional cost by providing temporary tablets in classrooms for special cases, especially since most students now own smartphones. Regarding security concerns about information and data leakage, data encryption and the use of internal networks are very secure methods for preservation. Concerning resistance to change, as the prevailing paradigm is strong and entrenched in the educational systems of

most countries, this can be addressed by training and raising user awareness, disseminating studies and scientific research on its benefits, and organizing conferences, seminars, and promotional days.

2. Study Problem

University education is witnessing a rapid transformation towards employing technological, especially digital, tools in various forms and types to improve the quality of the educational process, increase management efficiency, enhance the student learning experience, and achieve an enjoyable educational experience that boosts students' academic and research achievement. This is confirmed by reports from international organizations concerned with education, indicating that digitization has become a strategic choice to improve learning outcomes in higher education (UNESCO, 2025; OECD, 2023).

Despite this global trend, many university institutions still rely on traditional methods for attendance recording, such as roll calls or manual signatures, for distributing printed educational materials, and for applying tests using traditional mechanisms. This leads to wasted time and effort, poor accuracy, a high probability of administrative error, in addition to limited security and objectivity in assessment (Laudon & Laudon, 2018).

Given the challenges related to the costs of complex digital systems and weak internet infrastructure in some universities, especially in developing countries, the need arises for alternative technical solutions characterized by simplicity, low cost, and ease of integration within the university environment (OECD, 2023).

Literature on digital transformation in higher education indicates that effective technical solutions do not necessarily have to be complex or expensive; rather, they should be flexible, adaptable, and achieve operational efficiency while ensuring the security of academic and administrative information (Bouali, 2021; Ben Issa, 2022).

In this context, Quick Response (QR) Code technology is considered one of the simple digital solutions whose effectiveness in supporting the educational and administrative process has been proven by studies, by facilitating access to educational resources, improving attendance management, and enhancing data accuracy and processing speed (Law & So, 2010; Al-Khalifa, 2011).

Applied studies have also shown that employing QR Code technology in university education contributes to raising efficiency levels by reducing time and effort, improving accuracy by minimizing human errors, and enhancing reliability due to system stability and the ability

to refer back to recorded data (Al-Khalifa, 2011).

These results align with digital system quality models, such as the software quality model (ISO/IEC 25010), which affirms that efficiency, accuracy, and reliability are primary indicators for evaluating the quality and effectiveness of technical systems (ISO/IEC, 2011).

In the Algerian context, the importance of employing such simple technical solutions becomes apparent given the large number of higher education students, the official trend towards digitizing university services, and the pursuit of developing smart mechanisms that ensure speed, accuracy, and security within local networks without total reliance on the external internet (Bouali, 2021; Guessoum, 2020).

Accordingly, the idea of this study crystallized through an attempt to integrate QR Code technology within a closed local network as an effective solution to address problems related to university learning management, by achieving speed in routine processes, reducing human errors, ensuring data security, providing organized and equal access to educational resources, in addition to enabling the immediate analysis of academic and psychological data. From all the above, the following main research question can be posed:

Main Research Question:

What is the effectiveness of using Quick Response (QR) Code technology in university learning management via a local network among students at Hassiba Ben Bouali University of Chlef?

Sub-questions:

1. Are there statistically significant differences in using QR Code technology for recording student attendance and absence across certain variables (efficiency, accuracy, reliability)?
2. Are there statistically significant differences in using QR Code technology for providing and downloading educational materials across certain variables (efficiency, accuracy, reliability)?
3. Are there statistically significant differences in using QR Code technology for applying achievement tests and psychological assessments electronically across certain variables (efficiency, accuracy, reliability)?

3. Study Hypotheses

Based on the study questions, the following hypotheses were formulated:

Main Hypothesis:

There is effectiveness in using Quick Response (QR) Code technology in university learning management via a local network among

students at Hassiba Ben Bouali University of Chlef.

Sub-hypotheses:

1. There are statistically significant differences in using QR Code technology for recording student attendance and absence across certain variables (efficiency, accuracy, reliability).
2. There are statistically significant differences in using QR Code technology for providing and downloading educational materials across certain variables (efficiency, accuracy, reliability).
3. There are statistically significant differences in using QR Code technology for applying achievement tests and psychological assessments electronically across certain variables (efficiency, accuracy, reliability).

4. Study Objectives

- To evaluate the effectiveness of using QR Code technology in university learning management via a local network by university students.
- To identify differences in using QR Code technology for recording student attendance and absence across certain variables (efficiency, accuracy, reliability).
- To identify differences in using QR Code technology for providing and downloading educational materials across certain variables (efficiency, accuracy, reliability).
- To identify differences in using QR Code technology for applying achievement tests and psychological assessments electronically across certain variables (efficiency, accuracy, reliability).

5. Study Importance

Theoretical Importance:

- Enriching the psychological and educational literature related to employing various modern digital technologies in university education and pedagogical organization.
- Highlighting QR Code technology as an effective educational, administrative, and pedagogical tool in various university learning environments.
- Supporting modern research trends in the field of digital transformation in higher education, especially in Algeria.

Applied Importance:

- Assisting decision-makers in universities to adopt simple, low-cost technical solutions.
- Improving pedagogical mechanisms in managing university learning within various educational institutions.
- Raising the quality of academic assessment and evaluation, including

psychological scales, and digitizing them in an easy and effective manner.

- Enhancing the quality of the educational process and pedagogical management while raising the level of security and objectivity in assessment.

6. Previous Studies

First: Arab Studies

- **Guessoum (2020)** study titled: "Quality of Educational Information Systems in the Algerian University." It adopted the descriptive-analytical method on a sample of university students. Its results showed that the quality of educational information systems is closely linked to the elements of accuracy and reliability, as they are among the most important indicators of the success of digital systems in the university environment. This supports adopting these two dimensions for evaluating the effectiveness of using QR Code technology in similar and recent studies in the Arab world.
- **Bouali (2021)** study titled: "Digital Transformation in the Algerian University: Reality and Prospects." It aimed to diagnose the reality of digital transformation in Algerian universities and explore its future prospects. It used the descriptive-analytical method and concluded the necessity of adopting flexible, low-cost technical solutions that align with available capabilities.
- **Ben Issa (2022)** study titled: "The Reality of Using Digital Technologies in Algerian University Education." Its results indicated that simple, easy-to-use technologies enjoy a higher degree of acceptance and application compared to complex systems, which reinforces the trend towards adopting QR Code as a practical and effective solution in university learning management.
- **Dr. Jehad Almomani (2022)** study at Al-Ahliyya Amman University aimed to reveal the impact of using electronic barcode tests via smartphones on the achievement of postgraduate students in the Faculty of Educational Sciences and their attitudes towards it. The study used a quasi-experimental method on a sample of 63 male and female students, divided into experimental and control groups. The results showed a statistically significant difference in academic achievement favoring the experimental group and also showed high positive attitudes among students towards using electronic barcode tests, with no differences attributed to gender.
- **Lakhdar (2023)** study titled: "Effectiveness of E-Learning in Algerian Higher Education Institutions" focused on the impact of e-learning on improving academic and administrative performance. Its results showed notable improvement in administrative efficiency and accuracy of electronic assessment, supporting the axis of electronic

tests and psychological scales adopted in the current study.

