

TO STUDY THE INTEGRATION OF QR CODES IN TEXTBOOKS & THE PERCEPTIONS OF THE INTEGRATION BY IN-SERVICE TEACHERS AT GOVERNMENT SCHOOLS IN ANANTAPUR DISTRICT OF ANDHRA PRADESH

Manohar Srinivas Naik R

Department of Zoology, Yogi Vemana University, Kadapa, Andhra Pradesh, Indi

Email: manohar.srinu@gmail.com

G.L.N Prasad

Department of Zoology, Government College (A), Anantapur, Andhra Pradesh, India.

Dr.B. Sreedevi

Department of Zoology, Government College (A), Anantapur, Andhra Pradesh, India.

Manohar Srinivas Naik R,

<https://orcid.org/0009-0005-8255-078X>

G.L.N Prasad and Dr.B. Sreedevi³are now at Department of Zoology, Government College (A), Anantapur,

Andhra Pradesh,

Correspondence concerning, Manohar Srinivas Naik R, Department of Zoology, Yogi Vemana University, Kadapa, Andhra Pradesh, India.

ABSTRACT

The advent of novel technologies has brought out innovative methods of instruction and acquisition of knowledge. An example of such an innovation is the Quick Response (QR) code. The incorporation of QR codes into cellphones holds significant potential as a valuable tool for schools. In the academic year 2018-2019, the Department of School Education in Andhra Pradesh introduced textbooks containing QR codes to students in classes VI-X for subjects including mathematics, physical science, and biology. This was the first time such textbooks were used in India. Contemporary textbooks now incorporate QR codes, which allow students to scan and access more information on specific subjects, experiments, concepts, and procedures within the scientific method. Students can utilize the codes to gain entry to digital resources, such as text, as well as multimedia content like interactive animations, photographs, and videos. The objective of this research study is to investigate the implementation of QR codes in the textbooks of government schools in the Anantapur district of Andhra Pradesh state, as well as to assess the opinions of the present teaching staff regarding this integration. Data was collected via a survey that employed a Likert scale consisting of five points. A random selection was made of twenty-five educators who are currently employed in public schools in Anantapur district to participate in the data collecting. Based on the primary findings, 64 percent of the teachers currently employed believed that utilizing QR codes was a straightforward and efficient method to improve learning. Furthermore, the majority of individuals expressed a positive attitude towards the QR codes, with eighty percent indicating their intention to utilize the application for work-related endeavors in the future. The research featured informative examples of how QR codes were integrated into the classroom. Textbooks equipped with QR codes enable students to engage in self-directed study at their convenience. The incorporation and improvement of existing instructional techniques, through the utilization of QR codes, introduced a fresh and stimulating aspect to the process of learning in the classroom.

Keywords: QR Code (Quick response), class room activities, energising Text books, integration.

Introduction

Information and Communication Technologies (ICTs) are those groups of tools that make it easier for humans to generate, access, evaluate, and share information. A diverse collection of technical tools and resources used for information generation, dissemination, handling, storing, and communication is also known as information and communication technologies, or ICTs. Although humans have always communicated and accessed information, the digital aspect of today's technology sets them apart. Both the development of new technologies and their integration into existing ones are dynamic processes. utilizing information and communication technology (ICTs). Innovations in schooling are now possible thanks to technological advancements. Among these advancements are the QR (Quick Response) codes. Smartphone integration with QR codes may be a highly useful teaching tool in the classroom (Mehendale et al., 2017).

Students in Andhra Pradesh classes now have access to cutting-edge resources provided by the government. The nation's first state to use a novel method of reading textbooks on smartphones is Andhra Pradesh. The AP government implemented this to improve students' abilities and help them plan their future in secondary education. Approximately 70 lakh books were given to kids all over the state this year. During the 2018-2019 academic year,

the Department of School Education in Andhra Pradesh provided pupils in grades VI to X with stimulating text books that included QR Codes for non-language topics like mathematics, physical sciences, and biological sciences. These upgraded textbooks will present students with various forms of digital content, such as text, graphics, and interactive animations. The standard content contains QR codes that are placed inside it, covering a range of subjects such as scientific experiments, language, and procedures (Srinivasu, Nookarapu., 2019).

First, educators and students should download the "Diksha app." They should thereafter use the QR codes on their textbooks to scan for YouTube directly. Students can readily obtain their textbook courses on YouTube. There are texts created by subject matter specialists that use simple analysis methods. With the help of seasoned teachers, about 2,000 people have signed up for the program (Srinivasu, Nookarapu., 2019).

QR Code-History

In comparison to their one-dimensional counterparts, QR codes can hold more data due to their two-dimensional nature and the fact that they may be read in both the vertical and horizontal planes. One such industrial standard that QR codes fall under is ISO/IEC 18004. Denso Wave, a Japanese corporation, was the first to come up with and patent them in 1994. This method allows for more data storage capacity than one-dimensional barcodes, which means a more sophisticated reader is required. The 1994 development and legal protection of Denso Wave's design and patent confirmed the importance of QR codes in barcode technology. According to QRcode.com, the origins of QR Code can be found in DENSO WAVE.











