Using QR Codes for Improving the Educational Process of Students with Hearing Loss

Dia ABUALNADI
The University of Jordan

Ahmed AL-SALAYMEH
The University of Jordan

Feda' YOUSEF
The University of Jordan

Ghazi AL SUKKAR
The University of Jordan

Mohammed HAWA
The University of Jordan

Abstract: A QR (Quick Response) code is a two-dimensional barcode originally designed for use in the automotive industry. QR codes contain encoded information which is often a URL of a website. In this work, we investigate using QR codes to help teachers convey information to students suffering from hearing loss. Using QR codes for education can be highly engaging and can provide a new way to give students new information. Teachers can help deaf and hearing impaired students address their needs by giving them additional support to access audio-visual videos posted online. During classes teachers can also record their lessons in sign language and post them online for students to access from home while completing homework assignments. The homework sheets can have QR codes linking to the teacher's directions or video files of that assignment's targets/overview, online tutorials or other websites for additional support. Additionally, teachers can put their PowerPoint presentations online and provide the students with the QR code to access them. QR codes linking to pre-selected websites for research can be created and printed by the teacher ahead of time and given to students in the laboratory, and the students can use their tablets (equipped with camera and Internet access) to read the code and open such websites. Lastly, QR codes can be used to give students immediate feedback when QR codes embedded in classroom handouts and homework sheets link to the answers to problems so students can check their work.

Keywords: Mobile education, QR codes, Disadvantaged students, Video teaching material

Introduction

A QR code is a matrix barcode that stores data in two dimensions. Specific imaging devices (QR Scanners) can read this matrix and retrieve the stored data. QR codes were invented in 1994 by Denso Wave for vehicle tracking during manufacturing (Goyal et al., 2016). Several standards for data encoding in QR codes are available (Youan et al., 2011). Smart mobile devices such as smart phones and tablets can be used as QR code scanners.

One common use of QR codes is web address encoding where a Uniform Resource Locator (URL) is encoded in a QR code to provide more information about products (Goyal et al., 2016). The QR code is printed via specific software to represent the URL and when it is scanned by a smart phone or tablet, it will open a web browser and go to the specified web address given in the URL.

There are many specific applications that use QR codes. It has been used, for example, in security (Bani-Hani et al., 2014). It is also used to share information on certain products, and implement discount coupons when performing a purchase via mobile phones (Sungkur et al., 2016) (Torres-Jimenez et al., 2018). The concept behind using QR codes is that they have large storage capacity, variety of data can be embedded in them such as plain text, URL, SMS, e-mail address, contact information, etc. Their scanning is possible through different platforms by developing mobile device decoding applications, which can read different types of data like numeric, alphanumeric, binary, etc (Sungkur et al., 2016).

The continuous advancement in new technologies allowed the creation and development of new techniques to enhance and contribute to the teaching process. These new techniques make teaching more interactive, flexible and open. The daily use of mobile technologies, for example, favors the exploration of new dimensions in teaching and learning processes. It helps both teachers and students (Bekteshi, 2015) (Hayhoe, 2015) (Sung et al., 2016).

Primarily, digital education has three components: The content, the technology platform, and the delivery infrastructure (Haiyan & Dongming, 2012) (Hakkani-Tur et al., 2011). Implementation of QR codes for digital education fits within these components. Indeed, QR codes have been implemented in many aspects of the education system such as: teaching aid in class rooms with the help of mobile devices, automated exam process, certificate generation system, enhancing security in identity documents and digitized mark sheet system, and many others (Sungkur et al., 2016) (Torres-Jimenez et al., 2018).

In this work, QR codes are used in class to help teachers convey information to students suffering from hearing loss. Demonstration videos (that include Arabic subtitles and Arabic sign language interpreter along with the educational video) were developed via the video editing software Camtasia. Such videos were prepared at the University of Jordan with the help of instructors from Al-Amal secondary school. The videos are uploaded to a server and when a student scans the proper QR code, it permits the student to connect to the server to watch the video.