Second: Foreign Studies

- **Law & So (2010)** is among the early studies that addressed the employment of QR Code technology in education. It aimed to identify the potential uses of this technology in supporting e-learning. The study adopted the descriptive-analytical method, applied to a sample of students and teachers in digital learning environments, using questionnaires and observation. It concluded that QR Code facilitates access to digital content and improves educational interaction, supporting its selection as an effective educational tool.
- **Al-Khalifa (2011)** in her study "Utilizing QR Codes in Education" examined the effectiveness of using QR Code in improving educational content management. She used a partial experimental method on a sample of university students. The results showed high effectiveness of the technology in speed and accuracy of access to content, linking QR Code usage to concepts of efficiency and accuracy.
- **Davis (1989)** introduced the Technology Acceptance Model (TAM), a foundational model in explaining user acceptance of modern technologies. It affirmed that perceived ease of use and perceived usefulness directly influence technology adoption. The current study benefited from this model in constructing its theoretical framework, particularly in explaining the efficiency dimension.
- **Rogers (2003)** in "Diffusion of Innovations" explains the mechanisms of diffusion of technological innovations within societies. He affirmed that the adoption of any educational technology is linked to its simplicity, trialability, and ability to integrate into the existing context, supporting the employment of QR Code technology in the university environment.

Third: Commentary on Previous Studies

From the presentation of various previous studies, Arab and foreign, it is clear that there is significant agreement on the importance of the role of digital technologies in improving the quality and management of higher education. QR Code technology is also considered an effective and low-cost tool as it contributes to enhancing efficiency, accuracy, and reliability in various pedagogical processes within the educational environment. However, most studies focused on partial aspects or general educational environments, while the current study seeks to fill this gap by investigating the effectiveness of using QR Code in university learning management, especially via a local network, specifically in the Algerian university context and generally in the Arab context.

7. Definition of Study Terms

7-1. Effectiveness: Operationally defined as the total degree reflecting the success of using QR Code technology in university learning management, calculated through the average of students' scores on the three dimensions (efficiency, accuracy, reliability) as included in the questionnaire specific to this study.

7-2. Quick Response (QR) Code Technology: Operationally defined in this study as a two-dimensional digital means used within a local network to enable university students to quickly access university learning management services, including recording attendance and absence, downloading educational materials, and accessing achievement tests and psychological scales electronically. The effectiveness of its use is measured through students' responses to the items of the questionnaire designed for this study.

7-3. University Learning Management: Operationally defined as the set of digital pedagogical and academic procedures and regulations implemented using QR Code technology within the university environment, including organizing student attendance, providing educational materials, and executing assessment processes. Its level is measured through the average scores obtained by students on the scale across its three dimensions: efficiency, accuracy, and reliability.

7-4. Efficiency: Operationally defined as the ability of QR Code technology to enable students to perform academic tasks (recording attendance, downloading materials, taking tests) quickly, easily, and with minimal effort. This dimension is measured through the average of students' response scores on the items dedicated to the efficiency dimension in the questionnaire.

7-5. Accuracy: Operationally defined as the degree of correctness and integrity of academic data resulting from using QR Code technology, and its freedom from errors during attendance recording, provision of educational materials, and test application. This dimension is measured through the average of students' response scores on the items dedicated to the accuracy dimension in the questionnaire.

7-6. Reliability: Operationally defined as the degree of stability and dependability of QR Code technology in performing its academic functions without frequent failures, and the ability to rely on its results and refer back to its data when needed. This dimension is measured through the average of students' response scores on the items dedicated to the reliability dimension in the questionnaire.

7-7. Local Network: Operationally defined as a closed internal technical environment used in this study to operate QR Code technology without relying on the external internet, ensuring speed of access, data security, and service

stability. Its impact is measured through the level of student responses to the reliability and efficiency items in the questionnaire.

Theoretical Framework of the Study

8. Quick Response (QR) Code Technology

As a result of the rapid development in information and communication technologies, the concept of Mobile Learning emerged, which relies on employing mobile devices in the educational process, benefiting from the various applications and technologies they provide. This learning style has allowed the emergence of new forms of distance education systems, enabling teachers and supervisors to deliver educational and training materials via smartphones, and also allowing students to follow educational content, view lecture and exam schedules, and interact with them anytime and anywhere (Al-Momani, 2020, p. 59).

In this context, Quick Response (QR) Code technology is considered one of the tools supporting mobile learning, as it facilitates immediate access to digital educational resources by scanning the code using mobile devices, without needing to enter long web addresses. Employing QR Code also enhances the effectiveness of mobile learning by connecting students to educational content, interactive activities, and electronic tests, thereby supporting self-learning and increasing the level of interaction within the digital educational environment.

QR Code technology is one of the modern digital technologies that has seen widespread use in multiple fields, including education. A Quick Response Code is defined as a two-dimensional code readable by smart devices, allowing for fast and easy storage and retrieval of information. It is also characterized by ease of creation and use, low cost, speed of access to content, and the ability to link to various digital resources (Jiang & Lee, 2023).

Among the modern technologies that have begun to be employed in the educational process is Barcode technology. The term consists of two words: 'Bar' and 'Code'. There are multiple types of barcodes differing according to their usage purposes. QR Code is one of the most famous of these types, classified as a two-dimensional, square-shaped barcode consisting of a set of small squares, distinguished by guide squares in its three corners that accelerate the scanning process from different directions (DENSO Wave, n.d.).

QR Code technology was first developed in 1994 by the Japanese company DENSO Wave, a subsidiary of the Toyota Group. The primary goal of its invention was to track spare parts and vehicles on manufacturing lines, due to its speed in reading data and high capacity for storing information compared to traditional barcodes

(DENSO Wave, n.d.). Over time, the uses of this technology have expanded to include multiple fields, most notably education.

QR Code is an abbreviation for Quick Response Code. It is a matrix of small squares containing encoded information that can be read by camera-equipped devices like smartphones and tablets for quick access to data and websites. QR Codes can store various types of data, including web links, text, contact information, and payment data, making them an effective tool in multiple fields such as digital marketing, electronic payments, and security authentication. They have evolved to become an indispensable tool in many sectors, especially education, due to their efficiency in storing large amounts of data compared to traditional barcodes (Al-Zuhairi, 2025, p. 36).

