Study on Improvement Plan of Emergency Medical Services Through Information Use on QR Code

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ABSTRACT

The purpose of the study was to diagnose the subjectivity of university students of emergency medical technology (paramedicine) and identify the effects and factors related to each type of QR code. A total of 23 students of paramedicine (emergency medical technology) department filled out the questionnaire after an informed consent. Q survey included 25 statements. Data were analyzed using QUANL program for PC. There were three types in QR code.
Type 1(N= 11) : Effective recognition of information type
Type 2(N=8) : Information related emergency recognition type
Type 3(N=4) : Emergency-patient information application type

Each type had its own differences and characteristics. The analyzed contents showed that there was an overall interconnection among the respondents on how to improve emergency services by use of QR code information.

1. Introduction

QR Codes are being used effectively in everyday life. During the 2020 coronavirus pandemic, the use of QR codes has become an important service for consumers who have become accustomed to the online environment. As a result, QR codes have penetrated to businesses' marketing strategies and everyday life. First, drivers are putting QR parking numbers on their windshields instead of their phone numbers to show their contact information. This is important for privacy.

Second, factories manufacture goods. If a QR code is attached to a car and linked to a video, consumers can learn more about the product, which increases the value of the product (Rotsios et al., 2022). Products that require assembly instructions, such as assembled furniture and assembly equipment, can be conveniently explained to consumers through video explanations using QR codes. These QR codes can increase product sales (Hossain et al., 2018).

Third, if you sell products on an online shopping mall. If you add a video description of the product, you can increase sales. Fourth, hiking trails and routes. Since smartphones are well-connected in most mountains and rivers, providing directions using QR codes can help prevent distress, increase safety, and add convenience (Hossain et al., 2018).Fifth, in museums, video explanations of cultural assets, tourist destinations, and arboretum directions using QR codes are replacing cultural interpreters in the non-face-to-face era.
In this study, we propose to utilize various QR codes and make them easily accessible to improve emergency medical services. This study aims to diagnose the subjectivity of university students of emergency services and identify the effects and factors related to each type of QR code in terms of functionality to find out how to improve them (Sago, 2011). To answer the above issues, we utilize subjectivity study analysis. The research questions are as follows.

First, what are the types of acceptance perceptions regarding how to improve emergency services by use of QR code information?

Second, what are the homogeneous and heterogeneous characteristics and implications of each of these types?

This study uses the Q methodology to analyze the subjective dispositions of emergency rescue students to understand how to improve emergency services by use of QR code information (Luymes et al., 2017). The analysis of related literature can be objectively analyzed, enabling efficient research. The

evaluation after the analysis is objective, so it can suggest effective strategies and utilization methods (Zabala et al., 2018).

The Q-statements used in this study are based on previous studies organized by finding various domestic and foreign data. The scope of the research covered all available literature in Korea. The Q statements were organized by listening to the opinions of university students, collecting related literature, and researchers' opinions (Watts and Stenner, 2008).

This study aims to analyze the types of opinions of university students on how to improve emergency services by use of QR code information. By identifying and explaining the characteristics of each type, we create hypotheses and utilize the Q methodology appropriately (Okazaki et al., 2019). Through this analysis, the psychological subjectivity of the subjects is analyzed as a type. The types of university students' acceptance perceptions on how to improve emergency services by use of QR code information can be objectively analyzed by the existence.

quantitative R methodology. The Q-methodology analyzes the factors in the subjects' schema. Therefore, the Q methodology provides insightful analysis. Q methodology is different from traditional research methods. Q-methodology is to discover new hypotheses (hypothesis abduction) through the subjective images that ordinary people have. Q-methodology can diagnose the subjectivity of university students on how to improve emergency services by use of QR code information. In terms of functionality, detailed types of effects and factors can be identified, which can suggest improvements to the service.

