Usability of QR code in the design of Information system for recognizing historic buildings, Kota Lama, Semarang

by Dinar Mkn

Submission date: 09-May-2023 10:43PM (UTC+0700)
Submission ID: 2088652382
File name: qr_code_kota_lama.pdf (1.16M)
Word count: 4253
Character count: 21661

Usability of QR code in the design of Information system for recognizing historic buildings, Kota Lama, Semarang

Usability of QR code in the design of Information system for recognizing historic buildings, Kota Lama, Semarang

D M K Nugrabeni[1], D I K Dewi[2], A K Nugroho[3]

[1]Departement of Computer science/ Informatics, Faculty of Sciences and Mathematics, Diponegoro University Semarang, Semarang,Indonesia
[2]Urban Regional Planning Department, Faculty of Engineering, Diponegoro University, Jl. Prof Sudharto, SH Tembalang, Semarang, Jawa Tengah, Indonesia
[3]Electrical Department, Faculty of Engineering, Semarang University, Semarang, Indonesia

E-mail: dinar.mutiara@live.undip.ac.id

Abstract. Urban infrastructure or basic facilities such as museum is essential as the component of smart city. To support a natural museum for instances the exhibit of historical building in "Kota Lama Semarang "or The old city of Semarang, this paper used the QR code to recognising the information on the historical buildings, Kota Lama, Semarang. Leaflet map of Semarang Historic building commonly used to provide the location information. However, leaflet map has a limitations, it cannot provide enough information about the historic building. The limitations of leaflet maps is only provide little information which explaining the condition of the historic building. To expand the information about the historical building, prior research suggested the use of web technologies. However, some people suggested the usage of leaflet – map which can show the location and the web site can provide more additional information about the historical building. In this paper, the researcher purpose a design of Information System, which employs Quick Response (QR) code technologies as a link to combine the information between leaflet map and web technologies. Then, the design validated with identify the usability of design for using QR code for recognising historic building, Kota Lama, Semarang. The method that used to evaluate the design is SUS (System Usability Scale). The QR code usability test using SUS question showed the number that the design is in level usable from the user perspective.

1. Introduction

Smart city technologies are intended to improve citizens' lives. With the technology implemented in the smart city, the technology accelerates the pace of people searching of information. Urban infrastructures or basic facilities such as museum is essential to be supported by the technologies. "Kota Lama Semarang "or The old city of Semarang is a natural museum that exhibit historical buildings that tell stories the city of Semarang in the era of Dutch colonial rule. Many technologies has been used to engage the museum and the museum visitor. The engagement is essential because it can help the historical object in museum [1]. However, Rey et. [2] noted that the used of information and communication technology (ICT) do not reached the usability of the technology from the users' perspective. The user prefer used traditional style when visiting a museum.

Many museum provides web site as a tool to attract the visitor to museum event, however, the validation that the usage of web site for attracting a museum success is need to be measure [3] Another research

suggested for using a robot to replace the usage of human as guide tour in Museum [4]. But, the problem with the usage of technology in the museum to engages a visitor is financially problem.

With popularity of QR code, the usage of QR code for engage visitor for an art and museum exhibition is commonly usage. Evaluate the usage of QR code for help visitors personalize their visit to museum [5]. The result suggested that QR code is received positive respond from the museum staff, the used of QR code was assumed that generally young visitor owned smartphone and they familiar for using QR code.

Leaflet map of Semarang Historic building commonly used to provide the location information. However, leaflet map has a limitations, it cannot provide enough information about the historic building. The limitations of leaflet maps is only provide little information which explaining the condition of the historic building. To expand the information about the historical building, prior research suggested the use of web technologies. However, some people suggested the usage of leaflet – map which can show the location and the web site can provide more additional information about the historical building. In this paper, this paper purpose a new design for urban infrastructure facilities (natural museum), which employs Quick Response (QR) code technologies as a link to combine the information between leaflet map and web technologies. A usable interface is essential to allows mobility and ease of use of information using sharing system [6].

The originality or the value of the research is acceptable design for information system that combined map and web using QR code to access information about historic building in cultural space museum. And, the IS design has validated using usability testing that considered the user's prior knowledge for using QR code and SUS questionnaire and metric.