QR CODE STRUCTURE:

Among the many possible classifications for the QR Code symbol are: One way to find a QR code is to utilize the Finder Pattern (1). In order to determine the location, size, and angle of the QR Code, three position detecting patterns (Finder Patterns) are organized in the symbol's top left, top right, and lower left corners. The patterns can be easily identified in any orientation. Two separators: The white, one-pixel-wide separators improve the Finder patches' detection by separating them from the real data. Pattern 3 of Timing: The timing patterns are organized in both horizontal and vertical directions. Really, they're not much bigger than a single QR Code module. The actual purpose of this pattern, which changes between white and black patterns, is to determine the center coordinate of every cell. The alignment pattern consists of three modules: a central dark module, a light module, and five dark 5x5 modules. To fix the distorted symbol, this pattern is actually used. Finding the center coordinate of the alignment pattern will allow you to correct the symbol's distortion (Ji and Ji (2014). Format Details (5): This 15-bit area adjacent to the separators will hold the data regarding the selected masking pattern and the QR code's error correction level. The Data Pattern is the most important part of the QR Code symbol, which is represented by data (6). Codewords, which are 8-bit segments, are used to hold data once it has been converted to a bit stream. Similar to the data section, the error correction section uses 8-bit codewords to hold error correction codes (7). The Eighth Remainder Bit: The Remainder Bits section contains empty bits when the data and error correction bits cannot be divided into 8-bit codewords without remainder (Banegaon et al., 2022 and DURAK et al., 2016).

Features of a QR Code:

Rapid reading: A QR code's finder pattern enables rapid scanning in any direction (3600). Encoding data with high capacity: QR codes can read control codes, numbers, alphabetic characters, kanji, and kana, among other types of data. It has 4,296 alphabetic letters, 7,089 numeric characters, and 1,817 kanji characters for storing information. Because they can communicate data in both the vertical and horizontal planes, QR codes are compact and need little space when stored. Because of their Japanese heritage, QR codes are able to encode Japanese characters well. Resistant to Dirt and Damage: Thanks to its error correcting capabilities, data can be easily recovered even if a QR code symbol is partially dirty or broken. Reference: Ali et al. (2017). By utilizing the structured add function, it is possible to divide a QR code into many data portions. However, it is possible to merge the data stored in several QR code symbols into a single data symbol. Correction for Distortion: A QR code sign can still be read when displayed on a distorted or curved surface. Al-Khalifa (2011) states that... Based on the work of Sharma (2013).

Types of QR Codes:

 QR Code Model 1 and Model 2	 Micro QR Code	 iQR Code	 SQRC	 Frame QR
				
<p>[Feature] Model 1 is the original QR Code. The largest version of this code is 14 (73 x 73 modules), which is capable of storing up to 1,167 numerals. Model 2 is an improvement on Model 1 with the largest version being 40 (177 x 177 modules), which is capable of storing up to 7,089 numerals. Today, the term QR Code usually refers to this type.</p>	<p>[Feature] Only one orientation detecting pattern is required for this code, making it possible to print it in a smaller space than before. This code can be viable even if the width of its margin is 2 module-worth (QR Code requires a margin of 4 module-worth at least around it). The largest version of this code is M4 (17 x 17 modules), which can store up to 35 numerals.</p>	<p>[Feature] Code that can be generated with either square modules or rectangular ones. Can be printed as a turned-over code, black-and-white inversion code or dot pattern code (direct part marking). The maximum version can theoretically be 61 (422 x 422 modules), which can store about 40,000 numerals</p>	<p>[Feature] QR Code that has a reading restricting function. Can be used to store private information or manage a company's internal information) Its appearance is no different from the regular QR Code. > denso-wave.com</p>	<p>[Feature] FrameQR is a QR code with a "canvas area" that can be flexibly used. Since letters and images can be inserted inside the canvas area, FrameQR can be used for promotion, authenticity judgment, and other various uses. > denso-wave.com</p>

Because of their versatility, QR codes have taken on many different formats to meet a range of purposes and applications. The following lists different categories of QR codes:

DENSO, the pioneering company behind the development of the QR code, revolutionized data encoding with its innovative technology. Its subsidiary, DENSO WAVE, has further specialized in advancing QR code technology and its diverse applications. From the creation of the original QR code to the development of specialized types like iQR codes, SQRCs, and Frame QR codes, DENSO and DENSO WAVE have consistently expanded the utility and versatility of QR codes. These advancements highlight the adaptability of QR code technology across various contexts, from secure data management and high-capacity information storage to creative promotional uses. Through continuous innovation, DENSO and DENSO WAVE have cemented their roles as leaders in the field, demonstrating the wide-ranging utility of QR codes in meeting the evolving needs of different industries.

The original QR code model, known as QR Code Model 1, was developed in 1994 and has been largely replaced by QR Code Model 2 due to its limited capacity and usage. Model 1 is capable of storing up to 1,167 numeric characters, making it less practical for modern use cases that require more storage space. On the other hand, QR Code Model 2 was introduced in 2000 and offers a significantly higher storage capacity of up to 7,089 numeric characters. This increased capacity has made Model 2 the most commonly used QR code today for various applications such as commercial advertising, business cards, and product labels (“use of QR codes in education”)

