QR code m-payment from a customer experience perspective

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Abstract
This study aimed to examine the effect of the quality dimensions of information system success model (ISSM), perceived risk, perceived transaction speed, and optimistic perspective on Quick Response (QR) code mobile payment (m-payment) experience. For this purpose, a survey was conducted in Turkey involving 207 adults who had experienced the QR code m-payment method. Partial least squares structural equation modeling (PLS-SEM) was used to investigate the relations between the variables. Research results showed that information quality, system quality, perceived transaction speed, and optimism significantly affected customer experience. However, service quality and perceived risk regarding QR code m-payment had no impact on customer experience. This study tried to reveal behavioral intentions of users in future by bringing together the concepts of ISSM and marketing, examining the QR code m-payment customer experience in the pandemic period with an integrative approach. In this context, the research has theoretical implications that extend ISSM toward improving technology-based financial services and omnichannel marketing.

Keywords
QR code m-payment · ISSM · Customer experience · Intention to use · Turkey

Introduction
In connection with the fact that technology-sensitive users, i.e., early adopters, make use of their smartphones not only for communication purposes but also for shopping and banking transactions, traditional financial transactions in developed countries have moved to mobile platforms, and smartphones have become the most frequently used tools for mobile payments (m-payments). The most striking feature of this payment method is that m-payments are made by electronic methods by eliminating the physical feature of the payment (Lee et al. 2011). M-payments are even considered as cash death (Financial Times 2015). When statistics were analyzed, more than one-third of internet users worldwide used m-payment services in 2020. Moreover, m-payment platforms reached 441 million users worldwide, with 64 million users in the U.S and 8.3 million users in the U.K in 2019 (de Best 2020). However, it has been determined that the country using m-payment most actively is China, with a penetration rate of 81% (de Best 2020).

QR (Quick Response) code, which used to be a way of accessing information or websites in the past, constitutes an important form of social distance payment today and is a convenient, and safe payment method consumers are getting increasingly used to, especially in restaurants, cafes, bars, and other hospitality venues (Sorensen 2021). QR code m-payment, which has started in China and also has a wide user base in India, is a popular payment method used in Southeast Asia, Europe, and America, especially with the effect of the pandemic (Moran 2021). In 2020, QR code m-payments accounted for about half of the total point of sales (POS) payments in China, the birthplace of the product (Worldpay 2021). While statistics from all around the world do not reflect the information on the number of m-payment users with QR code, the amount of transactions with this payment method reached $2.21 trillion worldwide in 2020. It is expected in 2025 that transaction amounts will reach $2.71 trillion all over the world, and the largest acceleration is considered to occur in emerging markets (Statista 2021). Similarly, the number of QR code m-payment users and transaction amounts in Turkey do not go beyond estimates, too. However, the young and dynamic population, smartphone ownership and usage rates, high literacy, regulations, and arrangements on the digital future (Bunmark 2017) are
important indicators of the open front of m-payments in Turkey, one of the emerging market countries.

When the literature was examined, it was seen that the history of experimental studies on QR code m-payments dated back to 2015. These studies were based on Technology Acceptance Model (TAM) (Liébana-Cabanillas et al. 2015; de Luna et al. 2019; Yan et al. 2021; Tew et al. 2021), Unified Theory of Acceptance and Use of Technology (UTAUT) (Gao and Guo 2021), UTAUT & Protection Motivation Theory (PMT) (Lee 2021), UTAUT & Mental Accounting Theory (MAT) (Zhao and Bacao 2021) and self-determination theory (Liu et al. 2021a, b), and they investigated the intention to use of QR code m-payment in future. However, since past research focused more on behavioral intention, they remained far from the customer experience perspective for new financial technologies. Not relating to customer experience is an important obstacle afront the ability to ensure the continuity of use of new financial technologies and to develop products for the future and to take them further (Hoyer et al. 2020). In particular, the COVID-19 pandemic period we are currently in has forced businesses to reorient their payment operations and customer interactions (McKinsey & Company 2021). Although QR code m-payment was introduced to consumers before the pandemic, customer experience is increasing at the present time as its use is encouraged due to various reasons (social distance, avoiding contact, World Health Organisation (WHO)'s advice on cashless payment, etc.) in this period. Customer experience is a strategic process to achieve differentiation and sustainable competitive advantage and develop customer satisfaction, customer loyalty, purchasing intention, and positive word-of-mouth communication (Rawson et al. 2013). For this reason, focusing on customer experience in the research aims to help both banks and businesses that use this product as a payment tool to understand the features that need to be developed in order to ensure the future use of the product. Moreover, reflecting the experience of customers using the product is considered important in terms of shedding light on the future of m-payment in emerging market countries. Since QR code is a way of accessing information (Tiwari 2016), examining QR code m-payment within the information system success model (ISSM) is the starting point of this research. Studies show that as well as demographic, psychographic, personal, social, and cultural characteristics, many variables such as technology, product/service category, location, and timing of purchase are effective in determining customer experience (Verhoef et al. 2009). Therefore, ISSM was extended by incorporating other critical variables such as perceived risk, perceived transaction speed, and optimism in order to shed more light on QR code m-payment. It is thought that this extended model and its findings will advance the current development of ISSM literature. Similarly, some studies have been found to reflect consumer perspective in countries where QR m-payment is most used, such as China and other Asian countries (Liu et al. 2021a, b; Le 2021; Yan et al. 2021). However, there is limited research in the literature that reflects the QR code m-payment experience of users, especially in emerging market countries. Based on these limitations, this study uses data from Turkey to reveal user experience and future usage intention in emerging market economies. The reasons for choosing Turkey in the study were its dynamic and educated population and level of technology use (Eren 2021). Another important reason was that almost all banks in Turkey offer their clients the opportunity to use QR code m-payment services.

