Designing Social Networking Mobile App for Diabetes Management

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Abstract
The knowledge required for diabetes prevention and management among the rural people in developing countries vastly remains in the state of non-existence. To address this, a diabetic knowledge sharing platform, as an effective means for diabetes prevention, control, and treatment, can play role in increasing diabetes awareness and literacy. Currently researchers have emphasized the scope of peer-led learning by knowledge sharing on social media platforms in healthcare context. Therefore, by identifying this scope, we have prototyped a mobile app integrated with social media features to enable diabetic patients for cost-effective peer-led learning, knowledge sharing, and awareness building. In this process, we resorted to follow the cycles and guidelines as proposed in the Information System Research (ISR) framework for identifying users' needs and preferences as well as building the theoretical foundation for the design of an app. This study demonstrates that the users had positive response and well acceptance to this prototype app as a medium for peer-led for diabetes management. Based on the findings, the researchers are optimistic about the potentiality of the app for a wider scale adoption by diabetic patients as a cost-effective peer-led learning platform.

Keywords: Social Platform, Diabetes Management, Knowledge Sharing, mHealth, Mobile Apps.
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1. Introduction

In Bangladesh, about 8 million people have diabetes, which brings about 6.4 percent of all death incidents in the country (Palma, 2018). As of 2017, the International Diabetes Federation (IDF) has reported that 6.9% of the total population in Bangladesh has diabetes (IDF, 2018). An epidemiological study by Islam, Khan, Basak, Khanam, and Masum (2016) also reported about the disproportionate increase of diabetic patients in Bangladesh, a developing country, which is higher than earlier. They ascribed this worsening issue to the rapid urbanization and change in lifestyle. About 33% of the population who are above the age of 35 are pre-diabetic in Bangladesh (Aowsaf, 2018). Unfortunately, most of the time, diabetes among Bangladeshi patients is not diagnosed until complications appear, which often leads to adverse health conditions, which can be prevented most of the time. As a result, nationwide diabetes awareness and screening are suggested by experts, especially in low-income settings in rural areas (Hasan et al., 2019).

The common complications found in diabetic patients in Bangladesh are stroke, nerve damage, kidney disease, leg ulcers, and blindness (Haque et al., 2017). These complications exacerbate even more when poor diabetes management is attended by reduced blood-lipid profiles, hypertension and obesity. The treatment for diabetes is more expensive than other chronic diseases, which, in general, costs 6.1 folds more for diabetic patients than non-diabetic patients (Palma, 2018). Hence, a scoping review by Biswas, Islam, Rawal, and Islam (2016) on the diabetic patients in Bangladesh recommended for developing preventive and management strategies for diabetes with the assistance of government and stakeholders. The implementation of such a strategy can spread awareness and knowledge about diabetes, its risks, and mitigation.

The daily expenditure by diabetic patients has a negative economic impact on nations. For Bangladesh context, the prevention and well management of diabetes can significantly minimize the financial burden (Islam et al., 2017). Study shows that the required knowledge for diabetes prevention and management among the rural people in Bangladesh vastly remains in the state of non-existence, which is a threatening condition that necessitates large-scale awareness initiatives as soon as possible (Fottrell et al., 2018). With that regard, to increase diabetes awareness and literacy, the initiatives have to primarily involve knowledge sharing facility as a way for diabetes prevention, control and treatment, and for making awareness on the consequences of the risks associated with diabetes.

Diabetes has become a national health concern in Bangladesh; yet, its effective management rate is significantly low (Rahman et al., 2015). It is estimated that by 2030, Bangladesh will be the 6th country in the IDF SEA region in the world in terms of the population living with diabetes, which will challenge its health system to meet its population's demands (IDF, 2017). It is therefore expected that the increasing incidence of diabetes will have overwhelming social and economic impacts on the country's overburdened healthcare systems. Heisler (2007) reported that peer to peer support model is useful for improving diabetes management and achieving a clinical outcome. In such a situation, peer-led education by knowledge sharing on diabetes management is recommended by Khan, Saleh, and Pathan (2018) in Bangladesh context along with learning from the health professionals, which is too costly to provide to the individual patients. The peer-led learning is a form of
community learning through social support programs which is both cost-effective and flexible and preferred by the healthcare scientists, today. As social networking platforms nowadays have become an effective and ubiquitous platform for easy and quick exchange of information, the scope of peer-led learning through sharing and disseminating knowledge based on personal experience has increased exponentially (Alanzi et al., 2016).