2. Literature Review

From a marketing perspective, YES 24 in the Republic of Korea (South Korea) utilized QR codes to deliver books quickly and made a video about it. In South Korea, 11th and OK OUTDOOR.Com have embedded QR codes on the packaging of courier boxes to promote their companies. Aladdin, which sells books, uses them on its employees' name cards. In Korea, companies have been utilizing QR codes for years to create convergence marketing strategies. The power of QR codes has shown a great impact even in simple product promotion (Shin et al., 2012). For example, Hyundai Motors used QR codes to market its new car ahead of its launch. Hyundai Motors installed QR code advertisements on large outdoor buildings, subway screen doors, and bus stops, as well as at major sales offices nationwide. Depending on the medium in which the QR code is displayed, the company created customized content for newspapers, outdoor advertisements, etc. A South Korean mobile carrier launched mobile commerce by opening Q-STORE with a new concept experience store utilizing NFC and QR codes, at its headquarters in Seoul. Some companies utilize QR codes for cross-over marketing, linking them with print and TV ads. QR codes solve the shortcomings of print ads, where it is difficult to include a lot of content due to limited space. Some companies in South Korea use QR codes to connect online and offline. The use of QR codes to connect online and offline stores is also very popular in the food industry. A Korean food company has placed QR codes on its buses in Seoul, so that passengers waiting for the bus can scan the QR code with their smartphones and see food information and images related to the advertisement. The public relations representative said that QR codes are available at no additional cost. This will lead to more cases of actively utilizing QR codes for products and marketing activities.

These are just a few examples of how companies can use them for marketing. Here is a review of the literature on QR Codes. Lee stated that ROI information provided by QR codes embedded in integrated images includes a search key to effectively check medical information in case of emergency (Lee, 2016). This ROI information was implemented to protect biometric and medical information using the Advanced Encryption Standard (AES) encryption algorithm.

Laden et al. proposed a technique for protecting and securing medical information measured from various sensors (Laden et al., 2018). Vital signs are the main information of individuals and are related to privacy. Therefore, QR code, a two-dimensional coding technology, was applied for protection and

management.

Haugland et al. introduced a profile design that recognizes an individual's identity at an emergency scene by applying biometric technology to emergency medical services using the Internet of Things and the unique biometric characteristics of individuals (Trivedi et al., 2020).

Cata et al. proposed a method for tagging employee ID cards or personal mobile phones worn by coworkers in the event of an emergency in the workplace to provide appropriate first aid upon arrival of paramedics (Cata et al., 2013). In the event of a cardiac arrest or severe trauma, they proposed to provide accurate medical services by checking the medical examination information and input information of employees with their employee ID cards.

The purpose of this paper is to identify university students' opinions on how to improve emergency services by use of QR code information. This study uses the Q-methodology approach to find subjectivity through respondents' self-structuring. Q-methodology was first proposed by William Stephens (Watts & Stenner, 2008). It is a method that integrates concepts related to philosophical, psychological, and statistical psychometrics to study human attitudes and behavior. Q-methodology is a unique approach to using statistics to quantitatively analyze subjective concepts. Q statements deal with significance in intra-individual differences, not inter-individual differences.

Q-methodology is not severely limited by the number of demographic samples. The Q methodology allows for a more detailed study of individuals or subpopulations than the R methodology, which is cross-sectional and centered on many variables. This makes Q-methodology useful for consumer behavior research.

This differs from the research(R) methodology, which starts with the researcher's assumptions. Q methodology adopts the concept of operant definition as the researcher's operational definition, where the actor, the respondent, constructs their own opinion. From a scientific perspective, Q methodology applies a systematic and objective approach. Therefore, it utilizes the factor analysis method, which is common to both R and Q (Stenner et al., 2017). Factor analysis in R uses variables as factors, while Q uses people as factors. By utilizing the Q methodology, a new hypothesis is found to discover the subjective perception of university students' opinions on the medical noncontact service campaign perception in the corona era.

The following research questions were selected for this thesis. This paper is an in-depth analysis by university students on how to improve emergency services by use of QR code information, and the research questions are as follows.

First, what are the types of university students' perceptions of how to improve emergency services by use of QR code information? How are the types of university students' perceptions of how to improve emergency services by use of QR code information classified? What are the characteristics of these types?

How do these characteristics relate to university students' perceptions of how to improve emergency services by use of QR code information?

Second, what are the homogeneous characteristics between each type? What are the properties that all statements share across types? How does the Q methodology analyze subjective images with a small number of respondents?