It is considered that past studies, which do not present information technologies and marketing perspectives together, are insufficient to shed light on the future of the product since new technology products/applications do not reflect consumer perspective. However, since the viewpoints that do not reflect consumer experience will have a limited effect on the development of the deficient or weak features of the product/service, both limitations were tried to be overcome with this study. Therefore, this study has three important contributions to the current financial marketing literature. First, it fills the gap in the existing literature by associating ISSM with the concept of customer experience and evaluating relations within the framework of individual differences. Second, the study evaluates customer experience from a broader consumer perspective addressing motivations such as perceived risk, perceived transaction speed, and optimism in addition to ISSM in explaining customer experience. Third, research findings reflect insights that will help practitioners understand the behavior of QR code m-payment users, predict their future use, and develop strategies to increase the product’s spread in Turkey and similar emerging market cases of countries.

**Theoretical background and hypotheses development**

**QR code m-payment**

QR code m-payment is a form of payment performed at a workplace or at a compatible terminal, by bringing the mobile device closer to the terminal. It is getting more and more attention from individuals thanks to being an easy-to-use data exchange method, integrated with many different features, and functions of near-field communication (NFC) technology are unlimited (de Luna 2017). Since QR code m-payment services are accepted faster, easier, and safer than other mobile payment options, they have become widely experienced today, especially in societies with high technology sensitivity (Liu et al. 2021a, b; Sun
QR code m-payments are carried out in three ways: (1) reading the QR code generated by the business by the customer's mobile phone and transmitting the payment information (place of business, amount, etc.) to the customer's mobile phone; (2) QR code is scanned by the customer on the mobile phone and the phone is directed to an internet page, and then, the customer makes the shopping and pays; and (3) reading QR code containing the customer's payment information (such as credit card) by the QR code scanner on the workplace side and making the payment. Banks offer their customers two different QR code usage forms in Turkey. The first is that customers can perform automatic teller machine (ATM) transactions via the QR code produced by the customers in the bank application on their smartphone or tablet, and the other is the shopping transaction that takes place when the merchant has the QR code produced for the transaction to the bank application on the customer's smartphone or tablet and approves it. The application part of this study is based on the second form. In addition, the merchant is not obliged to use a POS terminal, and the seller can generate a QR code by using his smartphone as a POS terminal.

The workflow regarding QR code m-payment made by the customer by giving approval via bank application with the QR code produced by the merchant is shown in Fig. 1 (TCMB 2020, pp. 7, 8).

Customer experience and ISSM

The success of a new product or company depends on consumer experience; since today, the consumer is more interested in how the company sells, not just what the company sells (Sachdeva and Goel 2015). Customer experience is an integrated approach that includes interaction with the product and the company and is created during decision-making and consumption of services in this process, and it is the sum of emotions, perceptions, and attitudes. For this reason, the research is designed to be based on the concepts of customer experience and, accordingly, future use intention. In the rapidly developing information technology (IT) and IS environment, the experience of users will affect their future use intentions or attitudes toward these technologies. Hence, the intention will determine the usage of new technologies in future (Yoon and Yu, 2022). Customer experience approach was first put forward by Holbrook and Hirschman (1982) as an experimental approach to explain consumer behavior, based on providing customers with an unforgettable, unique, and enjoyable experience (Jain et al. 2017). The focus of unique customer experience is to develop lifecycle contact points for customers at every life stage and afford the customers to evaluate this experience positively (Henry and Greenhalgh 2005). The expressions used to measure

Fig. 1 Vendor-offered QR code m-payment workflow

1. The merchant starts the process of creating QR cod by entering the amount information related to the purchasing process.
2. The merchant's bank produces the QR code and transmits it to the merchant.
3. The customer scans the QR code on the screen of the merchant through the application he/she uses.
4. The customer transmits the transaction-specific reference information in the QR code forwards to the bank (customer's bank) through the application he/she uses.
5. The customer's bank, payment of the merchant through the QR code routing service forwards to the merchant's bank.
6. The merchant's bank, the information included in the QR cod, especially the reference information specific to the transaction verifies, creates payment and merchant information.
7. The actual information regarding the payment is transmitted to the customer.
customer experience in the study also include customer evaluations of the product from the customer's point of view.

Information system (IS) is “what emerges from the usage which is made of the information technology (IT) delivery system by users.” (Paul 2007, p. 194) “IS is used to acquire, store, manipulate, manage, display, transmit, or receive data. It includes both hardware and software.” (Gray 2006, p. 305) E-service is an information system and marketing channel, and in this respect, it is a technology and service-oriented concept. According to the updated ISSM, the quality of information systems is basically evaluated in three criteria: system quality, information quality, and service quality (Delone and McLean 2003). Perfection in IS quality means that the IS used includes latest technology, and the system provides faultless service (Gorla et al. 2010). Transactions made with a QR code are also considered to be one of the most effective ways to accelerate the flow and sharing of information. For this reason, the use of this model has been preferred to explain customer experience in QR code m-payment. This study examines the relations between quality dimensions (system quality, information quality, and service quality) and customer experience in QR m-payment, with an approach that brings together IS and marketing concepts.

### Information quality

Information quality is the measure of the value perceived by the user of the output produced by a website or application, and characteristics such as current, accurate, useful, complete information are considered as important determinants of perceived information (Bharati and Chaudhury 2004). In this context, complete, accurate, up-to-date, and proper presentation of information characterize are the four main characteristics of information (Wixom and Todd 2005).

In a web-based application, it is expected that the web content will be complete, relevant, easy to understand and secure so that users and potential users can make transactions, evaluate their transactions positively and continue to use the application (Delone and McLean 2003). Perceived quality of information regarding the application by the user is an important determinant in experience evaluations of web-based reference systems (Beyah et al. 2003). Customers' acceptance of a product as useful and easy to use is also an indication that the customer has a positive experience with the application. In this context, since quality of information makes the users think that the application is useful and easy to use (Shin 2015), higher the information quality and more positive customer experience regarding the use of the application are expected. Customer experience can be affected by the quality of knowledge of the technology used. Where information is irrelevant, unreliable, or outdated, consumers may doubt the reliability of service providers and their ability to provide quality service (Zhou 2013), and poor information quality can negatively shape customer experience (Saadillah et al. 2021). Since banks aim to create an overall customer experience while offering QR code m-payment to their customers, it is thought that the quality of the information provided by the QR code m-payment to the user for transaction or payment is effective in shaping customer experience. Therefore, the following hypothesis is suggested:

$H_1$ Perceived information quality of QR code m-payment has a significant and positive impact on customer experience.