QR Code is a type of two-dimensional (2D) code designed to store digital information, such as text and electronic links. It can be easily read using smartphones. This code is characterized by very high decoding speed and consists of black modules arranged on a white background within a regular square pattern. QR Code was originally developed to track car components on manufacturing lines, and its uses later expanded thanks to its flexibility and high data storage capacity.

With the expansion of its employment areas, QR Code has come to be used in many different applications, including research fields aimed at increasing data storage capacity and enhancing security techniques, such as digital watermarks and steganography techniques, as well as studies dealing with improving image recognition using deblurring techniques (Pandya & Galiyawala, 2014).

QR Codes are also defined as matrix-shaped codes developed to achieve three main goals: high-speed scanning from all directions, high storage capacity in a small space, and the possibility of easily transferring information at any time (Denso Wave, 2019).

Figure 01 represents a model of types of Quick Response (QR) codes.

In the educational context, QR Code technology has been employed by using barcode reader applications to scan the code, allowing the learner to be taken directly to specific digital content, an educational file, or a link to an electronic test. This content is represented either as barcode lines or as a square containing small squares in its corners, which facilitates access to digital educational resources and enhances interaction within the educational environment.

In the educational context, Abd Rabbo et al. (2018) indicate that using QR Code technology inside classrooms contributes to creating an interactive, learner-centered educational environment and enhances cooperation among students themselves and between them and teachers, especially in crowded classrooms, due to the flexibility and speed this technology provides for information exchange.

Hopkins (2013) also mentioned many examples illustrating the areas of using QR Codes in education. They can be used inside the classroom to facilitate information transfer between students and teachers by exchanging codes and benefiting from their digital content. They also contribute to documenting student portfolio activities. Regarding tracking student results, QR Code helps parents quickly access information about their children's level by including QR codes in periodic reports containing classroom and extracurricular activities and samples of student achievements. Additionally, QR Code can be used to enrich students' knowledge of scientific concepts and terms by placing the code below the term, so that when the student scans it, they are taken to a video, interactive explanation, or applied experiments related to the concept.

A set of technical advantages has contributed to the widespread use of QR Code in education, most notably those indicated by Siegle (2015): ease of design using online code generators, ease of accessing data using smart devices, simplicity of use without needing to type long web addresses, in addition to its high ability to encode various types of data. The code is also characterized by its readability from all directions thanks to the detection patterns in its corners, as well as its small size and ability to store a large amount of information in a limited space due to its reliance on horizontal and vertical two-dimensional encoding.

The QR Code consists of a set of basic structural elements that contribute to its functional performance and efficiency in storing and reading data. Parabhoi, Bhattacharjya, and Dhar (2017) identified them in five main elements (Al-Zuhairi, 2025, p. 38):

Table 1: Types of Barcodes (One-Dimensional and Two-Dimensional)

(One Dimensional – 1D Barcodes)الباركود أحادي البعد	(Two Dimensional – 2D Barcodes)الباركود ثنائي البعد
 UPC Code	 PDF417
 Code 39	 QR Code
 Code 128	 Data Matrix
 Interleaved 2 of 5	 Aztec Code

First - Finder Pattern: The finder pattern consists of three identical large squares located in three corners of the code (top-left, top-right, and bottom-left). Its function is to enable the scanner to accurately locate the code, recognize its direction and angle even if tilted, in addition to helping adjust size and orientation during the reading process.

Second - Alignment Pattern: The alignment pattern consists of small squares placed inside the code away from the corners. It is used to correct any distortion or tilt that may result from inaccurate printing or angled photography. This pattern usually appears as a small square inside another square, and its importance increases in large versions of QR Codes that contain large amounts of data.

Third - Timing Pattern: The timing pattern consists of an alternating sequence of black and white modules, extending horizontally and vertically between the finder patterns. Its function is to help the reader determine the precise coordinates of each cell within the code, ensuring correct data reading.

Fourth - Quiet Zone: The quiet zone is the white space surrounding the QR Code from all sides, typically consisting of at least four empty cells. This area is necessary to visually distinguish the code from its surrounding content, making it easy to detect and read accurately.

Fifth - Data Area: The data area contains the encoded information after converting it into binary format (0 and 1), integrated with error correction techniques that ensure data retrieval even if part of the code is damaged. This area consists of a grid of rows and columns, where black squares represent the value (1) and white squares represent the value (0).

It should be noted that many applications and websites are available for creating QR Codes, operating on various smart devices. However, practical experience indicates that **paid platforms and applications** often provide higher quality, greater ability to accommodate larger data volumes, compared to free or trial versions which have limited capabilities and are often accompanied by ads that may annoy the user and disrupt the scanning process.

First – Finder Pattern:

The finder pattern consists of three identical large squares located at three corners of the code (top-left, top-right, and bottom-left). Its function is to enable the scanning device to accurately detect the position of the code and recognize its orientation and angle, even if it is tilted. It also helps adjust the size and alignment during the reading process.

Second – Alignment Pattern:

The alignment pattern is made up of small squares placed داخل the code away from the corners. It is used to correct any distortion or misalignment that may occur due to inaccurate printing or angled scanning. This pattern usually appears as a small square داخل another square, and its importance increases in larger QR code versions that contain more data.

Third – Timing Pattern:

The timing pattern consists of an alternating sequence of black and white modules, extending horizontally and vertically between the finder patterns. Its function is to help the reader determine the exact coordinates of each cell within the code, ensuring accurate data reading.

Fourth – Quiet Zone:

The quiet zone is the white space surrounding the QR code on all sides, typically consisting of at least four empty modules. This area is essential for visually distinguishing the code from its surrounding content, making it easier to detect and scan accurately.

Fifth – Data Area:

The data area contains the encoded information after being converted into binary form (0s and 1s), combined with error correction techniques that ensure data recovery even if part of the code is damaged. This area is composed of a grid of rows and columns, where black squares

represent the value (1) and white squares represent the value (0).

It is worth noting that there are many applications and websites available for generating QR codes across various smart devices. However, practical experience indicates that paid platforms and applications often provide higher quality and a greater capacity to handle larger amounts of data compared to free or trial versions, which are usually limited in features and often include advertisements that may distract users and interfere with the scanning process.