Micro QR Code

Micro QR codes are the smallest version of QR codes, offering over traditional QR codes. With only one orientation detecting pattern, Micro QR codes are simpler and easier to create than their larger counterparts. Additionally, they require a smaller margin of 2 modules compared to regular QR codes that need a minimum margin of 4 modules. This makes them perfect for situations where space is limited, such as on small products or packaging. Despite their diminutive size, Micro QR codes can store up to 35 numeric characters, providing ample room for storing information like product numbers or inventory IDs. Whether you're looking to save space or add a touch of elegance to your designs, Micro QR codes are an excellent choice for any application that requires a compact and discrete code (“use of QR codes in education”)

iQR Code

The iQR code stands out for its impressive flexibility and capacity, making it a versatile solution for modern data encoding needs. It can be generated with either square or rectangular modules, accommodating various design requirements and spatial constraints. Additionally, iQR codes support multiple print formats, including turned-over codes, black-and-white inversion, and dot patterns, allowing for innovative applications like direct part

marking. The maximum theoretical version of an iQR code is 61, with dimensions of 422 x 422 modules, capable of storing up to approximately 40,000 numeric characters. This high data capacity, combined with its adaptable design features, makes the iQR code particularly suitable for industries requiring large amounts of information in a compact, customizable format ("use of QR codes in education")

SQRC

SQRC codes are a specialized type of QR code designed with a reading-restricting function, offering an additional layer of security. Despite their advanced capabilities, they maintain an appearance similar to regular QR codes, ensuring they can be seamlessly integrated into existing systems and applications. This feature makes SQRCs particularly useful for storing private information or managing internal company data, where confidentiality is paramount. By restricting who can access the encoded data, SQRC codes provide businesses and organizations with a secure method for handling sensitive information, enhancing both privacy and data protection ("use of QR codes in education").

Frame QR codes introduce a unique feature known as the "canvas area," which allows for flexible use beyond traditional data encoding. This innovative design enables the insertion of letters, images, and other visual elements within the QR code itself, making it a powerful tool for promotional activities and brand messaging. The canvas area can be creatively utilized for authenticity judgments, providing a visual verification method alongside the encoded data. This dual functionality makes Frame QR codes highly versatile, suitable for various applications where both information encoding and visual communication are important. By integrating promotional content and authenticity features within the same QR code, businesses can enhance their marketing efforts and ensure the integrity of their products or services ("use of QR codes in education")

Literature review

There has been a lot of study on the topic of technology integration in the classroom, with QR codes being the main focus. Two-dimensional barcodes called quick response (QR) codes can improve education by connecting pupils to digital resources including movies, websites, and apps in an instant. Sondhi and Kumar (2022) reviewed the literature that dealt with questions like how textbooks used QR codes and how instructors felt about technology in the classroom.

Considering QR codes in the context of education requires a facilitatory perspective on QR technologies. It is more important to focus on the students and the instruction rather than QR codes, since mobile technologies cannot guarantee better learning on their own.

To fully harness the potential of mobile learning, it is essential to establish educationally significant learning environments and possibilities. The focus should not be on integrating mobile devices into education but on promoting a more learner-centered approach (Zhang et al., 2010).

Utilizing QR codes can be advantageous in a wide variety of educational contexts, including trail activities, outdoor or field activities, paper-based tasks, learner-generated content, and working teaching. Working instruction, student-created content, assignments based on paper, field trips, and trail exercises are the five main categories into which these methods fall (Rikala & Kankaanranta)

Through trail activities, students investigate their local communities and use what they find to complete tasks. These activities can be designed as study aids for individuals, group projects, or competitions. Students completed math puzzles, explored their neighbourhoods, and scanned codes at each location along a math trail that Law and So (2010) created. The students were interested in new approaches that were different from what they normally did, and this activity sparked their curiosity (Law & So, 2010).

Using QR codes in field or outdoor activities allows students to explore life science subjects like wild flora and animals. Along with identifying clues, these codes might provide further information on the habitats of different species. By incorporating cellphones and QR codes into biology field excursions, Lee et al. (2011) made it possible for students to explore and identify species at the research location. They shared the results of their study with their colleagues through various presentations, seminars, and social media platforms. Because the codes contain relevant information, students learn more effectively, and instructors may create individualized field study guides for each student. Another interesting idea is to combine digital learning resources with field trips by using QR code activities (Lee et al., 2011).

Students can use QR codes to access multimedia resources, such as audio files or video clips, and guide themselves through the self-assessment process while working on paper-based tasks. For instance, by scanning the QR code

on a worksheet, students can access a website with the answers, allowing them to track their progress in learning. Law and So (2010) demonstrated the usefulness and flexibility of QR codes in a listening exercise, highlighting their ability to provide accessible materials and aid students in self-evaluation. According to Law and So (2010), students favoured using QR codes and mobile devices for individual activities due to their convenience and speed.

Students can include learner-generated information into online reports and resources by using QR codes. Some of their other possible projects include creating interactive reading experiences, developing children's books, and recording their readings. This approach fosters student-centered learning by encouraging the development of interactive experiences and the dissemination of student-created material (Sharma, 2013).

Teachers engage in working teaching when they provide students specific directions and explanations on how to do homework. To achieve this goal, teachers can attach QR codes to art and engineering materials; students will be able to study on their own and the codes will show them how to utilize the tools (Sharma, 2013).

There is evidence from studies on QR codes' usage in the classroom that they can improve students' interest and performance in class (Callaghan, 2021). According to research, using QR codes in the classroom can increase student engagement by giving them access to multimedia and interactive content. This, in turn, can help them remember important ideas and learn at their own pace (Bhat & Alyahya, 2024). In addition, students can easily access supplemental materials and resources through the use of QR codes, which promote accessibility (Bhat & Alyahya, 2024).

There are a number of obstacles that must be overcome before QR codes may be effectively used in the classroom. Individually, educators may be wary of embracing new technology if they do not feel prepared, secure, or convinced of the advantages (National Center for Education Statistics, 2011). Similarly, institutional factors such as a focus on time-honored evaluation and teaching practices and a lack of available technological resources can impede the use of QR codes in the classroom (Alsalam, 1989).