2. Validation Method

2.1 Grouping the user based on the QR code usage as respondents profile

It is expected that users will be familiar with technology and can return to the information system whenever necessary without prior training [7,8]. In usability, the user experience is influenced by subjective attitudes and feelings towards the system [9]. In 2010, ISO 9241-110 Ergonomics of human-system interaction: Human-centred design for interactive systems defined user experience as 'a person's perceptions and responses resulting from the use of a product, system, or service' [10,11]. The users' experience influences their perception of the system [8].

In the context of interactions with the system, the user's task also influences their perception of the system [12]. To use user perception as a measurement, it is essential that the user has an understanding about the technology. The users' perception is beneficial to the evaluation of technology that is reused to deliver public services; such as QR code or and website; because the user already uses the application. User's perception is also affected by the users' experience when they interact with the system [13].

User perception is a measurement commonly used when users are at the centre of the system evaluation and refers to users' opinions and judgements [14]. In addition, the user's perception of technology use is essential because it can influence the system information [15].

Table 1. Question for understanding the users' prior knowledge in the QR code's usage

No	Question	Scale
1	Smartphone ownership	- Smartphone - None
2	User experience for using QR code Have an experience for using QR code for payment or to get a link for an website.	- For Payment - To get link for a website
3	User's frequent of use for using QR code	- None - Beginner (1st time user) - Rarely used (1-3) - Regular user (more than 3 times)
4	User have experience for using Web to access information for historical building, Kota Lama, Semarang.	- None - Beginner (1st time user) - Rarely used (1-3) - Regular user (more than 3 times)
5	User have experience for using Map to get access as direction to explorer for historical building, Kota Lama, Semarang.	- None - Beginner (1st time user) - Rarely used (1-3) - Regular user (more than 3 times)
6	User have experience for using Map that contain with QR code to get access to a website for historical building, Kota Lama, Semarang.	- None - Beginner (1st time user) - Rarely used (1-3) - Regular user (more than 3 times)

To investigate prior knowledge and to assess the effectiveness of the QR code usage to provide information about the historic building, Kota lama, Semarang. This study used the user's Frequency of Use (FOU) of QR code. The user will be identified based on their ownership for smartphone, the experience for using QR code for payment and search for web link; the FOU of QR code usage; the FOU for using web as museum exhibit information; the FOU for using Map as guidance in museum exhibit and the FOU of QR code usage in map. Table 1 shows the user's prior knowledge for using QR code, map and web site. It essential for this study for grouping the participants, so the researcher can give a good recommendations about the design. As noted, to measure the effectiveness of museum information system design is not only about the user's acceptance. But, it also essential to understand the user's prior knowledge so the information system design can be usable for every visitor.

Trial and survey for this study used twelve students in urban regional planning, Universitas Diponegoro, Semarang, Indonesia. The reason for selecting the Urban Regional Planning department students due to that they familiar with the condition of Kota Lama, Semarang and they will be a potential user for using the Information System for study activities. The data of usability experiments should be collected from participants who are familiar with aim of the information system area being assessed [16]. The experiments conducted after the student finished a survey for recognising the historical building.

According to Krug [17] the ideal number of respondents is three to four for each test. Whereas according to Nielsen [18] the best number of respondents in each usability test is 5 people, respondents numbering 5 are considered to be able to represent most of usability problems without involving many resources.

And it suggested to use a real condition to trial the technology help the participants to feel the real environment when the technology used. In addition, it also to help the researcher with the condition of infrastructure such internet connection the area of Kota Lama, Semarang. Location and situation of the user when accessing the information system is included as one of factors in Physical Context in the

Context of Use in Human-Mobile Computer Interaction (CoU-HMCI model) [19]. In addition, Understanding a user's task includes the conditions and location in which the task is performed.

2.2 Method for understanding the users' usability

This study employed System Usability Scale (SUS) method to identify the user's design for using QR code. SUS is a tool that could quickly and easily collect a user's subjective rating of a product's usability[20]. The SUS, developed by Brooke (1996), reflected a strong need in the usability community for a tool that could quickly and easily collect a user's subjective rating of a product's usability. The System Usability Scale (SUS) is a reliable tool for measuring the usability. It consists of a 10 item questionnaire with five response options for respondents; from strongly agree to strongly disagree [21]. System Usability Scale (SUS) a reliable, low-cost usability scale that can be used for global assessments of systems usability [22].