Therefore, in this paper, the researchers aim to analyze the characteristics of university students' opinions on how to improve emergency services by use of QR code information. By analyzing the differences based on tangible characteristics, the researchers hope to apply the use of QR code information to improve emergency services.

3. Methodology

Study Design

The literature analysis on how to improve emergency services by use of QR code information is an objective value analysis. Therefore, it is possible to understand related studies efficiently. In addition, the evaluation of how to improve emergency services by use of QR code information can provide an objective analysis and effective types. The specific research method will be conducted as a case study by summarizing various domestic and foreign data. The scope of the research will cover all available literature in Korea.

In this study, a deep Q-survey was conducted targeting students from the Department of Emergency Medical Services. To deeply understand the perspectives on the topics of this paper, interviews with college students were conducted.

As a type of qualitative research, the in-depth Q survey analysis is conducted using the Grand Tour Technique, and the research questions are divided into common areas and individual areas. The research questions for this thesis were finalized before the research was conducted. As the interviews were conducted, additional questions were included in an evolving design, which is characteristic of qualitative research methods.

Q in-depth survey are conducted with university students to find out how the results of the initial interviews will influence the content of subsequent interviews.

The interview topics listed were not decided at the proposal stage, and the statements were organized into focused issues after the first three or four interviews.

Data Collection and Analysis

This paper will be based on the various opinions derived from the R-methodology and the results of the Q-methodology analysis, which can take structures of each type, identify the characteristics of each type, and create hypotheses.

Objective statistical analysis has been mainly used in the existing quantitative R methodology for improving emergency services by utilizing QR code information.

Q-methodological analysis papers can identify the communication between workers and the factors in the schema of respondents. This study aims to discover new hypotheses (hypothesis abduction) based on the subjective images that people have in their daily lives. Q-methodology starts from the perspective of the actor.

Therefore, it is possible to understand and explain the types of subjectivity structures that differ from person to person. The researcher believes that there are certain limitations in the existing methods to measure in-depth about how to improve emergency services by utilizing QR code information. The analysis is to categorize the cards in the form of statements. To create these statements, the researcher organized a Q concourse through interviews with university students.

After creating the Q-statement and selecting and sorting the P sample, Q-factor analysis was performed using the QUANL program for PC.

Q-sample and P-sample

Q sample is a statement consisting of a type of perception about how to improve emergency services by use of QR code information. This study aims to obtain the general ideas, feelings, opinions, and values of the respondents. 37 Q-populations (concourse) were constructed by in-depth interviews with university students, including professional books, academic books, and thesis studies related to the research. Among the statements in the Q-population, we randomly selected statements that were highly representative of the topic, and finally decided on a sample of 25 statements. The 25 selected statements are inclusive of all opinions and have a balance of positive, neutral, and negative sentiments ([Table 1]).

Table 1: Scores and statements by distribution

Distribution	**4**	**3**	**2**	**-1**	**0**	**1**	**2**	**3**	**4**
Scores	1	2	3	4	5	6	7	8	9
Number of statements	1	2	3	4	5	4	3	2	1

Q-methodology is not limited by the number of samples because it deals with intra-individual differences in significance, not inter-individual differences. Since the purpose of Q-methodology is not to infer the characteristics of the population from the sample characteristics, the selection of the sample does not follow a probabilistic sampling method. Unlike the R method, which appropriately considers demographic characteristics such as gender, age, and occupation based on the criteria presented above, the P sample in this study is 23 paramedicine students who gave their consent to the research through prior notification.

The Q-categorization task is a self-modeling of one's mental attitude toward a complex topic or situation, in which respondents read statements and then place a number in a certain distribution.

In Figure 1, the Q-sorting procedure categorizes cards with each statement selected as a Q-sample as positive (+), neutral (0), or negative (-) after the respondent reads them. Positive statements are categorized from the outside (+4) to the inside, starting with the most positive. Do the same for negative statements as for positive statements. Record an in-depth interview for one statement at the very end. This will provide useful information for interpreting the Q-factor.