Significance of the study

Learning how to think critically, interact effectively with others, and develop one's inner resources are all components of a well-rounded education in the modern world. The foundation of these abilities is in the hard sciences, mathematics, geography, and history; they are bolstered by expertise in the fields of media and technology, professional development, education, and new product development. Teachers have a responsibility to instill these skills in their students. Due to the novelty of the technology, there is a dearth of studies examining how students and their parents feel about the use of QR codes in the classroom. The current study aims to contribute to the existing body of knowledge by exploring the use of QR code integrated textbooks in group projects and instruction, as no prior research has examined teachers' viewpoints on this topic. The research hopes to fill a gap in our understanding of the role of 21st-century abilities in the classroom (Uçak & Usta, 2022).

Objective of the study

To investigate how in-service teachers in government schools in the Anantapur District of the state of Andhra Pradesh perceive the integration of QR codes in textbooks.

Methodology

Research design

One of the quantitative tools utilized in the investigation was the survey design. The steps involved in doing survey research include articulating the research topic, developing the survey, selecting a sample, collecting data, analyzing it, and finally, publishing the results while citing the appropriate literature. (Creswell, 2007.)

Study group

The study sample consisted of 25 in-service teachers employed in government high schools in the Anantapur district, selected using the cluster random selection approach.

Data Collection

The research on QR codes was used as a basis to build an anonymous Likert scale questionnaire with 12 items ranging from strongly agree/1 to strongly disagree/5. The questionnaire was based on previous studies by Gogova & Koceska (2014), Lee et al. (2011), and Shin et al. (2012). Although the majority of the Likert scale statements were collected from Rikala and Kankaanranta's (2012) study, a small number were sourced from Gogova and Koceska (2014), Shin et al. (2012), Rivers (2009), and Lee et al. (2002). In order to collect participant responses, we created a Google form and included these questions (Rikala et al., 2014).

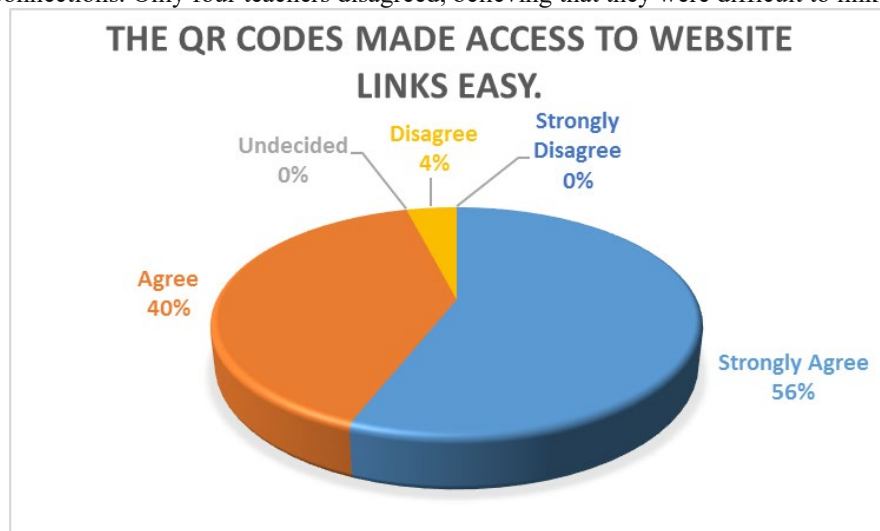
Results

The table displays information from an online survey of twenty-five respondents (n=25) on their experiences scanning QR codes to open links to websites and finish tasks. The scale is 1 to 5, where 1 is probably strong agreement and 5 is significant disagreement, or vice versa (the survey instrument would usually establish the precise scale interpretation). For every statement, the standard deviation (S.D.) and mean are shown in the table.

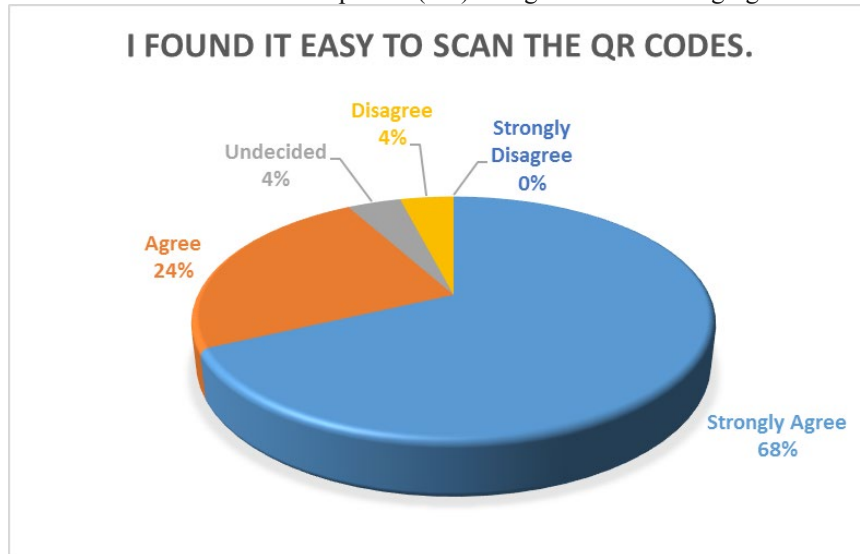
Table 01: mean scores and standard deviations of the QR code inventory questioner

