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To Study the Use of QR Code in the Classroom to Enhance Motivation, Communication, Collaboration and Critical Thinking

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ABSTRACT: Technology and trends rapidly increase day by day and has affected the education area. In the digital era, ICT has become an integral part of every economic and social activity. Mobile learning (m-learning) is education via the Internet or network using personal mobile devices, such as tablets and Smart phones to obtain learning material through mobile apps, social interactions and online educational hubs. It is flexible, allowing students to access information anywhere, anytime.

M-learning can be made more effective and powerful by the use of QR code (Quick Response). QR code is a type of two dimensional barcodes used to provide easy access to information through Smartphone. The QR Code system has become admired due to its features such as easy to generate, quick readability, and an abundant information load. Because of these features, QR code exhibits potential for integration in education.

The research paper studies the use of QR code in education. QR code can be integrated with Smartphone which can be very effective teaching aid in the classroom. QR code can be linked with learning material which may be in the form of Plain text, website URL, YouTube Video, PDF file and Image file. QR code for this learning material can be generated by making use of QR code generators which are freely available. This encoded information can be decoded by scanning the QR code with the mobile device having camera and QR reader and scanner software. The study shows that QR code integration in learning will enhance motivation, communication, collaboration and critical thinking in the classroom.

KEYWORDS: M-learning, QR code (Quick Response), education, student, smart phone, motivation, collaboration, critical thinking, classroom

I. INTRODUCTION

The QR code system was invented in the year 1994 by Denso Wave. QR code was initially designed for automotive industry in Japan. The main purpose was to track the vehicles at the time of manufacturing. Even though initially it was used for tracking parts in manufacturing of vehicles, these codes are now used in larger context. Users can generate their own QR code, take a print which can be further accessed by the smart phones. The decoded image will then fetch the information or link associated with it, then that accessed link will automatically be connected to the web and fetch the related information. Mobile technologies equipped with Quick Response (QR) codes, have great potential to improve teaching and learning because mobile technologies enable learning across multiple contexts,

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through social and content interactions. Learners can learn anytime and anywhere and learning can be personalized, situated and authentic.

A QR code is the abbreviation for quick response code. A QR code is a type of two dimensional code which provides easy access to information through a smart phone. QR code stores information in two directions: horizontally and vertically. It can be read easily and is capable of holding a great deal of information. A QR code consists of black squares arranged in a square grid on a white background, which can be read by an imaging device such as a camera, and processed using Reed–Solomon error correction until the image can be appropriately interpreted.

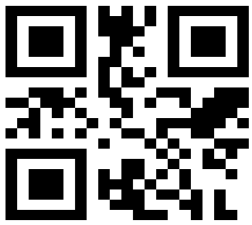

Fig-1 : Image of QR Code

Users can scan in codes using a mobile phone with a camera or QR reader and QR Code reader software. The decoding software then interprets the code. QR software can be downloaded from the Web: a list of applications suitable for a variety of handsets is available.

II. RELATED WORK

The research done by Bharat Kumar, Neha Sharma, Nidhi Yadav focuses on the various educational applications of QR code. QR code being easy to generate and as they contain abundant information. The author discusses how QR code can be generated for specific books and can also be linked to reviews or additional resources. QR codes can also be used for conducting exam.

The work proposed by Ahmed Amin Mousa, M. Abd El-Salam focuses on use of QR code for digitizing kindergarten curriculums and accessing various learning resources. The researchers have established a guide for kindergarten teachers based on the Egyptian official curriculum. The guide provides different learning resources for each scientific and mathematical concept in the curriculum, and each learning resource is represented as a QR code image that contains its URL. Therefore, kindergarten teachers can use smart phone applications for reading QR codes and displaying the related learning resources for students immediately. The guide has been provided to a group of 108 teachers for using inside their classrooms. The results showed that the teachers approved the guide, and gave a good response.