Identifying the Target Groups

An analysis survey was conducted aiming to examine the readiness and use of mobile technologies in educational institutions in Jordan, and seeking to assist in developing plans, strategies and programs that support education reform for people with special needs. Depending on the information gathered by means of questionnaires and interviews, and the analysis of the results; the target groups and their profiles, level of social adaptation, learning environment, abilities and specific needs were consequently defined.

The target groups of this study are shown in Table 1 along with the Jordanian university that conducted the relevant interviews and surveys for a specific target group. Table 2 summarizes the number of collected survey samples by each university.

Table 1. Jordanian universities responsible for the study target groups

Target group	Responsible university
General Secondary Schools for Children with Special Needs	The University of Jordan (UJ)
Higher Council for Affairs of persons with Disabilities	The University of Jordan (UJ)
Gazza refugees camp	Jordan University of Science and Technology (JUST)
Nazik Al Hariri welfare center for special education	Princess Sumaya University for Technology (PSUT)
Deanship of Students Affairs at each Jordanian University	UJ, PSUT, and JUST

Table 2. Number of collected survey samples by each university

University	Instructor's questionnaire	Student's questionnaire
UJ	35	57
JUST	29	53
PSUT	50	15
Total	114	125

Schools for Children with Special Needs

Students with special needs started to receive educational services in Jordan in the late 1960s. It was clear that these services were mainly focused on people who are visually impaired or deaf - those who had disabilities which were obviously physical instead of disabilities related to learning.

In 2010 the Ministry of Education in Jordan established two specialist departments in order to provide assistance: The department of special education combined with the department of talent (National e-learning strategy for higher education, 2009).

Al-Amal Secondary School for Deaf Students

The work presented here involved close cooperation with the Al-Amal secondary school for deaf students. This is a nonprofit public institution located in Jabal Allweibdeh in the middle of Amman, the capital of Jordan, about 8.5 km away from the University of Jordan.

The system of education in Al-Amal school is "coeducational", where girls and boys are jointly educated in the same classes. The approximate number of registered students is 109, while the number of staff is 32.

Students at Al-Amal school are divided into two categories: The first is deaf students (representing the majority of students in the school). Students who are found to be educationally deaf are being taught in classes where sign language is the primary language for communication and for teaching/learning, and where the written Arabic language is taught/learned by way of translation (i.e., bilingual education).

The second group is students with hard of hearing. Those are students with hearing impairments, who are being taught in classes where the Arabic (spoken) language is the main language, and where some sign language and total communication are used to clarify and ease the learning process.

The classification of students is done by a thorough assessment of the hearing loss, the student's capability to utilize his residual hearing, and the student's language-level (i.e., the student's possibility of acquiring the spoken language through hearing).

Teaching/Learning Methods at Al-Amal School

Since the education of the deaf needs so much extra teaching/learning material beyond textbooks and exercise books, the school also uses ample facilities for material production. Primarily, a good photocopying machine and also ample supplies of paper, cardboard, crayons etc.

The staff depends on visual-based learning as the main method of teaching. The languages used in the classroom by the teachers are: sign language and written English and Arabic languages. It is worth mentioning that courses in sign language for families and for beginner teachers, interpreters and other professionals working with the deaf are being offered by the expert teachers in the school.

Teacher Training

Qualified and motivated teachers are appointed by the school. The teachers are devoted and skillful. Training workshops for the teachers are being organized regularly, but they still need to receive training on new techniques and tools to implement newly acquired teaching approaches in the classrooms.

Pre-Vocational Training Program

Al-Amal school has pre-vocational programs. Experience at the school shows that not many of the deaf students are capable of receiving their higher education. Furthermore, for those who finish their education, they will have to compete on unequal terms with their hearing peers in a field where unemployment is growing in Jordan. Hence, pre-vocational programs are offered at the school.

Video Processing and Editing

In our study, we implemented QR codes to improve the process of educating students with hearing loss. Twenty-two videos were produced in different aspects of science such as physics, biology, geology and chemistry for students at Al-Amal school. The videos were designed for deaf students and those who suffer hearing problems. Figure 1 summarizes the design plan and target group for this effort.