S.NO	STATEMENT SCALE (1-5)	MEAN (n=25)	STADARD DEVIATION (S.D)
1	Access to website URLs was made simple by the QR Codes.	1.52	0.71
2	I had no trouble scanning the QR Codes.	1.44	0.76
3	I had no trouble picking up the skill of utilizing my mobile device to scan QR codes.	1.48	1.00
4	The QR code scanning speed was fast enough.	2.04	0.93
5	The usage of QR Codes was easy and convenient.	1.56	0.86
6	To do the exercises, I found it helpful to use the QR Codes outside of the classroom.	1.8	1.04
7	I finished the activities with the assistance of the information found in the QR Codes.	2.12	1.16
8	Using QR codes, one might obtain a wealth of helpful data.	2.08	1.15
9	I'd want to engage in QR activities once more.	1.72	0.97
10	plan to make use of QR Codes in the future.	1.44	1.04
11	In order to enhance in-class activities, I will push other educators to adopt QR Codes.	1.48	1.00
12	The QR Codes exercises should be incorporated into the curriculum that I teach.	1.48	0.82

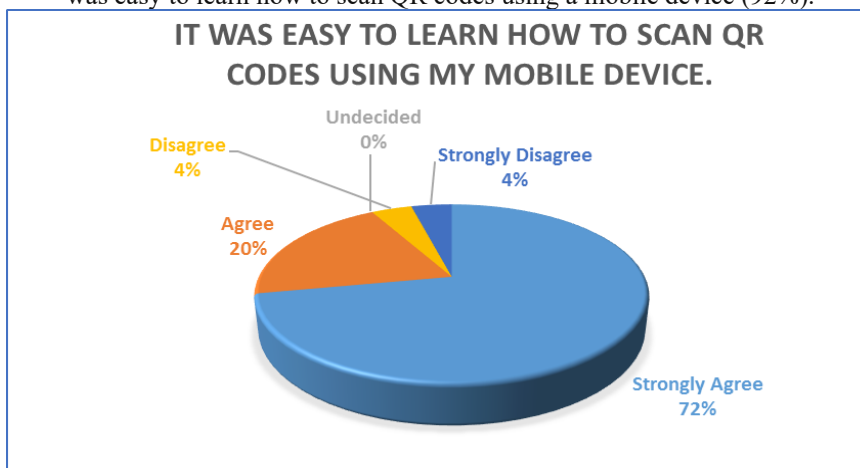
1. Of the twenty-four teachers surveyed, ninety-six claimed that QR codes made it easy to access website connections. Only four teachers disagreed, believing that they were difficult to link to.



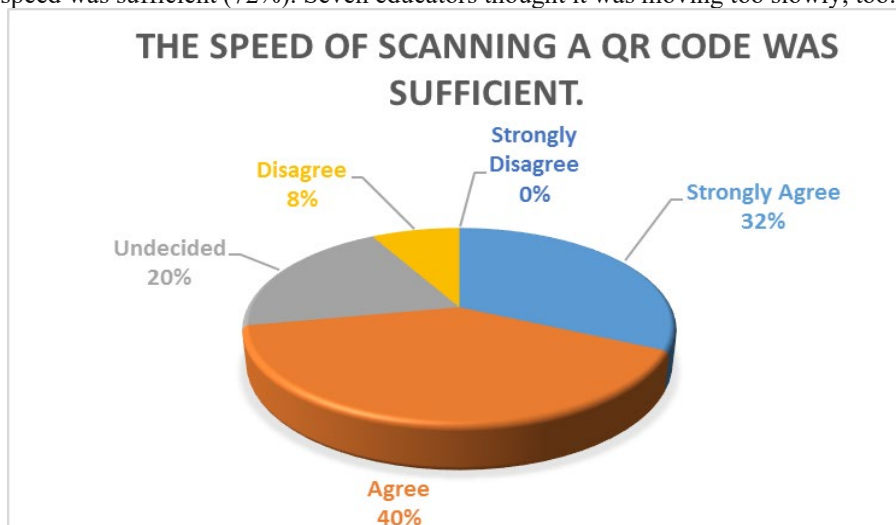
2. A total of twenty-three educators reported that using the reading program and scanning pages was simple. Nevertheless, despite the fact that scanning the code was simple, it occasionally required many scans in order to retrieve the desired information. Another person (4%) thought it was challenging to scan the QR code.



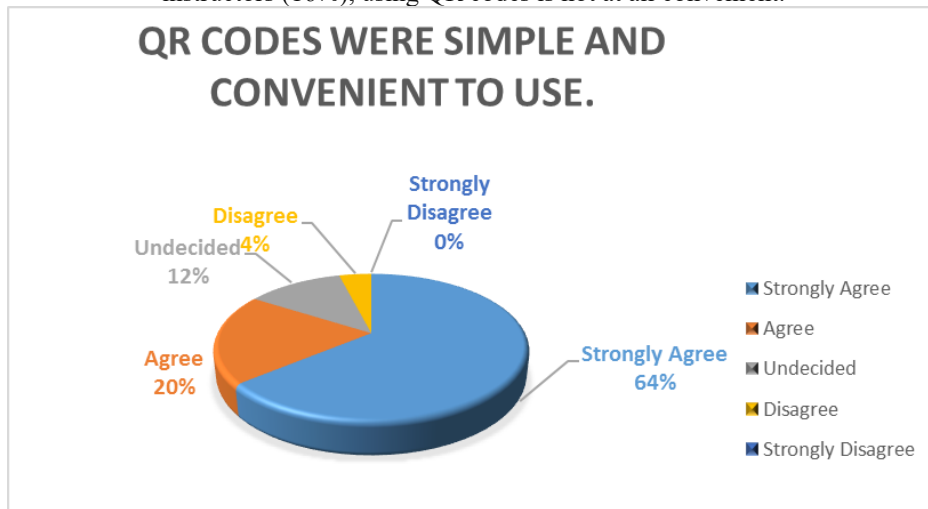
3. Two instructors thought it was very difficult to learn (8%), but twenty-three teachers said it was easy to learn how to scan QR codes using a mobile device (92%).