The research proposed by Vandita Sharma pays attention to use of QR codes for not only making the learning material more interactive in the classroom but also captivate the attention of students enabling them to learn effectively. Various aims and goals can be accomplished through it. As QR codes can hold any kind of information up to several thousand bytes. It opens up a new horizon for many applications in the educational world. The study found that QR codes can support smart learning in different contexts. It is also found that QR code supports both collaborative and independent learning.

The research done by Jenni Rikala and Marja Kankaanranta was especially to explore how mobile devices and QR codes can enhance and blend teaching and learning. The data were collected with a teacher interview and pupil surveys. The learning outcomes were measured with the test results after the experiment and with the pupil's self-evaluation. From a learner's point of view, the QR activity was motivating and brought much-wanted variation to the

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traditional learning method. The study shows that QR code leads to good learning outcomes by providing motivating and meaningful activities for pupils.

The work proposed by Ishan Sudeera Abeywardena focuses on bridging the gap between printed course materials and multimedia, such as YouTube videos. In this light, the use of mobile technologies and QR codes or 2D barcodes have gained the attention of practitioners as a means of building in interactivity and multimedia into a static printed course material. Print2Screen is an Android mobile application which harnesses the power of QR codes to enrich the learning experience of users who are still dependent on printed course materials for various socio, economic and technological barriers. The app allows learners to view multimedia embedded in a printed course material using a smart phone or mobile device. It also has the ability to keep a library of resources viewed, add notes to a particular resource for future reference and share a resource on social media for social learning.

Pedro Román Graván and Ángela Martín Gutiérrez in their study of "Facebook, as a learning environment" for studying and sharing Quick Response (QR) codes, is a tool that the student defines as close, reliable, easy to use, and has many advantages over other settings, as it becomes a place where people from different locations meet and share common educational experiences. Furthermore, this study emphasizes that using Facebook allows students to acquire and/or develop instrumental, interpersonal, and systemic competences. Combining innovative QR codes and Facebook led to a very interesting and dynamic piece of work among students.

III. WORKING OF QR CODE

QR Code can be generated by using a QR Code generator. There are a number of freely available QR code generators. By making use of QRStuff.com, QR code can be generated for text, URL, Image, Video, Audio, SMS etc. The following snapshot shows QR code generation for a simple text.

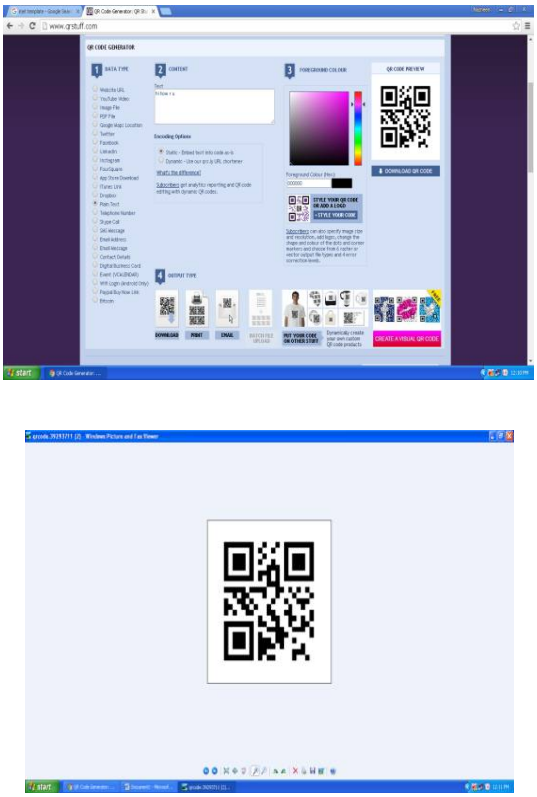

Fig-2 : Example of QR Code

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IV. STRUCTURE OF QR CODE

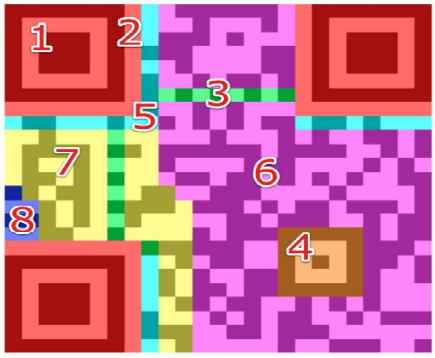

Fig-3 : Structure of QR Code

The symbol of QR Code can be classified into a number of parts as follows:

- **Finder Pattern (1):** This pattern can be used for detecting the position of QR Code. The position, size and angle of the QR Code can be determined with the help of the three position detection patterns (Finder Patterns) which are arranged at the upper left, upper right and lower left corners of the symbol. The patterns can be easily detected in all directions.
- **Separators (2):** The white separators have a width of one pixel and improve the recognizability of the Finder Patters as they separate them from the actual data.
- **Timing Pattern (3):** The timing patterns are arranged both in horizontal and vertical directions. These are actually having size similar to one module of the QR Code symbol. This pattern is actually used for identifying the central co-ordinate of each cell with black and white patterns arranged alternately.
- **Alignment Patterns (4):** The alignment pattern consists of dark 5x5 modules, light 3x3 modules and a single central dark module. This pattern is actually used for correcting the distortion of the symbol. The central coordinate of the alignment pattern will be identified to correct the distortion of the symbol.
- **Format Information (5):** This section of the QR code symbol consists of 15 bits next to the separators and will be able to stores information regarding the error correction level of the QR code and the selected masking pattern.
- **Data (6):** The Data Pattern is the most important section of the QR Code symbol. Data is converted into a bit stream and then stored in 8 bit parts (called codewords)
- **Error Correction (7):** Similar to the data section, error correction codes are stored in 8 bit long codewords in the error correction section.
- **Remainder Bits (8):** Remainder Bits section consists of empty bits, when data and error correction bits cannot be divided into 8 bit codewords without remainder.

V. CHARACTERISTICS OF QR CODE

- **High speed reading:**
  QR code has finder pattern which enables high speed reading in all directions (360^0).
- **High capacity encoding of data:**
  QR code is capable of handling all types of data such as numeric, alphabetic, kanji, Kana, Binary and control codes. It can hold 7,089 numeric characters and 4,296 alphanumeric characters, and 1,817 kanji characters of information.

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- **Small size:**
  As QR codes carry information horizontally and vertically so it requires less space.
- **Kanji and Kana Capability:**
  As QR code is originated in Japan it is capable of encoding Japanese characters efficiently.
- **Dirt and Damage Resistant:**
  Since QR code has error correction capability, data can be restored easily even though the symbol is partially dirty or damaged.
- **Structured Append feature:**
  QR code can be divided into multiple data areas. Conversely information stored in multiple QR code symbols can be reconstructed as a single data symbols.
- **Distorted Compensation:**
  A QR code symbol can be read even if its image is on curved or distorted surface.

VI. CHARACTERISTICS OF QR CODE RELATED TO CURRICULUM OR EDUCATION

6.1 Bridge between Online and Offline Media:

QR code is defined as a paper-based hyperlink. With a QR code reader on camera-integrated mobile phones, students will be navigated directly to limitless online resources after the reader decodes these barcodes. Due to the possibilities of bridging online and offline media, QR code could potentially increase students' interest and motivation to engage in instructional activities. Nonetheless, QR code can be placed almost everywhere including paper materials and online documents. QR code can be attached to book covers and navigate users to its online introduction after the barcode is scanned by the digital camera and analysed by the QR reader.