SUS consist with ten question which described, below:

1. I think that I would like to use this system frequently.
2. I found the system unnecessarily complex.
3. I thought the system was easy to use.
4. I think that I would need the support of a technical person to be able to use this system.
5. I found the various functions in this system were well integrated.
6. I thought there was too much inconsistency in this system.
7. I would imagine that most people would learn to use this system very quickly.
8. I found the system very cumbersome to use
9. I felt very confident using the system.
10. I needed to learn a lot of things before I could get going with this system.

The questionnaire for this study adapt from the SUS question.

1. I think I would like to use a QR code to find information on ancient buildings when I visit Kota Lama, Semarang
2. I found that using QR code unnecessarily complex.
3. I thought the QR code was easy to use to find the story of the historical buildings when I visit Kota Lama, Semarang
4. I think that I would need the support of a technical person to be able to use QR code to find the story of the historical buildings when I visit Kota Lama, Semarang
5. I found the various functions in this system (QR code, map and web information) were well integrated to deliver information about the story of ancient building when I visit Kota Lama, Semarang.
6. I thought there was too much inconsistency in this system (when QR code used to integrate maps and the web) to get information about the ancient building at Kota Lama, Semarang.
7. I would imagine that most people would learn to use this system (when QR code used to integrate maps and the web) very quickly.
8. I found the system (QR code, map and web information) very cumbersome to use when I visit Kota Lama, Semarang
9. I felt very confident using the system (QR code, map and web information) to obtain information about ancient buildings without the other's help
10. I needed to learn a lot of things before I could get going with this system (QR code, map and web information) to obtain information about ancient buildings.

2.3 Analysing the result

To examine the result of the question, the SUS provide scale between one and five using Likert scale. For odd question (number r1, r3, r5, r7 and r9) using formula the scale – 1. As for the even number

question (R2, R4, R6, R8 and R10) the participants respond should be count using formula scale -5. From the result of first and second equation the SUS final score can be reached by using the equation 1.

$$Score\ SUS: ((r1 - 1) + (5 - R2) + (r3 - 1) + (5 - R4) + ... + (5- R10)) * 2.5 \quad (1).$$

Legend: *r1, r3, r5, r7, r9 : result for odd number question*
R2, R4, R6, R8, R10 : result for even number question

The results of the SUS score for each respondent are then summed and divided by the number of respondents (Table 2). After calculating the average score of SUS, the score was compared with the range of values proposed [20].

Table 2. Score SUS

Score SUS	***Interprets***
< 50	Not Acceptable
50 – 70	Marginal
>70	Acceptable

3. Analysis and Result

3.1 User Prior Knowledge

User prior knowledge in this research is about, the technology ownership, user experience and user frequent of use QR code and web services is essential to identify the prior knowledge for user's usability perception in the usage of QR code to recognizing the historical building. This user prior knowledge is essential as precondition to measure the usability of design of Information System [21]. It as an aid to describe the result of SUS score.

Table 3 shows the user prior knowledge for QR code usage. From the Table 3 it can be defined all of the respondents has their own smart phone. The respondents with an experience for using QR code for payment is about 59.23% and 40.77% is to get link for a website.

Table 3. Users' prior knowledge in the QR code's usage

No	Question	Criteria	Frequency	Percentage
1	Smartphone ownership	Smartphone	27	100%
	User experience for using QR code	For Payment	16	59.23%
2		To get link for a website	11	40.77%
3	User's frequent of use for using QR code	Rarely used (1-3)	4	14,77%
		Regular user (more than 3 times)	23	85.12%
4	User have experience for using Web to access information for historical building, Kota Lama, Semarang.	None	4	14.82%
		Beginner (1st time user)	1	3.70%
		Rarely used (1-3)	9	33.33%
		Regular user (more than 3 times)	13	48.15%
5	User have experience for using Map to get access as direction to explorer for historical building, Kota Lama, Semarang.	None	2	7.41%
		Beginner (1st time user)	2	7.41%
		Rarely used (1-3)	3	11.11%
		Regular user (more than 3 times)	20	74.07%
6	User have experience for using Map that contain with QR code to get access to a website for historical building, Kota Lama, Semarang.	None	18	66.67%
		Beginner (1st time user)	4	14.82%
		Rarely used (1-3)	2	7.41%
		Regular user (more than 3 times)	3	11.11%