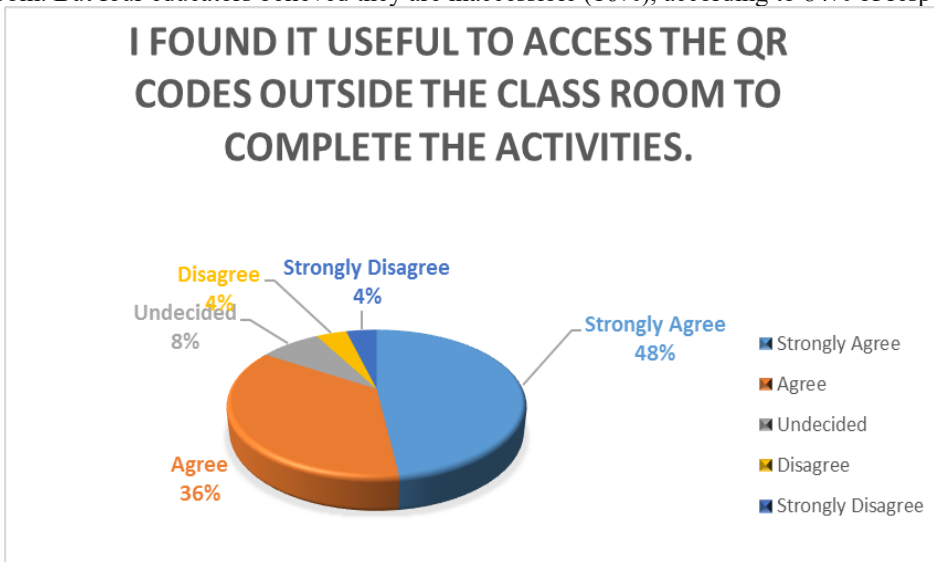
4. The majority of the schools are located in rural regions, thus 18 instructors concluded that a QR code's scanning speed was sufficient (72%). Seven educators thought it was moving too slowly, too. 28 percent.



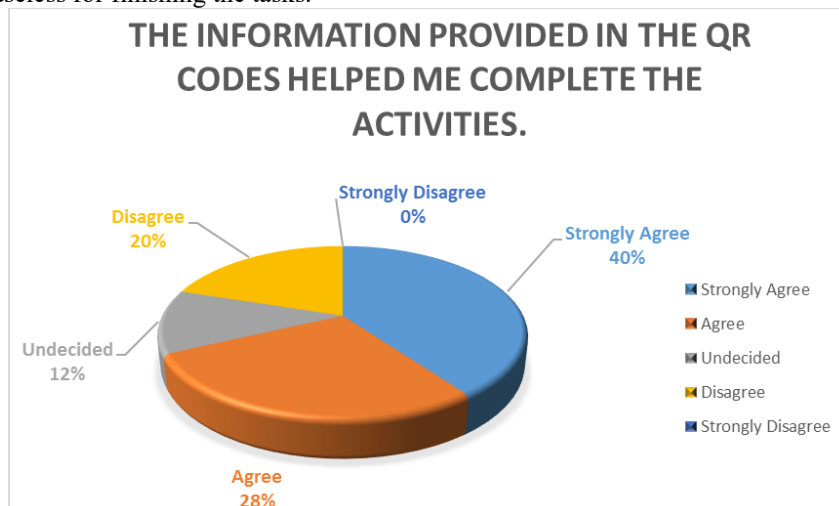
5. Twenty-one educators thought using QR codes was easy and convenient (84%). But according to four instructors (16%), using QR codes is not at all convenient.



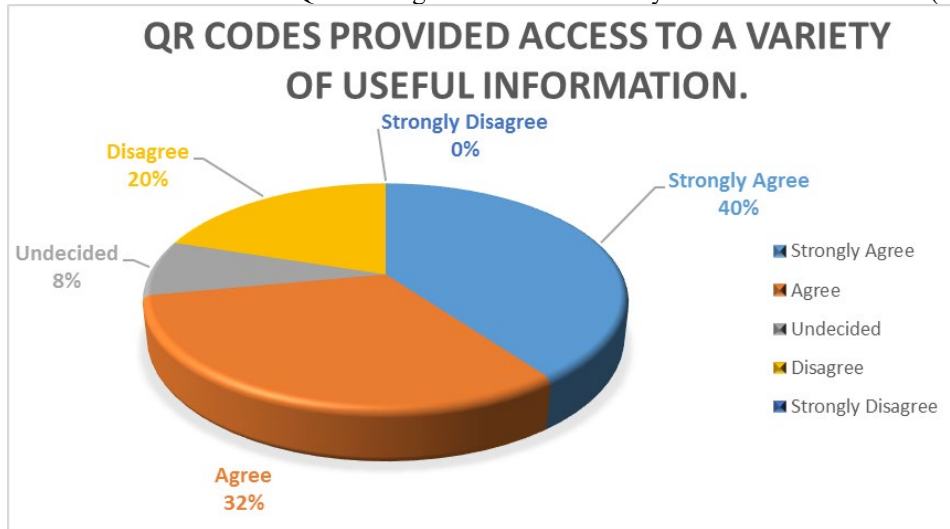
6. In order to finish the exercises, twenty-one teachers believed that QR codes might be accessed outside of the classroom. But four educators believed they are inaccessible (16%), according to 84% of respondents.