### System quality

In a web-based application, system quality measures features which system users care about, such as system availability, reliability, adaptability, and response time (e.g., download time) (Delone and McLean 2003). System quality is related to the overall performance of web-based application and is measured by the degree of user-friendliness perceived by the customer when shopping from an online retailer (Lin 2007b). In this context, system quality in terms of web-based IS defines the desired and expected features for an online retailer. In a broader meaning, system quality represents the quality of the information system, including software and data components, and the processing that actually delivers it, and is considered a measure of how technically sound the system is (Gorla et al. 2010).

The systematic features of a website or application are an attractive tool for experience and interaction and continuity of them between an online retailer and its customers (Hoffman and Novak 1997). Similarly, as the system quality increases, so do the user perception of the ease of use and usefulness of the application (Hau et al. 2012; Shin 2015) and thus, user experience of the application is positive. Inadequate system quality increases difficulties in using the application and prevents users from enjoying or being happy with the product (Saadillah et al. 2021). Studies designed related to QR code use indicate that system quality, including ease of use and usability, positively affects customer satisfaction following the experience (Zhong and Moon 2022). Problems in system quality for digital payment negatively affect customer experience (Zhou 2013). In this context, system quality is as effective on customer experience as service quality in contactless payments (Petter and McLean 2009). If the QR code m-payment does not provide the user with the opportunity to access information appropriately and technically and the usability of the system is not as expected, the user’s experience with it is expected to result in a negative way. On the contrary, it is thought that perceiving the usability of the system as easy by the user will contribute positively
to the customer experience. Based on this information, the following hypothesis is proposed:

**H2** Perceived system quality of QR code m-payment has a significant and positive impact on customer experience.

**Service quality**

Although service quality is considered a sub-dimension of system quality, developments in information systems have made it necessary to evaluate service quality as a separate quality dimension of the information system (Delone and McLean 2003). In the ISS model, the success of service quality is associated with concepts of assurance, empathy, and willingness. Therefore, service quality is explained and conceptualized based on DeLone and McLean (2003). In this study, understanding the problems and requests of QR code m-payment service users, showing sensitivity, delivering fast service, and customer support are discussed with the concept of service quality. Therefore, service quality is the quality of social interaction between users and the business, reflecting trust, empathy, and sensitivity that the business arouses in the use (Lin 2007a). Service quality on online platforms is defined as the degree to which a website or application facilitates efficient and effective exchange, purchasing, and product delivery (Zeithaml et al. 2002).

Service quality, which is accepted as the general support provided by the service provider, is important for evaluating the service experience of the customer or users and continuing to use the service in terms of assurance, empathy, and sensitivity (Delone and McLean 2003). The superior service quality offered by the service providers to their customers creates a positive attitude to users of the application (Raman and Aashish 2021). As the service quality for a web application includes general customer evaluations and judgments regarding the quality of online service delivery, it is an effective factor shaping customer experience. Service quality has a significant impact on user satisfaction and emotional reactions of the user (Ali and Raza 2017). Poor service quality leads to disappointment, leading to negative evaluations of the experience by customers (Saadillah et al. 2021). For this reason, it is considered that the high level of service quality provides customers with a positive experience due to the ability to meet the needs of the customers efficiently and precisely (Seol et al. 2016). The degree of service quality provided by an IS provider is an important dimension of service success (Delone and McLean, 2003). Hence, the following hypothesis is proposed:

**H3** Perceived service quality of QR code m-payment has a significant and positive impact on customer experience.

**Perceived risk**

One of the important factors in the use and adoption of web-based payment transactions is the perceived risk of the application (Slade et al. 2013). Perceived risk actually constitutes risk perception regarding personal information that the users may encounter while using the application, as well as the risk perception of the service provider regarding the risks that the user may encounter in a technological sense (Johnson et al. 2018). QR code that transmits the visual channel is actually considered to be a secure payment method, as it cannot directly verify payment information and as it only transmits merchant numbers, information numbers, and digital signature as a value. (Lee et al. 2011). On the other hand, although QR code payment and other mobile payment systems are thought to contain some security vulnerabilities, these difficulties are overcome thanks to blockchain technologies (Smahi et al. 2020). For this reason, it is important for banks to develop and continuously improve risk prevention and control mechanism in QR code m-payment in order to prevent these attempts (The People’s Bank of China 2017).

Reducing perceived risks will facilitate the adoption of QR code payment, as the contactless feature of QR code payment leads users to question their security and risk concerns (Chang et al. 2021).

Users of a website or app can often have concerns about providing their personal information to online retailers. In this context, perceived security and low-risk perception contribute to the positive attitudes of individuals toward m-payment with QR code m-payment (Chang et al. 2021). Research indicates that risk concerns, especially for the application, negatively affect the user experience of the application and prevent the adoption of the application (Chen 2008). Similarly, when users perceive application-related risks and fail to achieve the desired purchasing goals, they have the potential to negatively evaluate their experiences (Yang et al. 2015). Thus, the perceptions of individuals that their personal and financial information will not be in danger are one of the forerunners of a positive customer experience (Park and Kim 2003). Based on this information, the following hypothesis is proposed:

**H4** Perceived risk related to QR code m-payment has a significant and negative impact on customer experience.

**Perceived transaction speed**

Transaction speed or the response time of technology to the user is a remarkable issue in information systems and e-commerce applications due to the increase in the focus on the efficiency of operational resources, and it links with user experience and satisfaction (Yoon 2010). With the advent
of web technology, customers have been able to interact directly and quickly with the bank’s m-payment services.