From e-learning to peer to peer-based social learning in the healthcare context has increased not only the access to learning but also online social support (Hajli et al., 2013). Healthcare-focused social networking platforms such as PatientsLikeMe, MedHelp, TrackMyStack, and CureTogether facilitate the empowerment of patients, where the patients can share health knowledge and medical information, and as well as can participate in peer-led learning by continuing discourse on health education, health management and medical conditions (Wicks et al., 2010). Such peer-led learning eventually helps the peers by emotional support and to learn from each other about effective self-tacking, peer-tracking, peer-benchmarking, diagnosing disease symptoms, and personalization, modification, and altering of medications for better health management. People can be educated, and their awareness levels can be increased through information sharing and discussions via mobile social networking applications, which are very convenient and easy to use. This can rapidly decrease healthcare expenditures in managing such chronic diseases and help people to self-manage their condition effectively (Alanzi et al., 2018).

Mobile application (app) is now increasingly used for preventing and controlling diabetes through lifestyle management. Innovative approaches using information technology and mobile health (mHealth) might be an option where traditional methods have failed to deliver sustainable health attention to individuals with diabetes (Islam et al., 2016). The development and implementation of mHealth apps can play an alternative and imperative role in overcoming these limitations in low resource settings of Bangladesh (Vatsalan et al., 2010). Many private and public sectors have invested millions of dollars in this domain. In addition, a total of 180 mHealth apps available in Bangladesh under seven clusters that are primarily designed to fit more or less all the major mobile devices (Karim et al., 2016). Several controlled trials of mHealth intervention by sending a regular voice message along with community-led workshops in the rural areas in Bangladesh has shown cost-effective and positive outcome in awareness building and control of diabetes and its complications (Fottrell et al., 2018; Haghparast-Bidgoli et al., 2018). Kaium and Alam (2019) suggested using mHealth based follow-up and SMS for diabetic patients. However, none of these mHealth interventions for diabetes control worked specifically at peer to peer level that enables peer-led learning and sharing of more personal experience and motivation.

However, in Bangladesh context, little or no studies have examined the scope of designing and developing a mobile app based on the social networking concept that facilitates diabetic knowledge sharing for preventing and controlling diabetes. Most today's social networks are focused more towards teenagers and young adults as a virtual discussion area. However, there is a lack in one crucial area of social networking development, and that is the medical/healthcare industry. Such knowledge sharing by a mobile app is vital for cost-effective learning and awareness building by diabetic patients with various needs.

Diabetes mellitus demands continuous medical care, patient education, self-management, and regular access to support systems. Considering the complications associated with diabetes as well as factors like increasing mobile penetration in Bangladesh, the primary aim of this study is to design the social networking mobile application for increasing knowledge, self-
efficacy, and awareness about diabetes management among the patients in Bangladesh context. In this process, this paper presents the methods of designing and developing a mobile app based on a social networking platform for diabetic knowledge sharing by diabetic patients in Bangladesh.

2. Literature Review

There are two main approaches to perform data transfers in today's IP-based networks. One is based on FTP and several variations to that protocol, and the second, and much newer, approach is based on peer-to-peer networking configurations. Started with the use of Web 2.0 tools in the healthcare context that enable social networking functions such as knowledge sharing, social learning, and social interaction (Lau, 2011). Social media is now widely used for medical education (Popoiu et al., 2012). The researchers have emphasized understanding social interactions among online communities in the healthcare context (Tsouri et al., 2016). When studying the user preference for mobile app development for diabetic patients, Conway, Campbell, Forbes, Cunningham, and Wake (2016) reported that there is a demand for social media features integration in mobile apps for diabetes in their studies. A study of a diabetes-specific mobile app, which enables social networking for health knowledge sharing by the patients, reported well acceptability by users in Saudi Arabia (Alanzi et al., 2016). Also, Alanzi (2018) studied the role of social media in diabetes management and found positive influence of social media on the self-management of diabetes in the Middle Eastern region.