3.2 SUS result based on the user prior knowledge.

Table 4. Users perception on usability in the QR code's usage

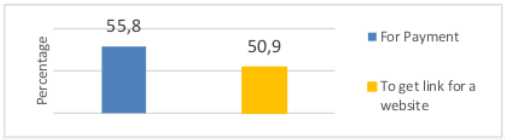
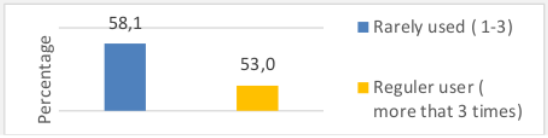
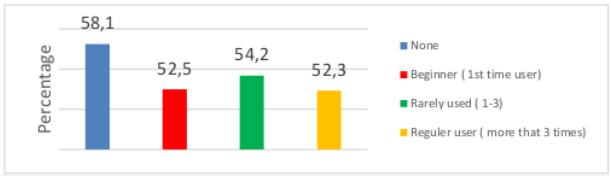
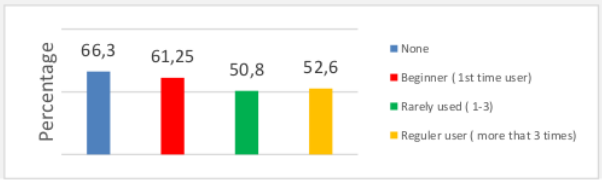
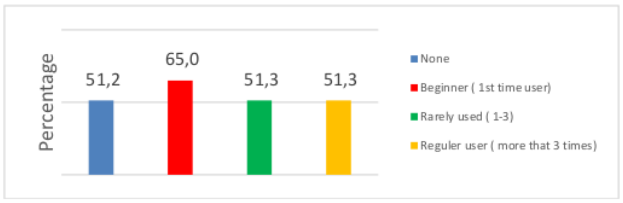
No	User Profile	SUS Result
1	User experience for using QR code for Payment and to get a link for a website	
2	User's frequent of use for using QR code	
3	User have experience for using Web to access information for historical building, Kota Lama, Semarang.	
4	User have experience for using Map to get access as direction to explorer for historical building, Kota Lama, Semarang.	
5	User with experience for using Map that contain with QR code to get access to a website for historical building, Kota Lama, Semarang.	

Table 4 shows the result of the SUS score for each respondents that have identified in Table 3 is marginal. In Figure 1, it explains the position of marginal for an adjective rating for the user.

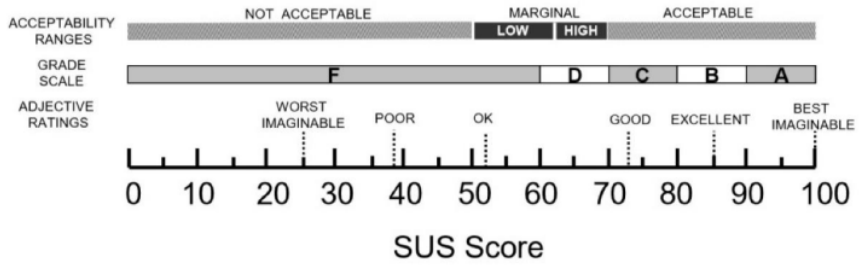


Figure 1. A comparison average SUS score

The usability testing in this research is to understand the Information System design using QR code for recognising the historical building has discover major problems in the user interface. It is suggested, that Usability testing has a number of possible goals and purposes. Certainly one of the most important is to discover major problems in the user interface that could result in human error, terminate the interaction, and lead to frustration on the part of the user [23].

Marginal according to Figure 1 with SUS score 50 can be describe as adequate, sufficient and acceptable for the user. It is due to that few of the respondent still not familiar with QR code technology (Table 3). With the result of the moderate. It is suggested that the design is still usable to be used, but is still need time for the responded to be familiar with technology. As noted in Nugrageni et al. [24] the user device and frequent of use of technology influence the ease of use of technology. Therefore, with the moderate result on usability by implementing QR code for recognising the historical building it can be applied in Kota Lama, Semarang.

Therefore, for each group that participate in the experiments examining the usability of QR code in the design of Information system for recognizing historic buildings, Kota Lama, Semarang is acceptable. Therefore, the design has a positive feedback from the participants who has an experience for visiting Kota Lama, Semarang. From the observation, many of the respondent still new with the QR code technology.