9. Using QR Code Technology in University Learning Management

The role of QR Code technology in university learning management is evident through its employment in a set of core academic processes, most notably recording student attendance and absence, providing and downloading educational materials, and applying achievement tests and psychological scales electronically. In the attendance domain, this technology contributes to speeding up the registration process, reducing human errors, and minimizing manipulation opportunities, thereby enhancing the accuracy of academic data. In the domain of providing educational materials, QR Code technology enables organized and equal access to digital content and helps overcome problems of paper distribution and weak internet connectivity. In the assessment domain, this technology enables the application of more accurate and objective electronic tests, with the possibility of immediate data collection and analysis, supporting the quality of evaluation processes.

Modern educational literature indicates that university learning management is no longer limited to traditional administrative aspects but now includes employing digital technologies in organizing the educational process and ensuring its quality. Zaytoun (2012) affirms that learning management in the digital environment is based on planning, implementation, follow-up, and evaluation using technical tools that contribute to achieving efficiency and quality.

Davis (1989) also explains, within the framework of the Technology Acceptance Model (TAM), that the effectiveness of any digital educational system is linked to its ease of use and the perceived usefulness by users. This aligns with adopting QR Code technology as a simple, easy-to-use educational tool with clear usefulness in university learning management.

In the same context, Laurillard (2012) indicates that digital learning management contributes to enhancing interaction among the parties of the educational process and supports self and organizational learning among students, especially when employing flexible technical tools adaptable to the educational context, which enhances the effectiveness of using QR Code technology in the university environment.

10. Local Networks

First: Concept of Local Area Network (LAN)

A Local Area Network (LAN) is defined as a computer network that connects a group of devices within a limited geographical scope, such as a classroom, laboratory, or single university institution, for the purpose of exchanging data and resources with high speed and efficiency (Laudon & Laudon, 2018). LANs are characterized by high transfer speeds, low latency, and the possibility of centralized control over access to resources.

In the university context, the local network is a fundamental technical infrastructure to support educational and administrative activities, especially in environments suffering from weak or expensive external internet connectivity (Bouali, 2021).

Second: Types of Local Networks:

Local networks are divided into two main types based on the connection medium:

- **Wired LAN:** Relies on Ethernet cables to connect devices, characterized by high stability and data transfer speed, often used in university laboratories and computer labs.
- **Wireless LAN (WLAN):** Relies on wireless communication technologies (Wi-Fi), characterized by flexibility and ease of use, making it suitable for educational environments that rely on mobile devices such as smartphones and tablets (Kurose & Ross, 2021).

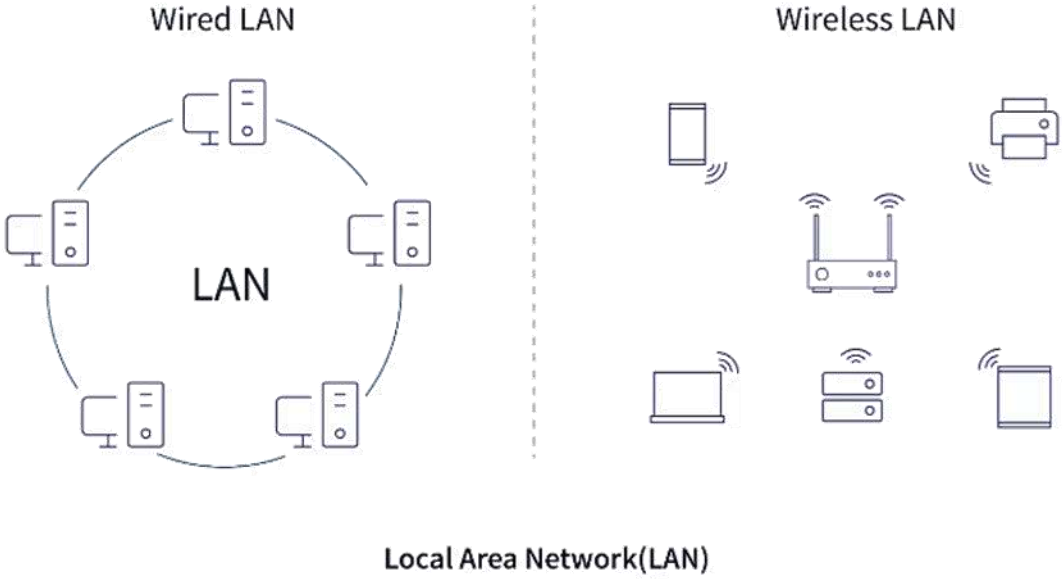


Figure (02): A diagram illustrating the types of local area networks (wired and wireless).

Third: Information Security in Local Networks

Information security refers to the set of procedures and techniques aimed at protecting data from unauthorized access, modification, loss, or damage (ISO/IEC 27001, 2013).

Information security relies on three basic principles known as the **CIA Triad**:

- **Confidentiality:** Ensuring data is accessible only to authorized individuals.
- **Integrity:** Maintaining data accuracy and preventing unauthorized changes.
- **Availability:** Ensuring data is available when needed.

Fourth: Importance of Local Networks in Enhancing University Information Security

Local networks contribute to enhancing information security within the university by:

- Reducing reliance on the external internet, limiting hacking risks.
- Controlling user access permissions.
- Protecting sensitive academic data such as student records and tests (Guessoum, 2020).
- Ensuring system stability during the execution of educational processes.

Studies on digital transformation in higher education confirm that local networks represent a secure and effective option to support the digital management of learning, especially in environments with limited resources (Bouali, 2021; OECD, 2023).

Fifth: Integrating QR Code Technology with the Local Network

Integrating QR Code technology with a closed local network allows for creating a secure digital educational environment, where QR codes are linked to educational services operating within the internal network, such as:

- Recording attendance and absence.
- Accessing educational materials.
- Executing electronic tests.

This integration is considered a low-cost, easy-to-implement technical solution that achieves high levels of efficiency, accuracy, and reliability in university learning management (Al-Khalifa, 2011; Jiang & Lee, 2023).

Table 2: Comparison between Traditional Methods and QR Code Methods

Item	Traditional Methods	QR Code Methods via Local Network	Supporting Studies
Attendance Recording	Paper lists or manual computer entry.	Scanning a QR Code for each lecture; attendance automatically recorded on the local server.	Al-Rubaie (2021) showed that attendance recording accuracy increased to 98% using QR Code compared to 85% with traditional methods.

Downloading Lectures	Email, cloud storage drives, or USB copies.	QR Code links directly to the file on the local server.	Al-Zuhairi (2020) indicated a 60% reduction in time needed to access a lecture when using QR Code.
Applying Tests & Academic Achievement	Printed papers, manual result entry.	Accessing tests via QR Code, results automatically saved on the local server.	Al-Muhanna (2019) showed that using QR Code reduced data entry errors by 75% and increased student and teacher satisfaction.
Data Security & Protection	Prone to loss or tampering.	Data stored on a secure local network with access control capabilities.	Al-Hanafi (2020) confirmed that digital security of files and achievement is much better with local networks and QR Code.
Process Speed	Takes a long time for registration, distribution, and analysis.	Nearly instantaneous; attendance, download, and assessment processes are automatic.	Multiple studies (Wenny & Suhartono, 2025) showed that the time needed to record attendance for a group of 50 students decreased from 15 minutes to less than 2 minutes.