The diabetes-focused mobile apps have shown evidence as a knowledge translation medium and in diabetes self-management and personalizing lifestyle behaviors (Goyal, 2017). A longitudinal study shows that the use of mobile health applications has been found convenient, beneficial, and promising to educate, motivate for self-management, and render social support for low-income Latino diabetic patients (Burner et al., 2018). Because of the wide-spread availability of mobile phones that enables easy access to health information and experience sharing, the design and application of mobile app as a platform with social networking functions is gaining popularity. For example, a mobile app called Bhalo Achi was designed based on social networking concepts to facilitate peer-led health information dissemination in the rural areas in Bangladesh (Miah et al., 2017). Based on the theory of Social Exchange, that app was found useful as a healthcare decision support medium and for reducing the digital divide among rural communities. Similarly, it was found that the application of the social exchange theory can explain three leading underpinning causes of knowledge sharing in the context of online health communities. The reasons are users' senses of self-worth, perceived social support, and achieving reputation that influence the users for health knowledge sharing on an online platform.

The ways and mediums for diabetes care and management in this digital age are remarkably transformed by the improvements of information and communications technology (ICT) (Fatehi et al., 2018). With that regard, Gavrila, Garrity, Hirschfeld, Edwards, and Lee (2019) identified that online peer support in diabetes social media communities could empower the diabetic patients through knowledge sharing, and emotional and technical supports. On the other hand, Oliveira, Souza, de Lima, da Silveira, and de Souza (2014) found that their peer-to-peer Mobile Exchange of Knowledge (MEK) software can facilitate active participation of the people with similar health interests and needs. Furthermore, in Sub-Saharan Africa, instant messaging mobile apps are used as a cost-effective means of knowledge creation and sharing that is now significantly considered as a new knowledge tool in global health context (Lee & Mwaikambo, 2018).
Kim and Seo (2014) propose an SNS-based mobile application for diabetes self-management. The system offers tailored information that can induce changes in patient behavior through relevant and helpful messages, exchanges, and news. Also, the usage of social networking applications like Facebook, Skype, and WhatsApp on mobile devices is increasing rapidly (Alanzi et al., 2018). Social networking platforms such as Facebook and Twitter have support groups in which people can share information and participate in discussions. On the other hand, apps like “MobiMood” allows seeking emotional support by sharing self-tracking records or achievements of mood on social networks (Caldeira et al., 2018). Another app also allows seeking social support and communication, which is designed explicitly for asthma patients (Roberts et al., 2016). However, none of these apps have been developed by following a Design science (DS) framework and theory together that can explain the underlying motivation of the users in peer-led learning and sharing their knowledge on diabetes spontaneously.

Numerous reviews have attempted to assess the quality and characteristics of current mobile applications, a challenge in the ever-changing world of app development (Hood et al., 2016). There is inadequate systematic assistance via social support to solve the problem of emotional support for people with diabetes, who need to receive lifelong treatment. To induce regular and comprehensive care for diabetes, rigorous self-management is essential during the diabetic's life; this is possible through a collaborative patient-physician healthcare model.

This study is significant as unlike other apps; the authors have used the theory of Social Exchange as a theoretical foundation of the designed app to justify the addition of social features in the app, and also followed Information System Research (ISR) framework (Hevner, 2007) to involve the users in the app design and evaluation phase. The social exchange theory can explain three leading underpinning causes of knowledge sharing in the context of online health communities. The reasons are users' senses of self-worth, perceived social support, and achieving a reputation that influences the users for health knowledge sharing on the online platform.