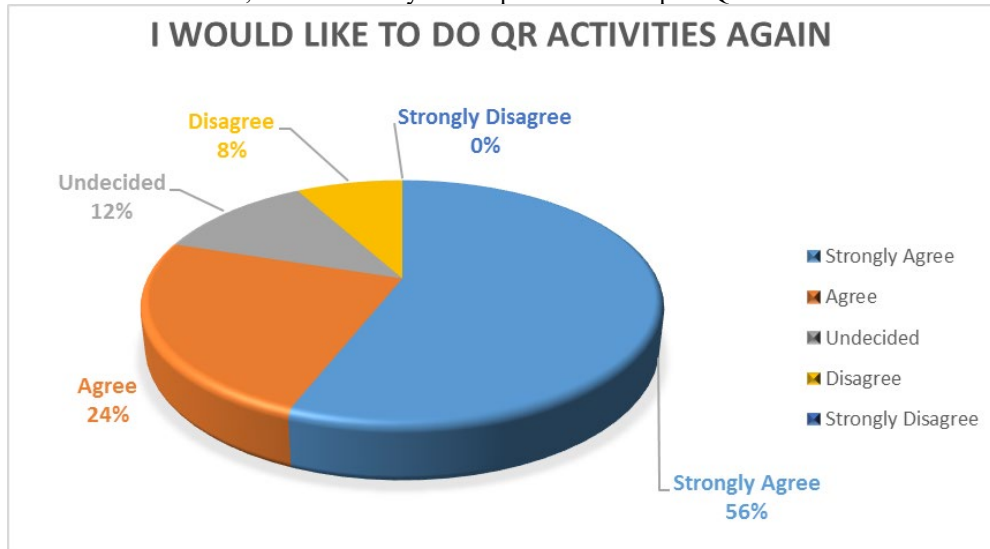
7. Twenty teachers discovered that eighty percent of them were able to finish the exercises with the aid of the information included in the QR Codes. However, 20% of the teachers said that the information contained in the QR Codes was useless for finishing the tasks.



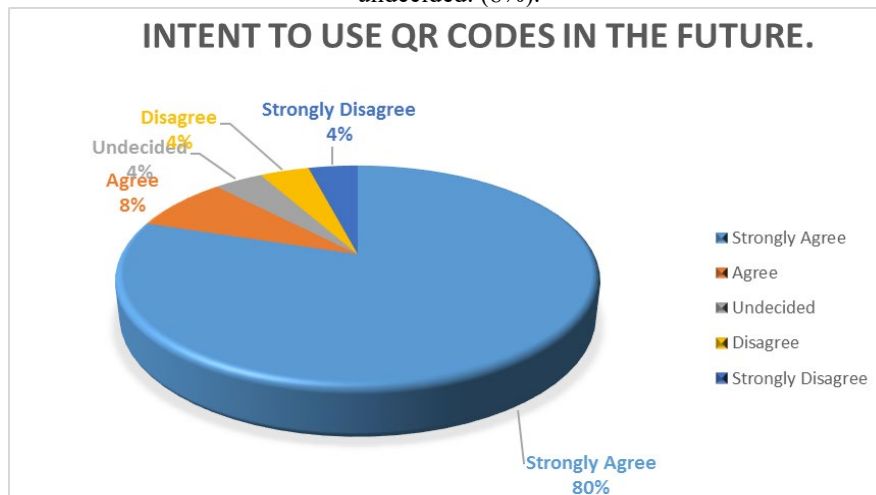
8. Seven instructors discovered that QR Codes did not offer access to a range of information (20%), whereas eighteen teachers claimed that QR Codes gave access to a variety of valuable information (80%).



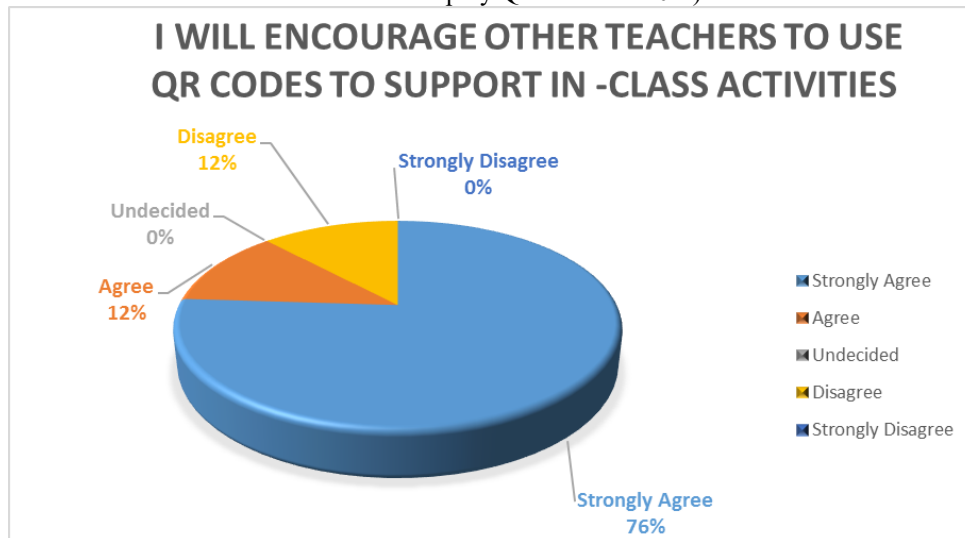
9. It was discovered by twenty teachers that they like doing QR activities again. 80% of instructors, however, stated that they would prefer not to repeat QR exercises.