4. Conclusion

The result of SUS score is 50 which describe as the QR code as link between map leaflet and web are adequate, sufficient and acceptable for the user. Information access using QR code can overcome the problem of short explanation in map leaflet that commonly used a guide in cultural space museum.

The information of historical building using QR code is sufficient or the visitor to learn the building history. As for he QR code usability test using SUS question showed the number that the design is acceptable. Using QR codes on map might help the cultural space museum enhance their accessibility, particularly as visitors increasingly arrive with their own smartphones or tablets.

5. Acknowlegment

This article was presented at the 2nd International Conference on Smart City INNOVATION (ICSCI) 2019, jointly held by Universitas Indonesia and Universitas Diponegoro. ICSCI conferences have been supported by the United States Agency for International Development (USAID) through the Sustainable Higher Education Research Alliance (SHERA) Project for Universitas Indonesia's Scientific Modelling, Application, Research, and Training for City-centered Innovation and Technology (SMART CITY) Center for Collaborative Research, administered through Grant #AID-497-A-1600004, Sub Grant #IIE-00000078-UI-1.

6. References

[1] Pérez-Sanagustín M, Parra D, Verdugo R, García-Galleguillos G and Nussbaum M 2016 Using QR codes to increase user engagement in museum-like spaces *Comput. Human Behav.* **60** 73–85
[2] Rey F B and Casado-Neira D 2013 Participation and Technology: Perception and Public Expectations about the Use of ICTs in Museums *Procedia Technol.* **9** 697–704
[3] Kabassi K 2017 Evaluating websites of museums: State of the art *J. Cult. Herit.* **24** 184–96
[4] Yamazaki K, Heath C, Yamazaki A, Okada M, Kuno Y, Kobayashi Y, Hoshi Y, Pitsch K, Luff P and vom Lehn D 2009 Revealing Gauguin *Proceedings of the 27th international conference on Human factors in computing systems - CHI 09* (ACM Press)
[5] Schultz M K 2013 A case study on the appropriateness of using quick response (QR) codes in libraries and museums *Libr. Inf. Sci. Res.* **35** 207–15
[6] Ozok A A, Gurses A P, Wu H, Nelson M, Moen D and Wei J 2009 Usability and User Acceptance for Personal Health Records: A Perspective from Healthcare Citizens *Online Communities and Social Computing* (Springer Berlin Heidelberg) pp 690–9
[7] Dishaw M T and Strong D M 1999 Extending the technology acceptance model with task-technology fit constructs *Inf. Manag.* **36** 9–21
[8] Nielsen J 1992 Finding usability problems through heuristic evaluation *Proceedings of the SIGCHI conference on Human factors in computing systems - CHI -92* (ACM Press)
[9] Lund A M 2006 Post-modern usability *J. Usability Stud.* **2** 1–6
[10] International Organization for Standardization 2006 *ISO 9241-110: Ergonomics of Human-system Interaction* (Dialogue Principles)
[11] Vermeeren A P O S, Law E L-C, Roto V, Obrist M, Hoonhout J and Väänänen-Vainio-Mattila K 2010 User experience evaluation methods *Proceedings of the 6th Nordic Conference on Human-Computer Interaction Extending Boundaries - NordiCHI -10* (ACM Press)
[12] Bradley N and Dunlop M 2005 Toward a Multidisciplinary Model of Context to Support Context-Aware Computing *Human-Computer Interact.* **20** 403–46
[13] Kuniavsky M 2007 User Experience and Hci *The Human-Computer Interaction Handbook* (CRC Press) pp 897–916
[14] Nielsen J and Levy J 1994 Measuring usability: preference vs. performance *Commun. ACM* **37** 66–75
[15] Dumas J and Fox J 2009 Usability Testing *Human Factors and Ergonomics* (CRC Press) pp 231–51
[16] Chowdhury G G and Chowdhury S 2011 *Information users and usability in the digital age* (Facet Publishing)
[17] Krug S 2014 Don't make me think, revisited: a common sense approach to Web usability *Choice Rev. Online* **51** 51–6218
[18] Nielsen J 2012 Usability 101: Introduction to usability **9** 35
[19] Jumisko-Pyykkö S and Vainio T Framing the Context of Use for Mobile HCI *Social and Organizational Impacts of Emerging Mobile Devices* (IGI Global) pp 217–48
[20] Bangor A, Kortum P and Miller J 2009 Determining what individual SUS scores mean: Adding an adjective rating scale *J. usability Stud.* **4** 114–23
[21] U.S. Department of Health and Human Services 2017 Usability
[22] Brooke J and others 1996 SUS-A quick and dirty usability scale *Usability Eval. Ind.* **189** 4–7
[23] Norman K L and Panizzi E 2006 Levels of automation and user participation in usability testing *Interact. Comput.* **18** 246–64
[24] Nugraheni D M K and de Vries D 2016 Profile of a typical mobile SMS user in emergency situations (empirical study in an urban flood prone area) *2016 2nd International Conference on Science in Information Technology (ICSITech)* (IEEE)