Methodological Framework of the Study

11. Study Limitations

11-1. Subject Limitations: The subject of this study was limited to investigating the effectiveness of using QR Code technology in university learning management via a local network, focusing on three main areas:

- Recording student attendance and absence.
- Providing and downloading educational materials.
- Applying achievement tests and psychological assessments electronically.

Measurement of effectiveness was also limited to the dimensions of efficiency, accuracy, and reliability, excluding other possible dimensions.

11-2. Human Limitations: The study sample consisted of students majoring in Clinical and School Psychology at Hassiba Ben Bouali

University of Chlef, totaling 70 male and female students.

11-3. Spatial Limitations: The study was conducted at Hassiba Ben Bouali University of Chlef. The application of QR Code technology was limited to the university environment, specifically within classrooms and educational facilities connected to the specific local network set up by the professor using a standard router.

11-4. Temporal Limitations: The study was applied and data collected during the academic year in which the study was conducted, the academic year 2024-2025.

12. Pilot Study

The pilot study aimed to:

- Verify the clarity of the questionnaire's items and their linguistic formulation among the sample members.
- Ensure the suitability of the questionnaire's items for measuring the dimensions of the effectiveness of using QR Code technology (efficiency, accuracy, reliability).
- Explore the extent of students' understanding of QR Code technology concepts and usage mechanisms within the university environment.
- Test the applicability of QR Code technology in university learning management via a local network.
- Identify potential technical or procedural difficulties students might face while using QR Code.
- Verify the time needed to answer the questionnaire and its appropriateness for the sample members.
- Calculate the initial indicators of validity and reliability of the questionnaire before applying its final version.
- Ensure the readiness of the technical environment (local network, devices, QR Codes) for the actual application of the study.
- Ensure the integrity of study procedures before commencing the main application.

13. Field Study Procedures

1. The researcher professor created a Local Network inside the classroom using a standard Router without relying on an external internet connection.
2. The router was configured to act as a closed internal network, allowing connection between student devices and the local server.
3. QR Codes were created and linked to educational services operating within the local network.
4. The educational services linked to the QR Codes included:
    - Recording student attendance and absence.
    - Providing and downloading educational materials.
    - Accessing electronic achievement tests and psychological scales.
5. QR Codes were distributed to students inside the classroom, and they were guided on how to use them via their mobile devices.

6. It was ensured that all students could connect to the local network and use QR Codes easily.

7. Attendance recording, material downloading, and test administration were completed electronically during class sessions.

8. Data resulting from using the technology was collected and stored on the local server to ensure information security.

9. At the end of the application period, the questionnaire was distributed to the sample members to measure the effectiveness of using QR Code technology.

10. Questionnaires were collected, data was entered, and analyzed statistically according to the methods adopted in the study.

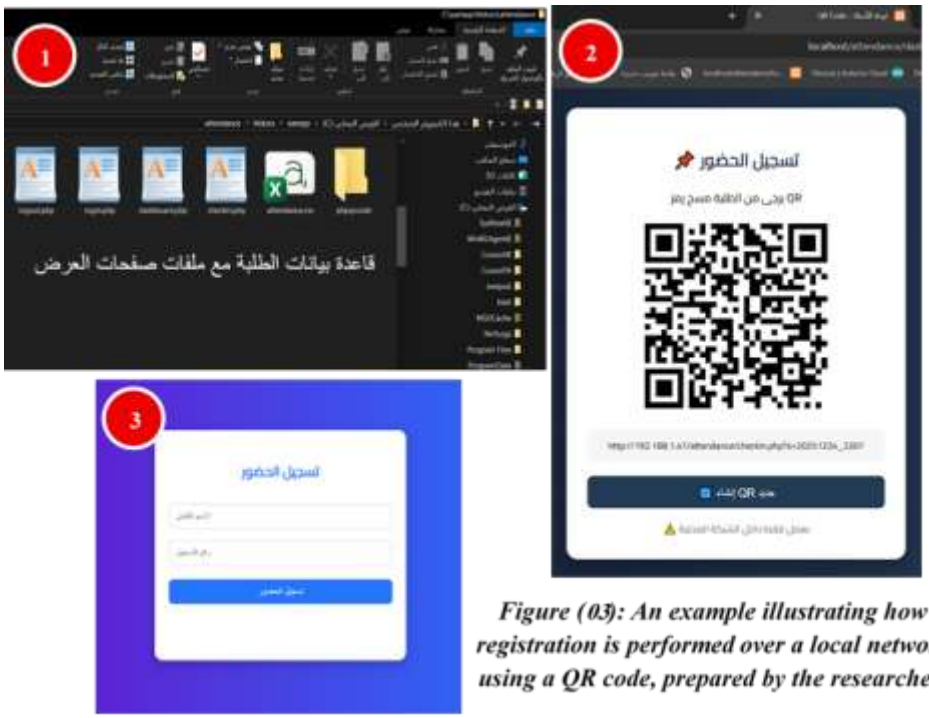


Figure (03): An example illustrating how registration is performed over a local network using a QR code, prepared by the researcher.

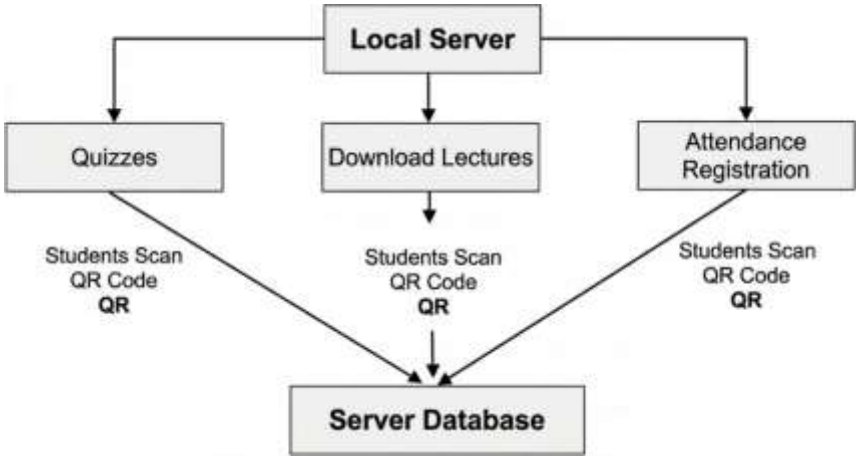


Figure (03): An example illustrating the stages of student registration via a local network using a QR code.