Nowadays, the processing speed of the application is an important determinant in positive customer experience and usage intention in future for time-efficient individuals, especially with high technology sensitivity and high compliance level. M-payments enable users to complete their payments faster and securely regardless of time and place (Liébana-Cabanillas et al. 2014). When m-payments are compared to traditional payment methods, the difference they create in terms of transaction speed also differentiates users’ experiences in a positive way (Chen 2008). NFC technology in m-payments is an application that allows users to complete the transaction on POS terminals without requiring any contact between the user and the merchant, allowing users to perceive the transaction easily and have positive experiences. (Tan et al. 2014; Boden et al. 2020). The fast realization of payment processes in m-payments made via QR code is considered as one of the most important eases of use of the application (Teo et al. 2015). As a result, transaction speed is one of the important requirements for users to have a positive experience in payment transactions (Chen 2008). It is predicted that QR code m-payment’s high transaction speed can positively affect customer experience, as the users find the application useful (Yan et al. 2021). Therefore, the following hypothesis is suggested:

**H₅** Perceived transaction speed related to QR code m-payment has a significant and positive impact on customer experience.

**Optimism**

Optimism is defined as “the tendency to believe that one will generally experience good versus bad outcomes in life” (Scheier and Carver 1992, p. 203). It is “a positive view of technology, belief in increased control, flexibility, and efficiency in life due to technology” (Walczuch et al. 2007, p. 207). Also, it is the opinion of individuals that technology contributes efficiency, flexibility, and control to their lives.

Individuals with an optimistic view are expected to be more likely to evaluate a new technology experience positively and accept the relevant technology as they focus more on positive issues (Walczuch et al. 2007). However, individuals with an optimistic point of view feel comfortable while using new technology, as well as expecting less evidence of the performance of the technology they use (Tsikritsis 2004), so their technology experience is likely to result in a positive outcome. When past studies are examined, it is seen that optimism focuses on the effect of optimism, on the usability and ease of use of mobile applications rather than investigating the effect on mobile application customer experience (Yan et al. 2021). Previous studies have indicated that optimism has a positive effect on the usefulness and ease of use of mobile applications (Kumar and Mukherjee 2013; Oh et al. 2014; Kim and Chiu 2019) and the acceptance of m-payments (Humbani and Wiese 2018). Based on these approaches, it is predicted that optimism, as an independent variable, will positively affect the QR code m-payment customer experience. In this context, the following hypothesis is suggested:

**H₆** Optimism has a significant and positive impact on QR code m-payment customer experience.

**Intention to use QR code m-payment**

Behavioral intention is defined as an individual's intention to perform various behaviors (Fishbein and Ajzen 1975). Intention to use is defined as a user's intention to continue using a technology (Bhattacharjee 2001). Measuring intention is considered important to show that consumer behavior is acceptable (Thakur and Srivastava 2013).

Service providers create relational bonds with customers by providing unique and unforgettable service experiences, thereby encouraging them to become permanent “beneficiaries” of the service (Vargo and Lusch 2008). Customers' positive cognitive and emotional responses related to a service they experience increase their intention to return to or repurchase a website (Pullman and Gross 2004). Positive customer experiences also positively affect the purchasing behavior of customers on online platforms (Zhou et al. 2007). Customers’ experiences in the process affect the decision to continue using the service. Similarly, a positive service experience leads to the willingness of customers to develop a continuous relationship with the service provider. Technology users' previous experiences are influential in shaping their future intentions (Rose et al. 2011). Therefore, the following hypothesis is proposed:

**H₇** Customer experience related to using QR code m-payment has a significant and positive impact on the intention to use QR code m-payment in future.

The research model developed in line with the research objectives and hypotheses is shown in Fig. 2.

**Methods**

**Data collection, measures, and sample**

This study was designed based on a quantitative research method. Questionnaire technique was used as the data collection method, and the scale items in the questionnaire were
adapted from studies whose validity and reliability were previously tested. These are shown in Table 1.

A five-point Likert-scale ranging from “1-strongly disagree” to “5- strongly agree” was used to measure these indicators. A questionnaire comprising these items was pre-tested. The scales used in the questionnaire were first translated into Turkish and then back into English, and the integrity of meaning and structure was ensured by obtaining the approval of academicians who are experts in their fields. The questionnaire applied to the participants in Turkish consisted of two parts: The first part contains statements about the customers’ QR code m-payment experience, and the second part contains statements to reveal the demographic structure and QR code m-payment usage habits of the customers.

In this study, convenience sampling technique, purposive sampling technique, and snowball sampling technique were used together. Sample size was calculated using the G.Power-3.1.9.7 program at a 95% confidence level before the data collection phase. Minimum sample number was determined as 206 by taking the magnitude of 0.31, the alpha value of 0.05 and the theoretical power of 0.95. Since the purposeful sampling requires participants who have experience in the research subject in order to reveal the situation more clearly (Etikan et al. 2016), the participants were asked whether they had a smartphone and QR code m-payment experience before the survey. The questionnaire form of those who answered yes to both questions was included in the sample. The survey was shared with 524 people who belonged to the author’s social media network and was over the age of 18 years via e-mail, social media (LinkedIn and Instagram), and messaging applications (WhatsApp). All participants live in Turkey. Moreover, it was requested from them to share the questionnaire with their network. The questionnaire was conducted between July–August 2021, and 213 individuals in total participated in the survey. The history of QR m-payment in Turkey is quite new, and there are no statistics on the number of individuals using this product yet. Participation in the survey was provided at a rate of approximately half. The most important reason for this can be explained as the participants having QR m-payment experience and the others not using it. As a matter of fact, 118 participants gave feedback that they did not use QR-coded m-payments despite having a smartphone. For these reasons, the sample is limited to the number of participants that could be reached. Nine questionnaire forms, which were filled carelessly through the control questions placed in the questionnaire, were taken from the data set before the analysis, and the questionnaire form of 207 participants was included in the analysis in the final case. The number of Likert-type scales in the questionnaire was 29, and it is considered sufficient for the sample to be between 2 and 10 times the number of scale expressions (Kline, 1994). The G power test also confirms that the sample is adequate (Faul et al. 2009). The reason for choosing Turkey for the application of the research is that Turkey has a population that is young, educated and uses digital banking applications intensively and the perspective that it can shed light on the future of m-payments in other emerging market countries.