Usability of QR code in the design of Information system for recognizing historic buildings, Kota Lama, Semarang

ORIGINALITY REPORT

12%	8%	8%	4%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	journals.ametsoc.org Internet Source	1%
2	Lecture Notes in Computer Science, 2015. Publication	1%
3	Submitted to Kaplan University Student Paper	1%
4	rehab.jmir.org Internet Source	1%
5	P A Cheremkhin, N N Evtikhiev, V V Krasnov, I P Ryabcev, A V Shifrina, R S Starikov. "New customizable digital data container for optical cryptosystems", Journal of Optics, 2021 Publication	1%
6	Thierry Chevallier, Gautier Buzancais, Bob-valery Occean, Pierre Rataboul et al. "Feasibility of remote digital monitoring using wireless Bluetooth monitors, the Smart AngelTM app and an original web platform for patients following outpatient surgery: A	1%

prospective observational pilot study.", Research Square, 2020
Publication

7	Dinar M K Nugraheni, Iga Alicy, Beta Noranita. "Usability evaluation to approve an information system design (case study: Immunization monitoring interface design)", E3S Web of Conferences, 2019 Publication	1 %
8	Submitted to City University Student Paper	1 %
9	Submitted to Murdoch University Student Paper	1 %
10	Vero Vanden Abeele, Bieke Zaman, Dirk De Grooff. "User eXperience Laddering with preschoolers: unveiling attributes and benefits of cuddly toy interfaces", Personal and Ubiquitous Computing, 2011 Publication	1 %
11	eprints.undip.ac.id Internet Source	<1 %
12	"HCI International 2019 - Posters", Springer Science and Business Media LLC, 2019 Publication	<1 %
13	iopscience.iop.org Internet Source	<1 %

14	worldwidescience.org Internet Source	<1%
15	orbilu.uni.lu Internet Source	<1%
16	Dinar M. K. Nugraheni, Denise de Vries. "Users' perception of ease of use (EOU) and confidence with skill using SMS in emergency conditions", Proceedings of the 3rd International Conference on Human-Computer Interaction and User Experience in Indonesia - CHIuXiD '17, 2017 Publication	<1%
17	www.researchgate.net Internet Source	<1%
18	Satu Jumisko-Pyykkö, Teija Vainio. "Framing the Context of Use for Mobile HCI", International Journal of Mobile Human Computer Interaction, 2010 Publication	<1%
19	"COVID-19 Challenges to University Information Technology Governance", Springer Science and Business Media LLC, 2022 Publication	<1%
20	businessdocbox.com Internet Source	<1%

21	media.neliti.com Internet Source	<1 %
22	ueaeprints.uea.ac.uk Internet Source	<1 %
23	btj.com.pl Internet Source	<1 %
24	"Data Driven Approaches in Digital Education", Springer Science and Business Media LLC, 2017 Publication	<1 %
25	Dinar Mutiara Kusumo Nugraheni, Denise de Vries. "Profile of a typical mobile SMS user in emergency situations (empirical study in an urban flood prone area)", 2016 2nd International Conference on Science in Information Technology (ICSITech), 2016 Publication	<1 %
26	mafiadoc.com Internet Source	<1 %
27	www.yumpu.com Internet Source	<1 %
28	researchnow.flinders.edu.au Internet Source	<1 %

Exclude quotes	Off	Exclude matches	Off
Exclude bibliography	On		

Usability of QR code in the design of Information system for recognizing historic buildings, Kota Lama, Semarang

GRADEMARK REPORT

FINAL GRADE

/0

GENERAL COMMENTS

Instructor

PAGE 1

PAGE 2

PAGE 3

PAGE 4

PAGE 5

PAGE 6

PAGE 7

PAGE 8

PAGE 9