Student Database with Web Page Files

Local Server: Download Lectures | Record Absence | Tests

Students scan QR Code | Students scan QR Code | Students scan QR Code

Server Database

Explanation of the previous section:

- All data (absence recording, lecture downloads, test administration) is directly linked to the local server.
- Students use QR Code for quick access to different functions.
- All data is saved and analyzed on the local server.

14. Study Methodology

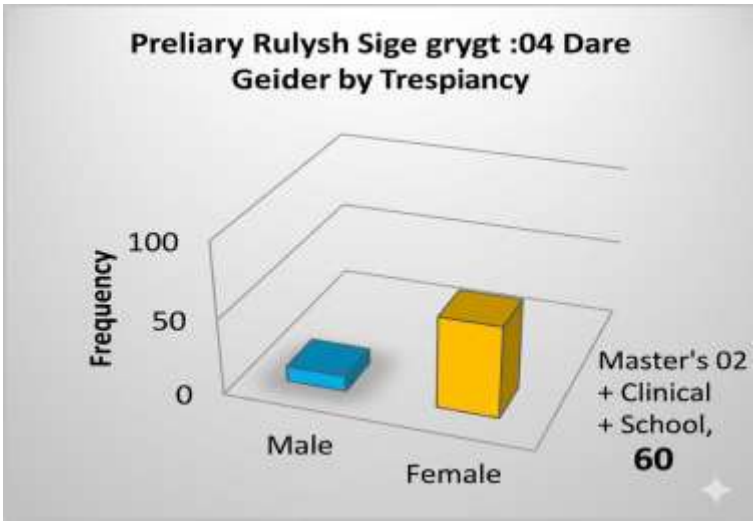
In our current study, we adopted the **descriptive-analytical method**, as it suits the nature of the study aiming to describe and analyze the effectiveness of using QR Code technology in university learning management from the perspective of university students.

15. Study Population and Sample

The study sample was selected **intentionally** and consisted of 70 male and female students specializing in Master 2 Clinical and Educational Psychology. The sample was chosen because it primarily represents students taught by the researcher, and secondly because Psychology is a specialization that relies on achievement tests and psychological scales, which serves the study's objectives.

Table 3: Distribution of the Study Sample by Specialization and Gender

Specialization	Male	Female	Total
Master 2 Clinical	8	48	70
Master 2 School	2	12	70



16. Study Tools

Questionnaire on the Effectiveness of QR Code in Learning Management:

Definition of the Questionnaire and Method of Construction: The study tool (questionnaire) was built based on the theoretical framework of the study, as well as relying on various educational literature and previous studies related to employing digital technologies in higher education, especially studies that addressed the use of QR Code technology in university learning management.

The construction of the tool was based on three concepts: efficiency, accuracy, and reliability, as fundamental dimensions for the effectiveness of digital educational systems. This aligns with the Technology Acceptance Model (Davis, 1989), the theory of technology use in education (Rogers, 2003; Zaytoun, 2012), in addition to the literature on digital transformation in higher education in the Algerian context (Bouali, 2021; Ben Issa, 2022).

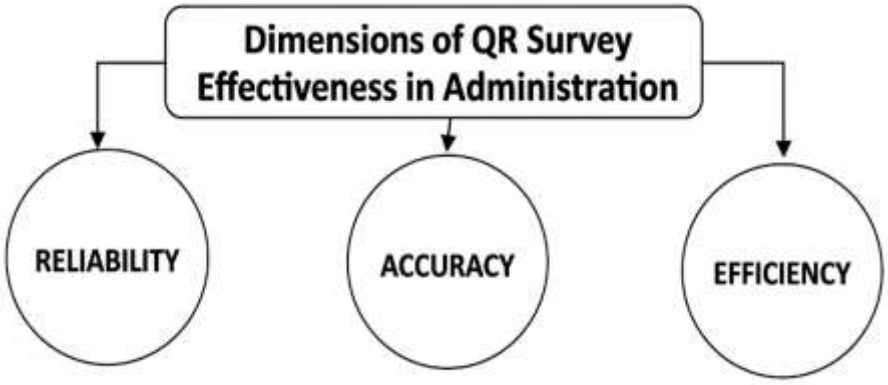
Reference was also made to a set of previous studies dealing with the use of QR Code technology in education and e-learning management (Al-Khalifa, 2011; Law & So, 2010), as well as studies that adopted the dimensions of efficiency, accuracy, and reliability as indicators for measuring the effectiveness of technical performance and the quality of digital educational systems (ISO/IEC 25010, 2011; Guessoum, 2020).

The questionnaire items were formulated in a clear, declarative manner, directed at university students, to measure their perception of the experience of using QR Code technology in university learning management and

pedagogical organization via an internal local network, considering linguistic clarity, avoiding repetition, and neutrality in formulation to ensure response validity and measurement accuracy.

The initial version of the questionnaire consisted of 30 items distributed across three sub-dimensions: efficiency, accuracy, and reliability, with 10 items per dimension. The **Likert** five-point scale was used to estimate the responses of the sample members, with answer alternatives ranging from (Strongly Disagree - Disagree - Neutral - Agree - Strongly Agree), as it suits the nature and objectives of the study.

Figure (05): The axes (dimensions) of the study questionnaire.



Dimensions of the Questionnaire on the Effectiveness of QR Code in Learning Management: Reliability, Efficiency, Accuracy

16-2. Scoring Key

Table 4: Questionnaire Scoring Key

Response	Score
Strongly Disagree	1
Disagree	2
Neutral	3
Agree	4
Strongly Agree	5

16-3. Method of Calculating Scores:

- **Efficiency Score** = Sum / Average of efficiency items (10 items)
- **Accuracy Score** = Sum / Average of accuracy items (10 items)
- **Reliability Score** = Sum / Average of reliability items (10 items)
- **Total Score of the Questionnaire** = Sum / Average of all items (30 items)
- **Maximum score per dimension = 10 × 5 = 50, Minimum score = 10**

The higher the score, the higher the perceived level of effectiveness of using QR Code technology from the students' perspective.

16-4. Psychometric Properties

First: Validity

A) Face Validity (Arbitrators' Validity)

Face validity refers to the extent to which a tool measures what it was designed to measure (Awad et al., 2002, p. 60). To verify the validity of the study tool, the initial version of the questionnaire was presented to a panel of arbitrators specializing in educational psychology, psychometrics, and educational technology. This aimed to ensure the suitability of its items for measuring the effectiveness of using QR Code technology in university learning management. The arbitrators' observations focused on:

- The linguistic soundness of the questionnaire items.
- The suitability of the questionnaire's three dimensions (efficiency, accuracy, reliability) to the study topic.
- The extent to which each item belonged to the dimension it was designed to measure.
- The relevance of the questionnaire items to the study problem and hypotheses.
- The clarity of the questionnaire instructions and ease of understanding for students.
- The difficulty level of the items and their suitability for the target group.