3. Design Methodology
To design a useful mobile app based on the social networking platform, we resorted to following the cycles and guidelines as proposed in Information System Research (ISR) framework (Hevner, 2007). ISR framework helps in the identification of users' needs and preferences regarding mobile app development and use (Schnall et al., 2016). It consists of three cycles, namely Relevance Cycle, Design Cycle, and the Rigor Cycle (Figure 1). The Relevance Cycle lets us understand the users' requirements concerning any problem by surveying them, and the Design Cycle lets develop the artifact (the mobile app) through constructing and evaluating the evolving artifact. And the Rigor cycle entails consideration of theories contributed to design the artifact. It is vital to follow the ISR framework for specifying a design-based solution artifact, applying the solution, assessing the design artifact, and presenting study details and results.

3.1 The Relevance Cycle
Since the overarching goal of this study is to design and develop a mobile app based on the social networking platform for knowledge sharing and peer learning by the diabetic patients, we started with Relevance Cycle where we have identified the problem relevance which is to develop a cost-effective way of knowledge sharing that is relevant and vital to the target population (i.e., diabetic patients). In this cycle, we also have conducted two focus group discussion (FGD) sessions consist of eight participants (five males and three females). The
participants were aged 25–65 years. All the participants were diabetic patients from rural areas to address their needs, and they were recruited based on purposive sampling because of the convenience of the authors. Each FGD session spanned slightly more than 50 minutes, involving proving the participants with multiple series of questions to understand their needs and motivation. The FGDs were essential to identify the functional requirements for cost-effective peer-led learning by knowledge sharing.

After focus group discussion, the thematic analysis shows that for peer-led learning, they are interested in knowledge sharing, and peer-performance sharing as functional requirements to manage diabetes. The interview of the health experts also guided to keep the app functions as per the medical guidelines. It also identified whether the participants indicated positivity in adopting such a mobile app as a tool for peer-led learning by knowledge sharing and diabetes management by peer-performance sharing. The intention of the adoption of such a social platform-based mobile app was found to be high among the younger participants aging between 35 to 45 years old who prefer a mobile app for better diabetes management.

![Figure 1: Information System Research (ISR) framework (Source: Hevner, 2007)](image)

### 3.2 The Design Cycle

After identifying the functional requirements, we also have conducted two more FGDs (consist of 6 participants) design sessions to identify the most desired features for peer-led learning for app design. The six participants (three males and three females) were recruited from the eight participants of the relevance cycle in a similar way. The respondents were encouraged to answer the probing questions that seek information on what users need from a mobile app used for peer-led learning, and how the functional requirements can be fulfilled by incorporating different features. During probing questions, the respondents revealed the preference for the usability features (Table 1, the rightmost column named 'How') of how the functional requirements can be fulfilled. The respondents recommended the inclusion of features such as answering other users' questions for knowledge sharing and diabetes tracking for peer-performance sharing.
<table>
<thead>
<tr>
<th>Topics</th>
<th>What (Contents)</th>
<th>How (Features)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knowledge sharing</td>
<td>An interactive social media platform</td>
<td>• Chat and communication</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Online discussion</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Share Diabetic educational contents</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Answering to other users’ questions</td>
</tr>
<tr>
<td>Peer-performance sharing</td>
<td>Tracking performance in diabetic management</td>
<td>• Diabetes (Glucose level) tracking</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Blood Pressure (BP) tracking</td>
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<td></td>
<td></td>
<td>• Weight tracking</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Activity (daily walk steps) tracking</td>
</tr>
</tbody>
</table>

**Table 1: Results from focus group sessions on app design**

A group of three participants from the last two focus group design sessions was present to give their opinion during the mobile app interface design for prototyping. They were shown the draft interface in Android Studio software. Also, in the design cycle involved the evaluation of the users' experience regarding user interface and app usability of the prototype. This process was iterative and formatively evaluated from the perspective of consistency with the previously identified functional requirements and users' needs.