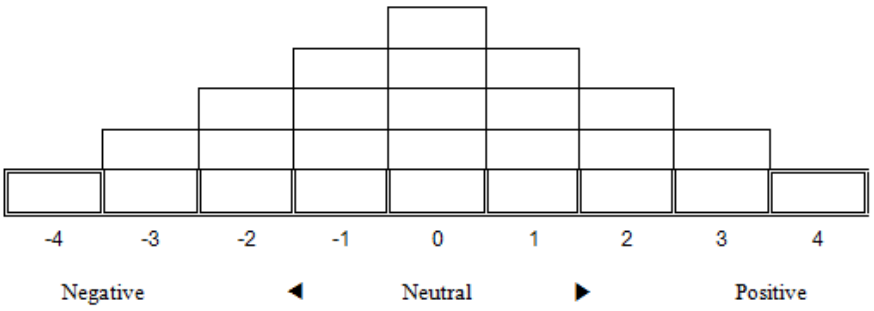

Figure 1: Sample sorting board and record sheet

To score the samples after the survey is complete, the Q-sample distribution starts with 1 for the most negative case (-4). Assign scores of 2 (-3), 3 (-2), 4 (-1), 5 (0), 6 (+1), 7 (+2), 8 (+3), and the most positive score of 9 (+4) ([Table 1]). Code the scores assigned by statement number and analyze the data with the QUANL program for PC.

4. Results and discussion

The results of the Q-factor analysis of university students' subjectivity types regarding their perceptions on how to improve emergency services by use of QR code information are as follows. There are 11, 8, and 4 respondents in the three types that explain 42.98% of the total variables. There are 2, 4, and 2 people with a factor weight of 1.0 or more, respectively, making Type 2 the highest factor. In Table 2, the eigen values for each type of variable size were 4.0271, 3.9875, and 1.8713.

Table 2: Eigen value and percentage of variable

Eigen value	**4.0271**	**3.9875**	**1.8713**
Percentage of variables	.1751	.1734	.0814
Cumulative frequency	.1751	.3485	.4298

Table 3 shows the correlation coefficient between each type, which indicates the similarities and differences between the types. The correlation between Type 1 and Type 2 is negative. The correlation between Type 1 and Type 3 is positive.

Table 3: Correlation between each type

	Type 1	Type 2	Type 3
Type 1	1.000	-	-
Type 2	-.049	1.000	-
Type 3	.351	.162	1.000

Table 4 analyzes the factor weighting by type according to the demographic characteristics of the respondents. In the three types, those that show a factor weight of 1 or more include '2, 4, 2', etc. The 'factor weight' indicates the explanatory power of the respondents for that type.

Table 4: Demographic characteristics of the subjects and cumulative frequency

Type	ID	Gender	Age	Major/Grade	Cumulative frequency
TYPE 1 (N= 11)	1	Male	25	Paramedicine/4	1.6614
	8	Male	23	Paramedicine/4	.7103
	9	Female	23	Paramedicine/4	1.3813
	13	Male	25	Paramedicine/4	.6136
	16	Female	24	Paramedicine/4	.6393
	17	Female	23	Paramedicine/4	.5015
	18	Female	22	Paramedicine/4	.5266
	20	Female	23	Paramedicine/4	.2526
	21	Female	23	Paramedicine/4	.6898
	22	Female	23	Paramedicine/4	.5557
	23	Female	23	Paramedicine/4	.7343
TYPE 2 (N= 8)	2	Male	25	Paramedicine/4	2.8765
	3	Male	25	Paramedicine/4	.2102
	4	Female	23	Paramedicine/4	.6723
	5	Male	25	Paramedicine/4	2.2572
	10	Male	23	Paramedicine/4	1.8237
	11	Male	25	Paramedicine/4	1.0664
	15	Male	24	Paramedicine/4	.4626
	19	Male	24	Paramedicine/4	.5130
TYPE 3 (N= 4)	6	Male	23	Paramedicine/4	2.8430
	7	Female	23	Paramedicine/4	1.0697
	12	Female	23	Paramedicine/4	.6810
	14	Male	25	Paramedicine/4	.4937

Type 1(N= 11) : Effective recognition of information type

Type 1 respondents had a factor weight of more than 1, as shown in Table 5

below, with 2 respondents showing the most positive agreement with Q-statement No. 2, "Quick recognition of information should be of great medical benefit (Z-score=2.14)," and the most negative agreement with Q-statement No. 12, "It is not necessary because it is more inconvenient than the existing method (Z-score=-1.70). Type 1 respondents are positive that they place much more importance on the "promptness" of medical information, more effective "understanding of content information," and "real-time checking" of related public institutions than on the inconvenience or understanding of "utilizing information.