The arbitration results showed a high agreement rate among arbitrators on the validity of the items, with agreement percentages ranging between 90% and 100%. Based on their observations, minor modifications were made, confirming that the tool possesses a high degree of face validity.

B) Discriminant Validity (Extreme Groups Comparison)

To verify the discriminant validity of the questionnaire, it was applied to the pilot study sample. Total scores were arranged in ascending order, and 27% of the highest scores and 27% of the lowest scores were selected. After applying the independent samples t-test, the results showed statistically significant differences between the two groups, indicating the questionnaire's ability to discriminate between students with high and low levels on the dimensions of efficiency, accuracy, and reliability.

C) Internal Consistency Validity

Internal consistency validity was verified by calculating Pearson correlation coefficients between each item's score and the total score of the dimension it belongs to, as well as between the scores of the three dimensions and the total score of the questionnaire. The results showed that most correlation coefficients were statistically significant at the 0.01 and 0.05 levels, indicating that the questionnaire items possess a high degree of internal consistency.

Second: Reliability

A) Test-Retest Reliability

The reliability of the questionnaire was calculated using the Test-Retest method. The tool was re-applied two weeks after the first application, and the Pearson correlation coefficient between the scores of the two applications was calculated. The results showed a high, statistically significant correlation coefficient of 0.87, indicating the stability of the questionnaire over time.

B) Cronbach's Alpha Reliability

The reliability coefficient was also calculated using Cronbach's Alpha method for each dimension of the questionnaire (Efficiency = 0.924, Accuracy = 0.651, Reliability = 0.848) and for the entire questionnaire (0.823). The coefficient values were within statistically acceptable limits, confirming that the tool possesses a satisfactory degree of reliability.

17. Statistical Methods

To achieve the study objectives and test its hypotheses, a set of statistical methods suitable for the nature of the descriptive-analytical method and the study tool were used, employing the **SPSS** statistical software as follows:

- **Arithmetic Means** to determine the level of effectiveness of using QR Code technology.
- **Standard Deviations** to identify the degree of dispersion in the sample members' responses.
- **Relative Weights and Percentages** to interpret the response level on the questionnaire dimensions (efficiency, accuracy, reliability).
- **One-Sample t-test** to analyze the study hypotheses.

18. Analysis and Discussion

The One-Sample t-test was used to compare the arithmetic mean of the sample members' responses with the hypothetical mean of the questionnaire (3) to verify the existence of statistically significant differences in using QR Code technology across the dimensions of efficiency, accuracy, and reliability.

18-1. Data Presentation in Light of Study Hypotheses

First: First Hypothesis

The first hypothesis states that: There are statistically significant differences in using QR Code technology for recording student attendance and absence across the dimensions (efficiency, accuracy, reliability).

Table 5: Significance of Differences in Using QR Code for Attendance and Absence Recording

Dimension	Arithmetic Mean	Standard Deviation	Hypothetical Mean	t-value	Significance Level
Efficiency	4.12	0.68	3.00	7.84	Significant at 0.01
Accuracy	4.05	0.72	3.00	6.93	Significant at 0.01
Reliability	3.98	0.75	3.00	6.11	Significant at 0.01
Total Score	**4.05**	**0.65**	**3.00**	**8.26**	**Significant at 0.01**

It is clear from Table 5 that there are statistically significant differences at the 0.01 level between the arithmetic means and the hypothetical mean, favoring the use of QR Code technology for recording student attendance and absence. These results indicate that students perceive the use of QR Code as having a high degree of efficiency, accuracy, and reliability compared to traditional methods. Accordingly, the first hypothesis is accepted.

Second: Second Hypothesis

The second hypothesis states that: There are statistically significant differences in using QR Code technology for providing and downloading educational materials across the dimensions (efficiency, accuracy, reliability).

Table 6: Significance of Differences in Using QR Code for Providing and Downloading Educational Materials

Dimension	Arithmetic Mean	Standard Deviation	Hypothetical Mean	t-value	Significance Level
Efficiency	4.18	0.61	3.00	8.92	Significant at 0.01
Accuracy	4.09	0.67	3.00	7.45	Significant at 0.01

Reliability	4.02	0.70	3.00	6.88	Significant at 0.01
Total Score	**4.10**	**0.58**	**3.00**	**9.14**	**Significant at 0.01**

The results in Table 6 indicate statistically significant differences at the 0.01 level favoring the use of QR Code technology for providing and downloading educational materials. These results indicate that QR Code contributes to improving the speed of access to content, the accuracy of obtaining it, and the reliability of its use, making this technology more effective than traditional methods in distributing educational materials. Thus, the second hypothesis is accepted.

Third: Third Hypothesis

The third hypothesis states that: There are statistically significant differences in using QR Code technology for applying achievement tests and psychological assessments electronically across the dimensions (efficiency, accuracy, reliability).

Table 7: Significance of Differences in Using QR Code for Applying Tests and Psychological Assessments

Dimension	Arithmetic Mean	Standard Deviation	Hypothetical Mean	t-value	Significance Level
Efficiency	4.25	0.59	3.00	9.67	Significant at 0.01
Accuracy	4.20	0.63	3.00	8.54	Significant at 0.01
Reliability	4.08	0.68	3.00	7.21	Significant at 0.01
Total Score	**4.18**	**0.56**	**3.00**	**10.02**	**Significant at 0.01**

It is clear from Table 7 that there are statistically significant differences at the 0.01 level favoring the use of QR Code technology for applying achievement tests and

psychological scales electronically. These results indicate that students view this assessment method as characterized by efficiency in execution, accuracy in results, and reliability in data storage and analysis, confirming the effectiveness of the technology in the field of electronic assessment. Accordingly, the third hypothesis is accepted.

18-2. Discussion of Data in Light of Study Hypotheses

First: Discussion of the First Hypothesis

The first hypothesis states that there are statistically significant differences in using QR Code technology for recording student attendance and absence across the dimensions of efficiency, accuracy, and reliability.

The results of the current study indicate statistically significant differences in using QR Code technology for recording student attendance and absence, favoring the three dimensions: efficiency, accuracy, and reliability. This result can be interpreted in light of what several previous studies have confirmed regarding the role of simple digital technologies in improving administrative processes within educational institutions.