6.2 QR code is easy to generate:

There are numerous free QR code generators online, and users may select the proper one to satisfy their demands. E.g.:- QR Stuff would help them out. Most often, a basic level of QR code generator (such as Kaywa) is adequate to produce a satisfying barcode. Users only need to open the generator pages and input required contents in the blank area. Then a QR code will come out within 399 several seconds. Therefore, it is easy and convenient for users to generate a QR code and get access to the bridge between online and offline media.

6.3 Quick Readability:

Quick readability means QR code can be easily decoded. QR code reader, a common application for mobile phones or iPod, etc., can decode the code quickly. Although its composition and matrix of arrangement are very complicated, the decoding process is really quick for users. The decoding process requires only around 23 microseconds by a QR code reader. On the other hand, quick readability also means users can access the targeted content in a simpler process. The contents embedded in QR codes are no longer only texts and characters but also links to multimedia files, like pictures, audios, and videos. As is often the case, people have to start the computer and open specific programs if they intend to view those multimedia documents. However, all these procedures could be avoided upon the usage of QR code. Without logging into their accounts, QR code readers would directly demonstrate all the contents that users expect after decoding, no matter what the formats are. In other words, the decoding process would be finished once the reader captures the targeted code. Furthermore, QR code could navigate users exactly to where they expect to go, escaping the trouble of inputting a wrong link (Law & So, 2010). So in teaching practice, the quick readability of QR code provides much convenience and mobility to curriculum. For example, if students are required to submit their assignments in hard copies, they may not be able to clarify certain abstract issues through the use of traditional sentences but need a presentation composed of multimedia files. Therefore, they could attach a QR code linking to animation or video they designed as a supplement to the answer when they submit final works. With QR code, the instructor could view students' answers as soon as he/she takes a photo and decodes QR code via a code reader.

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6.4 Abundant Information Load:

One QR code can handle up to 7089 characters of text information (letters, numbers or symbols in the Latin alphabet) so that it becomes possible to pack a ton of information, including a URL, message, text or phone number, into a small space. In fact, the information load of QR code is large enough for teachers to send students reading materials, assignment requirements, and resource links, and then give them an interactive reply. In contrast, one SMS message can contain 160 characters at most and a twitter message can carry up to 140 characters. Practically, the abundant information load of QR code is really a good assistant for instructors.

VII. INNOVATIVE USE OF QR CODE IN EDUCATION

7.1 Learner centered learning:

Learners can produce reports or other materials online and share their work with QR code.

7.2 Green classroom:

Use of QR code will make the educational environment paperless and save trees.

7.3 Keeping record in less space:

QR code reduces the space required for storing the record related to student curriculum.

7.4 Enhance Knowledge :

QR code can be pasted on books at important point which may connect the student to related video, web page or other sources of information which will help them to enhance their knowledge about specific topic.

7.5 Home assignments :

QR code can be generated to provide home assignments for practice session.

7.6 Magzine :

QR code can be added to school or college magazine which can lead to student, teacher and parents to the quality work submitted by the student but was not printed in the magazine.

7.7 Interactive library :

QRcan be generated for recording audio, video review of the books they have read. This review can help the other students for selecting a better reference.

7.8 Exemplar :

QR code can be created for linking students to more examples of the related topic for better understanding of concept.

7.9 Extend learning to outdoor activities :

Instead of carrying a laptop or other bulky devices outside the classroom, a student can engage into the learning process by a pocket sized device.

7.10 Collection of information :

QR code can be generated for the link of Google Forms which are good source of collecting information from students or parents at events.

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VIII. CONCLUSION

The research study shows that there are a variety of ways to use QR code in educational context. As QR codes store abundant information it enables users to access a variety of multimedia materials which help students to gain more information. They enable to enhance collaborative learning. The study also shows that there are innovative ways for using QR code in education. QR code can be integrated with Smartphone which can be very effective teaching aid in the classroom. QR code can be linked with learning material which may be in the form of Plain text, website URL, YouTube Video, PDF file and Image file. Use of QR code will enhance motivation, collaboration and critical thinking among students.

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