Table 5: Statements with a standardized score of ±1.00 or higher

Q Statements		Standard score
Positive	2. Rapid recognition of information should be of great medical benefit. 16. Effective and diverse content recognition and understanding. 15. Real-time verification should be able to be shared with police, fire departments, and first responders.	2.14 1.46 1.23
Negative	10. focus on providing classroom and hands-on training in first aid. 11. have a good understanding of the options available in a crisis management situation.	-1.00 -1.22

	12. It's more inconvenient than the old way, so you don't need it.	-1.70

Type 2(N=8) : Information related emergency recognition type

As analyzed in Table 6 above, the 8 respondents in the second category have a factor weight of more than 1, with 4 respondents showing the most positive agreement with Q-statement 14, "It should be improved to enable location identification for people in critical situations who are unconscious (Z-score=1.93)," and the most negative agreement with Q-statement 16, "I think it is necessary to recognize and understand more effective and diverse content (Z-score=-1.85)".

Type 2 respondents are more positive about checking information for emergency patients, announcing urgent medical information, and recognizing prescription information for the people than they are about emergency medical services, education, or understanding information contents.

Table 6: Statements with a standardized score of ±1.00 or higher

Q Statements		**Standard score**
Positive	14. unconscious emergency situations should be improved to allow for location.	1.93
	5. It should also be useful for announcing vaccination information at health centers during the corona crisis.	1.34
	4. necessary to recognize prescriptions for the general public people.	1.28
Negative	7. It should be complementary to the provision of close-to-home emergency medical services.	-1.06
	10. emphasis should be placed on providing classroom and hands-on training in first aid.	-1.28
	16. I think there is a need for more effective and diverse content awareness and understanding.	-1.85

Type 3(N=4) : Emergency-patient information application Type

Type 3 respondents were most positive about Q-statement #3, "It is necessary to check urgent patient information (Z-score=1.85)." In Table 7 below, the number of respondents with a factor weight over 1 was 2. They were most negative about Q-statement 12, "I don't need it because it's more inconvenient than the existing method (Z-score=-1.77). Type 3 respondents are interested in verifying and improving the information and location of patients in crisis. Even if it is urgent situation or various services in the medical environment (statements 5, 8, and 12), it is necessary to utilize information such as sufficient communication and empathy.

Table 7: Statements with a standardized score of ±1.00 or higher

Q Statements		**Standard score**
Positive	3. You need to verify patient information urgently.	1.82
	14. improvements should be made to enable localization for people in critical situations who are unconscious.	1.52
Negative	5. It should also be useful for announcing vaccination information at health centers during the corona crisis.	-1.49
	8. be able to effectively report unauthorized practice in a healthcare organization when directed or witnessed.	-1.64
	12. It's more inconvenient than the old way, so you don't need it.	-1.77

Table 8: Consensus Q-statements & average Z-scores of each type

Item Description	**Average Z-Score**
9. recognize that CDC and fire department lay CPR training is essential to improve survival rates.	.01

6. capitalize on the strength of its large capacity to hold a variety of three-dimensional information.	-.53
11. be accompanied by a good understanding of the treatment options available in a crisis management situation.	-.64

As shown in [Table 8] above, there were three Q-statements that were similarly agreed upon by the three types derived from this study {Type 1 [(N= 11) 2:

Effective recognition of information Type], Type 2 [(N= 8) 4: Information related

emergency recognition Type], and Type 3 [(N= 4) 2: Emergency-patient information application Type]}, with one positive and two negative items. In this analysis, respondents tended to agree with the statement as it was written for the most positive statement (9. CDC and fire departments should recognize public CPR as a requirement to increase survival rates [Z-score=0.01]). For the remaining negative statements (11. It should be accompanied by a sufficient understanding of the treatment methods available in a crisis management situation [Z-score=-0.64]., 6.

The generous capacity should be utilized as a strength to contain various three-dimensional information [Z-score=-0.64]). The opposite trend was seen in Statement 9. As shown in statement 9, respondents emphasize that efficient coping measures are needed for the medical basics of daily life that have been acquired during the recent corona crisis, and that they are necessary even in everyday situations that are not emergency situations, such as improving the quantity of information, as shown in statements 6 and 11.