Common method bias (CMB) refers to the amount of spurious covariance shared between variables due to the common method used in data collection (Buckley et al. 1990). Although there are methods for exceeding CMB, Richardson et al. (2009) argue that these techniques are insufficient in finding and correcting CMB and error, and therefore, they should not be used, and instead procedural remedies should be used to control CMB. Based on their argument, first, study participants were reassured about the anonymity and confidentiality of their responses to reduce evaluation anxiety. Then, in order to reduce the perception of any direct connection among the respondents, a psychological distinction was tried to be created by presenting the study variables in a different order and adding questions about the demographic profile between (Podsakoff et al. 2003). Also, as a statistical solution, Harman’s 1-factor (a single factor) test via explanatory factor analysis (EFA) and common method factor analysis were applied to the data to control the probability of CMB (Podsakoff et al. 2003). The results demonstrated that the average substantively explained variance of the indicators was 0.53, while the average m-based variance was 0.02. The ratio of substantive var method variance was about 26:5. So, the method is unlikely to be a severe concern for this study (Liang et al. 2007).

Demographic characteristics of the study’s participants are shown in Table 2. Overall, 60% of the participants were women (124), 58% (83) were aged between 27 and 44 years, and 48.8% (168) held undergraduate degrees. Moreover, Table 2 shows that 77.5% of the participants started to use QR code m-payment in the pandemic period and often for grocery spending.
In this study, the partial least squares structural equation modeling (PLS-SEM) approach was used to analyze the theoretical model, and Smart PLS was selected as the statistical tool. The reason for choosing this analysis approach is based on data/sample characteristics and moderation analysis, and similarly, this approach has gained a lot of importance in studies related to the marketing field (Rigdon et al. 2017). In addition, this method is suitable for simultaneously estimating a group of equations for the proposed research model, revealing the relationship between variables and measuring indirect ways (Hair et al. 2017).

As a result of the descriptive analysis, it was seen that the data were close to the normal distribution and acceptable for exploratory factor analysis (AFA) because the skewness and kurtosis values between the values were between +2.0 and −2.0 (George and Mallery 2010). To perform factor analysis, KMO (Kaiser–Meyer–Olkin Measure of Sampling Adequacy), the sample adequacy criterion, and sphericity (Barlett’s Test of Sphericity) must first be sufficient. In the principal component analysis applied to the data, it was seen that the sample size was sufficient (KMO = 0.923).

Table 1  Measures & items

| Measurement items | Measurement items |
|-------------------|-------------------|
| **Information quality** Brown and Jayakody (2008) |
| QR code m-payment provides me with the necessary information |
| QR code m-payment provides responses to queries as I expect |
| QR code m-payment provides sufficient information |
| I am satisfied with the accuracy of the information provided by QR code m-payment |
| The information provided by QR code m-payment is helpful regarding my questions or problems |
| **System quality** Brown and Jayakody (2008) |
| I find it easy to become skillful at using QR code m-payment |
| I believe that QR code m-payment is easy to use |
| Using QR code m-payment requires minimal mental effort and is quite quick in response |
| QR code m-payment is reliable |
| **Service quality** Brown and Jayakody (2008) |
| I am satisfied with the customer support provided by bank offering QR code m-payment services |
| I am satisfied with the after-sales service provided by bank offering QR code m-payment services |
| Bank offering QR code m-payment understands my problems and requests |
| Bank offering QR code m-payment service responds to my requests fast enough |
| **Perceived risk** Tam (2012) |
| I perceived the QR code m-payment service was risky |
| I perceived that while using the QR code m-payment, there was a chance that something could go wrong in the outcome |
| I perceived that the QR code m-payment service outcome and effect were difficult to predict |
| **Perceived transaction speed** Teo et al. (2015) |
| I believe that using QR code m-payment will improve the speed of transactions |
| Using QR code m-payment helps me to reduce the time spent shopping |
| Compared to traditional payment methods, I believe that transactions will be fast if I use QR code m-payment |
| **Optimism** Lu et al. (2011) |
| Technology gives me more control over my daily life |
| Products and services that use the newest technologies are much more convenient to use |
| I like the idea of doing business via technology because I am not limited to regular means |
| I enjoy using QR code m-payment |
| The experience of using QR code m-payment was interesting |
| I am happy with the experience of using QR code m-payment |
| **Behavioral Intention** Venkatesh et al. (2012) |
| I intend to increase the use of QR code m-payment in future |
| I intend to use QR code m-payment when the opportunities arise |
| I would like to use QR code m-payment for purchasing instead of traditional payment methods |
| I will strongly recommend to others to use QR code m-payment |
for factor analysis according to KMO test (Tabachnick and Fidell 2007). The Barlett sphericity test was also significant ($X^2 = 5385.525; p < 0.001$) (Tabachnick and Fidell 2007). In addition, since the measures of sampling adequacy (MSA) value was above 0.50, the analysis was continued without any questions. Having ensured the assumption of multivariate normality indicates that the assumption of linearity is also provided (Fornell and Larcker 1981). Before PLS-SEM as a first step, the survey data were analyzed using EFA. Each expression was loaded on its own factors, with factor loadings above 0.60. Table 3 shows satisfactory results for both independent and dependent variables, as well as the means, standard deviations, and eigenvalues measures.

### Confirmatory factor analysis

In the study, the model was tested with confirmatory factor analysis (CFA). A measurement model consisting of 8 latent variables and 28 indicators was evaluated using CFA. As the first step, fit values of the model were examined. Compatibility indexes (NFI = 0.929, SRMR = 0.059, $d_{ULS} = 1.706$, $d_G = 0.879$, Chi-Square = 1049.491) related to the model were obtained. The results indicate that the model seems to fit the data well (Schumacker and Lomax 1996).