### 3.3 The Rigor Cycle

The objective of this cycle is to improve the users' acceptance. In this cycle, the researchers studied the theories that explain the users' motivation for knowledge sharing for peer-led learning on a social media platform. After reviewing the literature, it was found that the application of 'Social Exchange Theory' can explain the underpinning factors influencing the 'exchange of resource' (e.g., knowledge sharing) (Hall, 2003). This theory conceptualizes why a person values something that belongs to another person and prefers to exchange based on cost-benefit analysis (Cook et al., 2013). The benefits could be of various types of rewards, such as economic, social, and personal rewards (Hall, 2003) (Figure 2).

As social exchange drives knowledge sharing, this theory explains why users would exchange information in an online environment. This theory can aptly interpret the reasons for the co-construction of knowledge on the online social networking platforms by the users by understating the worth of entering into an exchange (i.e., knowledge sharing). Therefore, based on figure 3 below, this study postulates five hypotheses based on which the researchers have incorporated features of peer-led learning by knowledge sharing in the artifact. Based on the FGDs in the previous cycles and 'Social Exchange Theory,' these hypotheses assume that the diabetic patients share experience on the social platform because of social rewards, economic rewards, personal rewards, health rewards, and for attaining reputation. Hence social media-based mobile app for peer-led learning by knowledge sharing is useful for diabetes management. These five hypotheses are:

- Peer-led learning opportunity encourages knowledge sharing on social platform.
- Low-cost access to information supports knowledge sharing on a social platform.
- Personal satisfaction encourages knowledge sharing on social platforms.
- Personalized healthcare opportunity helps knowledge sharing on a social platform.
- Reputation gaining opportunity encourages knowledge sharing on social platforms.
4. Functional structure and features

The diagram of the overall system architecture of the mobile app is shown in figure 3 below. The system has two parts, 1) the user end, and 2) the back end. From the user end, the users can use two functional modules, which are: 1) knowledge sharing and 2) peer-performance sharing. And from the back end, the functions of admin panel module are maintained. For data security and scalability, cloud storage is used with maintaining user privacy. The prototype of the app runs only in the android mobiles. Figure 4 below shows the screenshots of the functionalities, as described below.

Figure 3: User end and back end with their respective function modules

4.1 Knowledge Sharing Module

This module has the features that allow the users for knowledge sharing by answering different questions on diabetes or by starting a discussion on any diabetic topic. Such activities lead to peer-led learning where the users continue discussion asynchronously. Other peers or users can like the posts during the discussions, and most users with the maximum...
number of like’s area ranked in the dashboard. A similar function helps a user to increase their reputation and interest in knowledge sharing. Under this module, screenshot 1 (figure 4) shows that the app has the features of Chat and communication, Online discussion, Share Diabetic educational contents, and Answering to other users’ questions.

4.2 Peer-performance Sharing
The screenshot 2 (figure 4) shows that using this module, the users from the peer group can keep records of their Diabetes (Glucose), Blood Pressure (BP), weight tracking, and activity (daily walk steps) performance with other peers. This function shows the graphical representation of their performance on various diabetes management criteria. It works like content sharing on the social networking sites that allows comparing one member’s performance against the other peers in the groups. The most successful achiever(s) from the peer group encourages others by sharing his/her positive experiences and allows them to share their record with other peers in their peer groups.

Figure 4: The screenshots of the app

4.3 Admin Panel Module
Screenshot 4 shows the necessary functions that the admin needs to maintain the system that includes scalability, user registration tracking, and preventing the users from spamming.