Pilot Class:	10th grade		
Age:	15-16	Pilot Courses/Teaching materials to be developed:	
Characteristics: • Mixed classroom and labs. • (12) Students per calss. • (6-7) hrs daily class. • Each lecture is (45) mins.		**Physics/Chemistry** (11) lessons	**Biology/Geology** (11) lessons
		• Physics lectures are being offered to students three times a week while Biology is given two times a week.	
Methods to be used: QR Code **QRC Scanner Apps:** Red Laser, Qrafter or any other mobile app.		**Open Recourses:** • iPads. • Computer lab • Science lab	

Implementation Plan:
✓ **Teachers can easily create QR codes**
   - A short manual and training session given to teachers.

✓ **Excite students about upcoming material**
   - To connect a QR code to the "Figure" or "Question of the day" and use it as an anticipatory set to get students thinking about upcoming information.

✓ **Link QRC to favorite websites.**
✓ **Make interactive worksheets**

Idiom	Page number in book

✓ **In the case of films the free video sharing portal YouTube or Flicker is applicable, and teachers can upload sets of their own videos or tutorials there.**

✓ **Teachers can put small icons in the middle of the QR Codes to indicate the content.**

Figure 1. Course design plan

The illustrative videos were edited by adding Arabic language subtitles in addition to an Arabic sign language interpreter. The produced videos were divided into three windows, a big one with the illustration of the lesson, a side one with the interpreter and a lower one with Arabic language subtitles (see Figures 2 and 3).

The teacher produces a QR code connected with the video such that when the student scans the code, a software on the student's mobile device will call the video and run it so that the student will have extra information regarding the lesson being discussed.

In this work, illustration videos and educational supplemental material for students (that includes sign language) were developed and linked with the scientific content of their regular lessons via the QR code technology. The Arabic subtitles (as text) and the Arabic sign language interpreter were added to the video via the Camtasia video editing software. Synchronization between the video frames, the Arabic subtitles and the sign language interpreter was a challenging problem. Figure 2 shows a screenshot of the process of editing a video using the Camtasia software. The topic of the video was earthquakes and Richter scale. The figure shows the three parts of the video: the demonstration video, the Arabic subtitles and the Arabic sign language interpreter. Figure 3 shows another sample video after being edited, with all the three parts running synchronously on a test machine.

Figure 2. Screenshot of editing a video

Figure 3. An edited video running on a test machine

The process of recording the Arabic sign language interpretation is illustrated in Figure 4. Figure 5 shows a class in which students are using the QR code (handed by the instructor) to launch the educational video to get information about the topic being discussed. Both students and staff report high level of engagement from students using this teaching technique (see Figure 6).

Figure 4. Recording the Arabic sign language interpretation

Figure 5. Students using QR codes to launch demonstration videos

Figure 6. Engagement of students in the learning process

Results and Conclusions

QR codes were successfully implemented in the process of improving the quality of education for students with hearing loss in Jordan. Several videos were produced in different aspects of science for students who suffered hearing problems. The videos were edited by adding Arabic subtitles and Arabic sign language interpreter for the benefit of those students. QR codes were used to download and activate such videos.

For the future, we anticipate that QR codes can also be encoded such that the teacher can give a quiz, conduct a survey, or send a questionnaire to the students. This technique can also be applied in schools that suffer a shortage in physical resources such as the disadvantaged regions of the country to do lab experiments in all scientific disciplines. The experiments can be done in a center by qualified teachers, recorded on video and watched by many students. The videos can be edited by a video editing software to add animations and other useful information. QR codes can be handed out to students at schools in the disadvantaged regions, where the QR codes direct the students to the location of the video, so that when a student scans the code via his/her mobile device, it will call the video and run it on the mobile device and the student can see that information.

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Author Information

Dia Abualnadi
The University of Jordan
Amman, 11942, Jordan

Feda' Yousef
The University of Jordan
Amman, 11942, Jordan

Mohammed Hawa
The University of Jordan
Amman, 11942, Jordan
Contact E-mail: hawa@ju.edu.jo

Ahmed Al-Salaymeh
The University of Jordan
Amman, 11942, Jordan

Ghazi Al Sukkar
The University of Jordan
Amman, 11942, Jordan