In addition, PLSpredict was run to measure the predictability of the model, and it was seen that all of the $Q^2$ values in PLSpredict were positive in the model. However, linear regression model (LM) provides prediction errors and summary statistics that ignore the specified PLS path model. A comparison with the PLS-SEM results offers information on whether using a theoretically established path model improves (or at least does not worsen) the predictive performance of the available indicator data (Shmueli et al. 2019). In comparison with LM outcomes, it is confirmed that PLS-SEM results have a lower prediction error (for RMSE, MAE, and MAPE) than LM. $Q^2$ values of items of the CE scale are 0.252, 0.548, and 0.582, and the items of the IU scale are 0.017, 0.184, and 0.203. When $Q^2$ value is between 0.02 and 0.14, it indicates a small predictor between variables, a medium predictor between 0.15 and 0.34, and a large predictor when it is greater than 0.35 (Shmueli et al. 2019). These values show that there is a close to large predictor among the CE variables and a medium predictor among the IU variables.

| Variable | Item | Factor loads | Mean | SD | KMO | Eigen value | Cronbach's alpha | CR | AVE |  
|----------|------|--------------|------|----|-----|-------------|------------------|----|-----|  
| CE       | 3    | 0.752–0.929  | 4.291| 0.757| 0.637| 6.303       | 0.828            | 0.897| 0.746|  
| IU       | 3    | 0.868–0.940  | 3.666| 1.063| 0.742| 4.205       | 0.936            | 0.952| 0.797|  
| O        | 3    | 0.792–0.829  | 3.830| 0.908| 0.718| 1.113       | 0.729            | 0.847| 0.648|  
| PR       | 3    | 0.839–0.935  | 2.692| 1.092| 0.718| 1.631       | 0.866            | 0.907| 0.765|  
| PTS      | 3    | 0.885–0.891  | 4.106| 0.844| 0.739| 2.777       | 0.867            | 0.918| 0.789|  
| SEQ      | 4    | 0.807–0.868  | 3.923| 0.940| 0.835| 1.728       | 0.862            | 0.906| 0.707|  
| SYQ      | 4    | 0.707–0.904  | 4.208| 0.721| 0.729| 1.773       | 0.829            | 0.885| 0.662|  
| IQ       | 4    | 0.861–0.912  | 4.058| 0.803| 0.877| 1.856       | 0.900            | 0.937| 0.831|  

Table 2 Demographic characteristics of respondents ($n = 207$)

| Gender | Age F | Gender | Age F | Usage time f |
|--------|-------|--------|-------|--------------|
| Female | 124   | 60     | 18–26 | 5            | 0–1 year 160 | 77.5  |
| Male   | 83    | 40     | 27–44 | 120          | 1–2 year 34  | 16.2  |
|        |       |        | 45–56 | 65           | 2–3 year 13  | 6.3   |
|        |       |        | Over 57| 17          |              |       |

Table 3 Loadings, Cronbach’s alpha, composite reliability and average variance extracted
Table 3 shows that all of the first-order constructs achieved internal consistency reliability and convergent validity as Cronbach’s alpha and composite reliability (CR) values were beyond the recommended value of 0.70 (Hair et al. 2009) and average variance extracted (AVE) values were beyond the recommended value of 0.50 (Henseler et al. 2016).

Discriminant validity is the degree showing how much a dimension can be distinguished from other dimensions. To ensure discriminant validity, the square root of the mean residual variance for a dimension must be greater than the square of the correlation between this dimension and other dimensions (Cooper and Zmud 1990). Table 4 shows that the square root of AVE in all of the data models exceeded the inter-construct correlations and satisfied the criterion of discriminant validity at the level of the construct (Fornell and Larcker 1981). In the determination of discriminant validity, Henseler et al.’s (2015) heterotrait–monotrait ratio (HTMT) criteria were also used. HTMT expresses the ratio of the mean of the correlations of the expressions of all variables in the study (the heterotrait–heteromethod correlations) to the geometric means of the correlations of the expressions of the same variable (the monotrait–heteromethod correlations). HTMT value should be below 0.90 for all concepts and below 0.85 for concepts that are far from each other in terms of content. As shown in Table 5, HTMT values were found below the threshold value. Based on the findings in Tables 4 and 5, discriminant validity is considered to be provided.

Tolerance and VIF values are statistics that provide information on whether there are multiple connections. If the tolerance value is less than 0.10 and the VIF value is greater than 10, it indicates multiple connections (Tabachnick and Fidell 2007). According to Table 6, there is no multiple connection problem.

The research results show that 73.7% of CE and 15.8% of UI are explained by the related variables. Besides evaluating the magnitude of the $R^2$ values as a criterion of predictive accuracy, Stone-Geisser’s $Q^2$ value accepts as a criterion of predictive relevance, and the $Q^2$ value of latent variables in the PLS path model is obtained by using the blindfolding procedure (Hair et al. 2017). Blindfolding

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**Table 4** Discriminant analysis (Fornell and Larcker 1981)

|     | CE  | IQ  | O   | PR  | PS  | SEQ | SYQ | UI   |
|-----|-----|-----|-----|-----|-----|-----|-----|------|
| CE  | 0.864 |     |     |     |     |     |     |      |
| IQ  | 0.720 | 0.893 |     |     |     |     |     |      |
| O   | 0.722 | 0.702 | 0.805 |     |     |     |     |      |
| PR  | −0.145 | −0.080 | −0.067 | 0.875 |     |     |     |      |
| PS  | 0.724 | 0.757 | 0.726 | −0.152 | 0.888 |     |     |      |
| SEQ | 0.667 | 0.705 | 0.637 | −0.049 | 0.678 | 0.841 |     |      |
| SYQ | 0.676 | 0.699 | 0.593 | −0.183 | 0.665 | 0.637 | 0.812 |    |
| UI  | 0.397 | 0.441 | 0.425 | 0.115 | 0.474 | 0.507 | 0.426 | 0.912 |

The square root of the average variance extracted for each construct is denoted in bold and italic along the diagonal line, while the inter-construct correlations are shown below.