5. Conclusion and future scope

This study utilized the Q methodology to examine the subjective tendencies of the inmates. After analyzing the Q program, three types of problems were identified.

Each type had its own differences and characteristics. The analyzed contents showed that there was an overall interconnection among the respondents on how to improve emergency services by use of QR code information.

Because this discussion utilizes only college students, it does not allow for comparative analysis across many variables. Type work with small groups can provide a preliminary basis for specialized research. It is necessary to develop a Q-methodology that analyzes and discusses various issues well to construct a research method that can suggest universality. Inviting respondents to participate in the study by dividing them into small groups can increase the persuasiveness of the results.

It's important to be able to connect the dots between the past and the present to have a robust discussion going forward. Think about who the campaign is for and what the average consumer has in common with the content. It is necessary to communicate at eye level that can be mutually understood by those who can discuss. At the end of the day, it is important to provide accurate guidelines on key issues and trustworthy information to stakeholders on how to improve emergency services by use of QR codes.

Through this study, it is important to promote emergency medical services by utilizing QR code information.

Reference

[1] Cata, T., Patel, P.S., Sakaguchi, T. (2013). QR code: A new opportunity for effective mobile marketing. Journal of Mobile Technologies, Knowledge and Society, 2013:p.1.

[2] Hossain, M. S., Zhou, X., Rahman, M. F. (2018). Examining the impact of QR codes on purchase intention and customer satisfaction on the basis of perceived flow. International Journal of Engineering Business Management, 10, 1–11.

[3] Laden, M. A., Wharrad, H., Windle, R. (2018). Towards understanding healthcare professionals' adoption and use of technologies in clinical practice: using Q-methodology and models of technology acceptance. BMJ Health and Care Informatics. 18;25(1). https://doi.org/10.14236/jhi.v25i1.965

[4] Luymes, CH., Boelhouwer, N.J, Poortvliet, RKE., de Ruije,r W., Reis, R., Numans, ME. (2017). Understanding

deprescribing of preventive cardiovascular medication: a Q-methodology study in patients. Patient Prefer Adherence, 11, 975-84. https://doi.org/10.2147/PPA.S131625

[5] Okazaki, S., Navarro, A., Mukherji, P., Plangger, K. (2019). The curious versus the overwhelmed: Factors influencing QR codes scan intention. Journal of Business Research, 99, 498-506. https://doi.org/10.1016/j.jbusres.2017.09.034

[6] Rotsios, K., Konstantoglou, A., Folinas, D., Fotiadis, T., Hatzithomas, L., Boutsouki, C. (2022). Evaluating the use of QR codes on Food Products. Sustainability, 14(8), 4437.

[7] Sago, B. (2011). The Usage Level and Effectiveness of Quick Response (QR) Codes for Integrated Marketing Communication Purposes among College Students. International Journal of Integrated Marketing Communications, 3(2).

[8] Shin, D., Jung J., Chang, B. (2012). The psychology behind QR codes: user experience perspectives. Computers in Human Behavior, 28(4), 1417-1426. https://doi.org/10.1016/j.chb.2012.03.004

[9] Stenner, P., Watts, S., Worrell, M. (2017). Chapter 13. Q methodology. In; The SAGE handbook of qualitative research in psychology. 212255. https://doi.org/10.4135/9781526405555.n13

[10] Trivedi, R., Teichert, T. and Hardeck, D. (2020), "Effectiveness of pull-based print advertising with QR codes: Role of consumer involvement and advertisement appeal", European Journal of Marketing, Vol. 54 No. 1, pp. 145-167. https://doi.org/10.1108/EJM-06-2018-0383

[11] Watts, S, Stenner, P. (2008). Doing Q methodology: theory, method and interpretation. Qualitative Research in Psychology, 67-91. https://doi.org/10.1191/1478088705qp022oa

[12] Zabala, A, Sandbrook, C, Murkherjee, N. (2018). When and how to use Q methodology to understand perspectives in conservation research. Conservation Biology, 32(5),1185-94. https://doi.org/10.1111/cobi.13123