Guessoum (2020) showed that the quality of educational information systems in the Algerian university is closely linked to the elements of accuracy and reliability, which are essential elements in recording academic data, including attendance and absence data. This result also agrees with the findings of Bouali (2021), which emphasized the necessity of adopting flexible, low-cost technical solutions in the Algerian university environment, which applies to QR Code technology used for quick and accurate attendance recording while reducing human errors.

On the international level, the results of Law & So (2010) supported this hypothesis, showing that using QR Code facilitates access to information and organizes educational processes, which positively reflects on the efficiency of administrative procedures. Al-Khalifa (2011) also showed that QR Code achieves high levels of accuracy in accessing data, enhancing the reliability of electronic registration systems.

Second: Discussion of the Second Hypothesis

The second hypothesis states that there are statistically significant differences in using QR Code technology for providing and downloading educational materials across the dimensions of efficiency, accuracy, and reliability.

The results of the current study showed statistically significant differences in using QR Code technology for providing and downloading educational materials, reflecting the

effectiveness of this technology in improving educational content management within the university environment. This result aligns with Ben Issa (2022), who concluded that simple, easy-to-use technologies enjoy higher acceptance among students and professors compared to complex systems, which makes QR Code an effective tool for distributing educational materials in an organized and fast manner.

These results also agree with Bouali (2021), who affirmed the importance of flexible digital solutions that do not require complex infrastructure or permanent internet connection, a characteristic of QR Code technology when used within a local network. At the international level, Law & So (2010) showed that QR Code facilitates access to digital content and improves the learner's experience, enhancing efficiency and reliability in managing educational resources.

These results also support the theoretical framework based on the Technology Acceptance Model (Davis, 1989), which affirms that perceived ease of use and perceived usefulness lead to the acceptance and effective use of technology. Thus, accepting the second hypothesis reflects the consistency of the current study's results with relevant educational literature and theoretical models.

Third: Discussion of the Third Hypothesis

The third hypothesis states that there are statistically significant differences in using QR Code technology for applying achievement tests and psychological assessments electronically across the dimensions of efficiency, accuracy, and reliability.

The results of the current study showed statistically significant differences in using QR Code technology for applying achievement tests and psychological scales electronically, indicating the effectiveness of this technology in improving assessment processes in terms of speed, accuracy, and reliability. This result clearly agrees with Almomani (2022), who showed the superiority of the experimental group that used electronic barcode tests over the control group in academic achievement, in addition to high positive attitudes among students towards this assessment method.

Lakhdar (2023) also supports these results, showing that e-learning contributes to improving administrative efficiency and the accuracy of electronic assessment in Algerian higher education institutions. Theoretically, the results of this hypothesis are explained by the TAM model (Davis, 1989), which links perceived ease of use and perceived usefulness to the success of electronic assessment systems.

Furthermore, these results intersect with Rogers (2003) in the Diffusion of Innovations theory, where he affirmed that the adoption of

modern educational technologies is linked to their ability to improve performance and their potential for easy integration into the existing context. This applies to the use of QR Code in electronic assessment within the university environment.

18-3. General Result

From the discussion of the three hypotheses, it is clear that the results of the current study are largely consistent with the results of previous Arab and foreign studies and with the theoretical frameworks adopted in interpreting the use of educational technologies. The results also confirmed that QR Code technology represents an effective, low-cost tool for improving **efficiency, accuracy, and reliability** in university learning management, especially when employed within a local network. This distinguishes the current study and contributes to filling a research gap in the Algerian and Arab university context.

19. Conclusion

Finally, it can be said that using QR Code in an educational environment via a local network provides an innovative and effective solution to facilitate educational, administrative, and pedagogical processes. It also increases data accuracy, reduces reliance on traditional methods, contributes to improving the experience of both students and professors, and prepares universities for the transition towards integrated smart education. Therefore, this study sought to investigate the effectiveness of using Quick Response (QR) Code technology in university learning management via a local network among university students, focusing on three main academic areas: recording student attendance and absence, providing and downloading educational materials, and applying achievement tests and psychological scales electronically, in light of the dimensions of efficiency, accuracy, and reliability.

The study results showed that employing QR Code technology effectively contributes to improving the efficiency of academic processes by speeding up procedures and reducing effort, enhances data accuracy and limits human errors associated with traditional methods, in addition to providing a high level of reliability and stability in learning management within the university environment from the students' perspective. The results also showed that this technology is a flexible, low-cost digital solution, easily integrated with existing technical infrastructure via a local network, making it suitable for higher education institutions suffering from limited resources or poor internet connectivity.

The importance of this study also lies in its contribution to supporting the trend towards digital transformation in university education by

presenting an applied model based on a simple and secure technology that can be employed in academic, administrative, and pedagogical aspects alike, thereby enhancing the quality of learning management and improving the experience of students and professors. The study results also open horizons for deeper future research seeking to measure the actual impact of this technology on various aspects of the educational, learning, and pedagogical process, such as academic achievement and assessment quality, and to expand the scope of its application in diverse educational environments.

In light of the above, it can be said that QR Code technology, when thoughtfully employed within a local network, represents a practical and effective option to support university learning management and contributes to achieving a flexible and secure digital transformation that meets the requirements of higher education in the digital age.

20. Study Suggestions

1. Integrate QR Code technology into the existing digital infrastructure of universities, linking it to a closed local network to ensure performance speed, service stability, and protection of academic data.

2. Adopt low-cost technical solutions like QR Code as an alternative or complement to complex digital systems, especially in universities suffering from limited resources or poor internet connectivity.

3. Develop standard models for using QR Code within educational institutions that can be generalized on a national scale.

4. Encourage faculty members to employ QR Code technology in managing their lectures, especially for tracking attendance and distributing educational materials.

5. Train professors on designing effective and secure QR Codes and linking them to organized educational content within the local network.

6. Use QR Code as a means to enhance interaction within the classroom by linking it to short educational activities, quick tests, or enrichment resources.

7. Raise student awareness of the importance of using QR Code ethically and responsibly, and not exploiting the technology for cheating or manipulating attendance or assessment.

8. Involve students in periodically evaluating the experience of using QR Code to improve and develop the system according to their actual needs.

9. Provide simplified guides for students on how to use QR Code within classrooms and local platforms.

10. Conduct quasi-experimental or experimental studies measuring the actual impact of using QR Code on academic achievement compared to traditional methods.

11. Study the effectiveness of using QR Code in different university specializations (scientific, literary, technical) and compare the results.

12. Study the attitudes of professors and administrators towards using QR Code in university learning management.

13. Study the possibility of integrating QR Code with emerging technologies such as artificial intelligence or learning analytics.

14. Study the effectiveness of using QR Code in distance learning or blended learning management.

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