**Table 5** Discriminant analysis (HTMT)

|     | CE  | IQ  | O   | PR  | PS  | SEQ | SYQ | UI   |
|-----|-----|-----|-----|-----|-----|-----|-----|------|
| CE  | 1   |     |     |     |     |     |     |      |
| IQ  | 0.803 |     |     |     |     |     |     |      |
| O   | 0.814 | 0.844 |     |     |     |     |     |      |
| PR  | 0.144 | 0.089 | 0.077 |     |     |     |     |      |
| PS  | 0.845 | 0.838 | 0.810 | 0.157 |     |     |     |      |
| SEQ | 0.776 | 0.784 | 0.795 | 0.047 | 0.780 |     |     |      |
| SYQ | 0.769 | 0.784 | 0.734 | 0.184 | 0.776 | 0.743 |     |      |
| UI  | 0.447 | 0.474 | 0.510 | 0.148 | 0.520 | 0.560 | 0.488 | 1    |

**Table 6** Multicollinearity analysis results

|     | VIF    | Tolerance |
|-----|--------|-----------|
| IQ  | 4.550  | 0.286     |
| O   | 2.875  | 0.172     |
| PR  | 1.215  | 0.905     |
| PS  | 3.630  | 0.236     |
| SEQ | 2.959  | 0.466     |
| SYQ | 3.055  | 0.387     |
| UI  | 1.000  | 0.290     |
results show both CE and IU’s $Q^2$ values are higher than 0.00 ($Q^2_{CE} = 0.496$ $Q^2_{IU} = 0.125$).

**Testing the proposed hypotheses: SEM**

Within the scope of structural model investigations, bootstrapping was performed with 5,000 sub-samples and no significant change option at 95% confidence interval to test direct effects with PLS-SEM (Streukens and Leroi-Werelds 2016). The results of the hypotheses representing the direct effects according to this process are shown in Table 7. Table 7 shows that information quality, system quality, perceived transaction speed, and optimism have significant impact on customer experience ($\beta = 0.227$, $p = 0.010$; $\beta = 0.206$, $p = 0.013$; $\beta = 0.213$, $p = 0.013$; $\beta = 0.257$, $p = 0.002$); therefore, H1, H2, H3, and H4 are supported. Alike, service quality and perceived risk have no significant impact on customer experience; hence, H3 and H4 are not supported. Moreover, customer experience has a significant impact on intention to usage ($\beta = 0.397$, $p = 0.000$); so, H7 is supported.

When the research model is examined in terms of impact power ($f^2$), the optimism (O) variable has the highest effect ($f^2 = 0.100$) on the customer experience (CE)-dependent variable.

**Importance-performance map analysis (IPMA)**

To finalize the PLS-SEM analysis, IPMA was done. The standardized total effects (importance) and the standardized latent variable scores (performance) are shown in Table 8:

In terms of importance, optimism (0.284) scored the highest followed by system quality (0.185), perceived transaction speed (0.176), information quality (0.160), service quality (0.063), and perceived risk (0.046). In terms of performance, optimism (88.113) scored the highest, followed by perceived transaction speed (82.725), system quality (82.318), information quality (80.946), service quality (52.045), and perceived risk (41.510). Thus, to increase customer experience, aspects related to perceived risk and service quality should be prioritized.

**Discussion and suggestions**

In this study, the effects of the quality elements within ISSM, perceived risk, perceived transaction speed, and optimism on the QR code m-payment experience of the users were investigated. In addition, in the study, the moderator effect of age, gender, and education on the relationships between QR code m-payment customer experience and ISSMI variables and other variables were examined besides QR code m-payment customer experience’s effect on the intention to use it in future.

The results of the study show that information quality and system quality related to QR code m-payment positively affect QR code m-payment customer experience. As the positive perception of users about information and system quality increases, so does QR code m-payment customer experience. The results are supported by Zhou et al. (2011) and Trivedi (2019). Contrary to the proposed hypotheses, the results of the study indicate that service quality does not affect customer experience. It is thought that the fact that the research was conducted during the pandemic period and that participants, by putting the evaluation of service quality into the background, focused on features such as access to information, the accuracy of information, ease of

**Table 7 Hypotheses testing**

| Paths       | $\beta$ | Mean  | Standard deviation | $T$ statistics | $P$ values | Confidence interval | $f^2$ | Hypothesis support? |
|-------------|---------|-------|--------------------|----------------|------------|---------------------|-------|---------------------|
| H1. IQ → CE | 0.227   | 0.215 | 0.085              | 2.654          | 0.010      | (0.020, 0.337)      | 0.025 | Yes                 |
| H2. SQ → CE | 0.206   | 0.213 | 0.083              | 2.487          | 0.013      | (0.039, 0.387)      | 0.044 | Yes                 |
| H3. SEQ → CE| 0.072   | 0.086 | 0.070              | 1.020          | 0.308      | (−0.126, 0.060)     | 0.009 | No                  |
| H4. PR → CE | −0.022  | −0.025| 0.053              | 0.409          | 0.683      | (−0.133, 0.076)     | 0.007 | No                  |
| H5. PS → CE | 0.213   | 0.202 | 0.085              | 2.490          | 0.013      | (0.015, 0.323)      | 0.024 | Yes                 |
| H6. O → CE  | 0.257   | 0.252 | 0.083              | 3.083          | 0.002      | (0.156, 0.424)      | 0.100 | Yes                 |
| H7. CE → IU | 0.397   | 0.402 | 0.062              | 6.431          | 0.000      | (0.268, 0.508)      | 0.187 | Yes                 |

**Table 8 Importance and performance of IPMA**

| Variable | importance | performance |
|----------|------------|-------------|
| IQ       | 0.160      | 80.946      |
| O        | 0.284      | 88.113      |
| PR       | 0.046      | 41.410      |
| PS       | 0.176      | 82.725      |
| SEQ      | 0.063      | 52.045      |
| SQ       | 0.185      | 82.318      |
application, contactless, and promptness during payment. In addition, the conceptualization of service quality with "quick service, understanding customer problems and requests and providing customer support" may have affected the result in this way. This result contradicts the results of Mbama and Ezepue (2018), Zhou et al. (2011) and Trivedi (2019) in the literature. Similarly, it is concluded that there is no significant relationship between perceived risk related to QR code m-payment and customer experience toward it. It is thought that the fact that the participants do not have risk concerns regarding this payment method affects the result in this direction since the buyer and the seller are mutually together in QR code m-payment and the seller takes the payment with the buyer's approval. This result is supported by Mbama et al. (2018). In addition, the result of the study shows that as the transaction speed perceived by customers in QR code m-payment increases, QR code m-payment customer experiences are also positively affected. Mbama et al. (2018) also argue in their study that transaction speed drives customer experience. However, another result of the study is that the optimistic perspective of the users toward the technology positively affects the QR code m-payment experience. There is no study examining the relationship between the two variables in the marketing and technology literature. However, there are studies showing that optimism provides a higher perception of the ease of use and usefulness of technological applications (Kumar and Mukherjee 2013; Oh et al. 2014; Kim and Chiu 2019). Moreover, the study results indicate that the positive customer experience related to QR code m-payment has a positive effect on the users' intention to use it in future. This result is in line with Wang (2015), Chen and Yang (2021), and Rather and Hollebeck (2021).