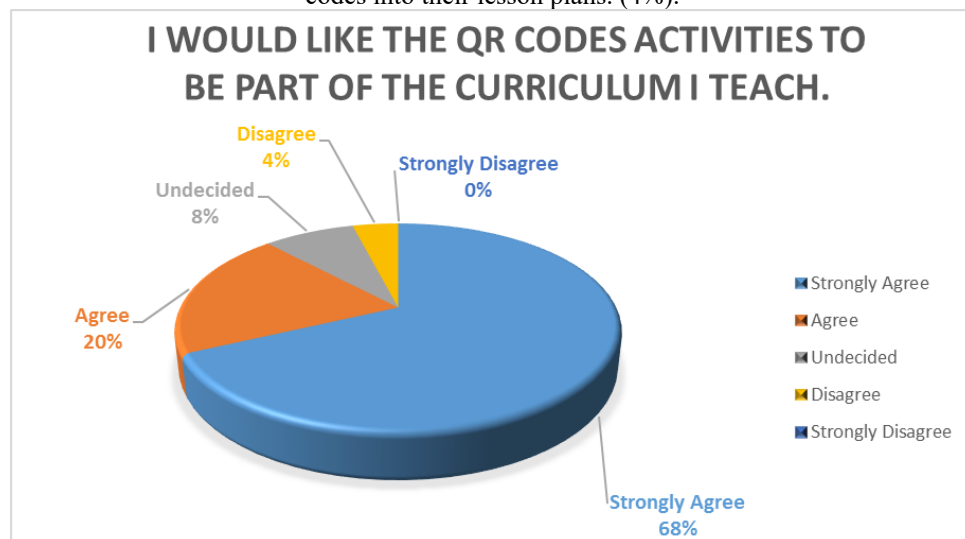
10. In the future, twenty-two educators said they planned to employ QR Codes. (88%). Two instructors discovered that they are not interested in using QR Codes in the future, and one teacher (4%), found to be undecided. (8%).



11. In order to enhance in-class activities, twenty-two educators said they would urge other educators to employ QR Codes. (88%). To promote in-class activities, three teachers, however, are unwilling to advise other educators to employ QR Codes. 12.0%).



12. Activities involving QR codes were discovered to be a component of the curriculum by twenty-two instructors. (88%). Additionally, two teachers (8%) are unsure. Nevertheless, one educator declined to use QR codes into their lesson plans. (4%).



Discussion

The purpose of the research was to learn how people felt about using QR codes in the classroom. The findings demonstrated that QR codes simplified the process of accessing website links, scanning them, and learning to scan them using mobile devices. Although there was a little greater variation in answers, the speed of scanning QR codes was adequate. Quick response (QR) codes were easy to use and provided a quick way to access resources outside of class to finish assignments. While the data contained in QR codes did aid in the completion of tasks, the answers varied considerably. (The UGD Academic Repository's The Use of QR Codes in Education, n.d.).

The participants were enthusiastic about the usage of QR codes, said they would use them again, and even encouraged other educators to do the same. They also wanted to use QR codes in their lessons, albeit their answers were all over the map. While replies varied, the survey did find that respondents generally wanted QR code exercises included in the curriculum. In sum, the results show that QR codes can help teachers improve their lessons and give students access to useful information. Nevertheless, the study also note that the outcomes might differ based on the particular setting and the extent to which participants agree. (Updated by Gradel and Edson, 2011).

Conclusion

Thanks to their capacity to retain and link comprehensive information to digital resources like webpages, movies, and multimedia content, QR codes—originally created for inventory tracking—have become a promising instructional tool. Educators can take use of these codes to enhance student engagement and accommodate a variety of learning styles by supplementing static learning materials with dynamic and interactive resources. Several advantages can be gained from textbooks that incorporate QR codes. These include creating more interactive learning environments, giving students faster access to supplemental materials, and offering resources that are specifically designed to meet the needs and skills of different students. In order to foster analytical thinking, problem-solving, and teamwork abilities, educators can use QR codes into their lesson plans to provide students with access to interactive simulations, multimedia presentations, quizzes, and more.

Problems with device compatibility, internet access, and QR code legibility arise while using QR codes in the classroom. To keep the gaps in digital literacy and access to resources from widening, it is essential that all students have equal access to digital resources. Teachers need enough chances for professional development and training to ensure they have the pedagogical competence and instructional design abilities necessary for QR integrated textbooks to be effective.

In sum, using quick response (QR) codes in textbooks is a great way to up the ante on classroom instruction. Maximizing the educational benefits of QR codes in varied educational environments would require addressing technological problems and offering full assistance for educators.

Limitations of the study

Technical constraints, insufficient teacher training and expertise, a lack of student participation and interaction, and insufficient funding are just a few of the factors that affect the study's ability to draw firm conclusions on how instructors are using QR integrated textbooks. Only 25 currently hired teachers from public schools in the Anantapur District of Andhra Pradesh would be included for the sample. Technological constraints, such as the accessibility of devices and the internet, may have affected the perspectives and experiences of the participants.

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