In this context, the research has theoretical implications that extend ISSM toward improving technology-based financial services and omnichannel marketing. It fills a gap in the existing literature by associating ISSM with the concept of customer experience and evaluating the relations within the framework of individual differences. Moreover, the study evaluates customer experience from a broader consumer perspective by addressing motivations such as perceived risk, perceived transaction speed, and optimism in addition to ISSM in explaining customer experience. Finally, it reflects the insights that will help practitioners understand the behavior of QR code m-payment users, predict their future use, and develop strategies to increase the product's spread in Turkey and similar emerging market cases of countries.

As with other mobile payment methods, the number of QR code m-payment users and frequency of use are increasing nowadays. However, countries in which this payment method cannot be reached and the number of users uninformed of this payment method point to a large population. Conducting regular user surveys on service quality, information quality, and especially system quality related to QR code m-payment, and improving the system in line with the feedback received will also pave the way for a more positive customer experience. These days, when the necessity of maintaining physical distance has become a part of our routine, it is possible that the QR code m-payment will lead to more positive customer experiences as the duration of the encounter between the user and the merchant is shortened. In addition, banks or businesses that offer QR code m-payment services as a payment option convince their customers that QR code m-payment provides efficiency, flexibility, and control to their lives, which is another important factor that will positively affect the customer experience. Although the pandemic period may have accelerated the QR code m-payment experience prematurely, it is expected that the payment habits of individuals will be settled in the post-pandemic period. Therefore, it is thought that banks’ listening to the voice of the users can guide them in product development and new product design. Banks or technology companies should focus on marketing activities (such as promotions and rewards) to reduce the perceived risks of individuals and to convince them of QR code m-payment’s reliability. On the other hand, banks should cooperate intensively with technology companies in order to eliminate potential risks by always making serious investments in blockchain technology for the same purpose. In addition, banks can increase the attractiveness of the product by organizing various campaigns that include gifts or reward points that increase customer interest in the process of introducing the product to their customers or placing the product. Similarly, the public spot can be organized by governments, and various regulations can be made in order to reduce cash and direct individuals to safe payment methods.

Research’s implications for practice and society

QR code m-payment is a payment method that mediates the shopping transaction of customers with the merchant in a social distance, and due to the reduction of physical interaction, it has attracted the attention of the user, especially during the COVID-19 pandemic process. Although individuals try to stay away from sociality, they still have to be in social life due to their daily routines. In this context, the QR code m-payment is a payment form that fills an important gap in minimizing physical contact. In QR code m-payment, customers scan QR code (produced by the merchant) from their smartphones or tablets and confirm the payment and purchase information sent to the screen by the bank, and then, the payment transaction is made. In this context, it is expected that the customer experience will improve positively as the overall quality of QR code m-payment,
especially service quality, increases and users' hesitations about giving payment approval from smartphones/tablets decreases. In addition, these positive experiences will create a viral effect and increase the frequency of usage and the number of customers using QR code m-payment over time. Unlike other m-payment methods, not requiring a credit card or debit card and completing payment in a very short time with a single confirmation button from a device make it easier for users to accept the QR code m-payment. Technological adaptation of individuals and the formation of optimistic perspectives toward technology will increase the potential for a positive evaluation of the experience after the trial and trial of new financial products. However, many developing countries and emerging market countries are still outside of this system. In this context, banks' shifting their technological investments to cashless payment methods of the future will enable them to participate in the competition as well as reduce their operational costs significantly. Since the QR code m-payment will reduce cash circulation, the reduction in operational costs it will create will enable banks to direct these funds to new product research and development (R&D) activities. Thus, customers will be able to meet new products that add value to their lives faster.

From the point of view of merchants, it is an important opportunity to use the QR code m-payment option in collections, especially for small businesses that avoid the cost of this device and do not want to buy a POS terminal. It is a suitable payment method especially for businesses with less than 100 transactions daily. Moreover, apart from face-to-face purchases, QR code m-payment also negates efforts such as entering the card number, expiry date, and CVC2 codes in online purchases. Small- and medium-sized businesses, in particular, should therefore be aware of the payment solutions available to them and be motivated to encourage the use of those that best serve their needs and the needs of their customers. These conveniences and simplifications in the QR code m-payment method can also help attract more merchants, lower the cost and improve the merchant experience.

**Limitations and future research**

This study was conducted with a limited number of participants and reflects only a part of the population of Turkey. Even if the results may not be generalized to the entire population of Turkey, they reflect the reality of emerging markets with relatively high technology sensitivity and a young population. The fact that the research was conducted during the pandemic period can also be considered a limitation. This study is based on the method of making payments over the bank’s application with a QR code. However, payment with QR code is widely used independently of the banks, through chain restaurants, music, and social media applications or telephone operators. Similarly, banks offer their customers the opportunity to make transactions with QR codes in ATM transactions. Therefore, future studies may focus on these application areas. On the other hand, the effects of different variables such as trust, personality, and social influence on customer experience can be included in the study, and the effects of these variables on customer experience or use intention can be examined. However, future research can be designed to measure satisfaction, loyalty, or word-of-mouth communication behavior related to QR code m-payment, as well as reflect different country perspectives or different age groups. In addition, cultural differences or the moderator effect of other demographic characteristics can be investigated.

**Declarations**

**Conflict of interest** The author states that there is no conflict of interest.

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QR code m-payment from a customer experience perspective

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