5. Findings and Discussion
Once the prototype is developed by following the iterative process of the ISR framework, the usability study shows the result of the usability aspects of the prototype app. For usability study, a total number of 40 diabetic patients (25 males and 15 females) were asked to install the app in their Android mobile. The average age of the participants was 41.4. The participants were shown how to use the two modules of the app (knowledge sharing and peer-
performance sharing) and asked them to apply for three months. Then it was found that a total number of 67 chat sessions were recorded as details presented in Table 2. In the peer chat sessions, the peer mainly liked to get motivation for life-style and diet management for diabetes management. Also, 31 times the peers (users) have answered the questions of other peers, and nine times the peers shared diabetic educational contents with other peers. Moreover, it was found that 38 and 19 participants tracked their blood glucose level and activity (daily walk steps) respectively. Likewise, it was found that only 8 participants out of 40 participants shared their diabetes tracking information with their peers. In contrast, 10 participants out of 40 participants shared their activity (daily walk steps) tracking performance.

<table>
<thead>
<tr>
<th>Features used</th>
<th>Use frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chat and communication</td>
<td>67</td>
</tr>
<tr>
<td>Online discussion</td>
<td>15</td>
</tr>
<tr>
<td>Share Diabetic educational contents</td>
<td>9</td>
</tr>
<tr>
<td>Answering to other users’ questions</td>
<td>31</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Features used</th>
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</thead>
<tbody>
<tr>
<td>Diabetes (Glucose level) tracking</td>
<td>38</td>
</tr>
<tr>
<td>Blood Pressure (BP) tracking</td>
<td>15</td>
</tr>
<tr>
<td>Weight tracking</td>
<td>7</td>
</tr>
<tr>
<td>Activity tracking</td>
<td>19</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Features Shared</th>
<th>Share frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diabetes (Glucose level) tracking</td>
<td>8</td>
</tr>
<tr>
<td>Blood Pressure (BP) tracking</td>
<td>2</td>
</tr>
<tr>
<td>Weight tracking</td>
<td>5</td>
</tr>
<tr>
<td>Activity (walk steps) tracking</td>
<td>10</td>
</tr>
</tbody>
</table>

**Table 2:** Frequency of the features used and performance shared by the participants in two months

About 58% participants asked questions about where and what treatment to seek for diabetes-related complexities and 22% participants asked question about what diet tips to follow for diabetes control. Two doctors monitored and moderated the contents and answered when needed to avoid the dissemination of wrong information. It was also found that most of the time, the users followed the guidelines appropriately for content sharing, questioning, and answering on the app. At the same time, the participants' feedback has provided a strong foundation for the development of this prototype version to a potentially usable and widely adopted app. The feedback for the participants shows that although peer-led learning is informal, this app allows constructivism-oriented learning where the individuals (learners) actively interact with other individuals and experts for learning by knowledge sharing.

Lastly, the participants were given a questionnaire (Table 3) to rate their overall perception of the app. The initial result indicates high general acceptance by participants in using the app. The user's overall satisfaction was also positive. Furthermore, 81% of the participants were strongly agreed when asked about the app as a source for knowledge sharing. Hence, the integration of social media features has brought a new change of health-seeking behavior in diabetes management. The overall reaction of the participants regarding the use of this app was good. Hence, depending on the awareness creation of this app, the researchers are optimistic about the wide-scale adoption of the app as a means of cost-effective peer-led learning platform.
<table>
<thead>
<tr>
<th>Items</th>
<th>Item Mean (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Not useful/Useful</td>
<td>4.71 (1.23)</td>
</tr>
<tr>
<td>2. Difficult/easy</td>
<td>4.69 (1.30)</td>
</tr>
<tr>
<td>3. Frustrating/satisfying</td>
<td>4.01 (1.31)</td>
</tr>
<tr>
<td>4. Inadequate empowerment/adequate empowerment</td>
<td>4.43 (1.22)</td>
</tr>
<tr>
<td>5. Dull/Interesting</td>
<td>4.29 (1.12)</td>
</tr>
<tr>
<td>6. Low educative/High educative</td>
<td>4.07 (0.94)</td>
</tr>
<tr>
<td>7. Lowly interactive/Highly interactive</td>
<td>4.81 (0.13)</td>
</tr>
<tr>
<td>8. Low social integration/High social integration</td>
<td>4.59 (0.97)</td>
</tr>
<tr>
<td><strong>Overall Mean =</strong></td>
<td><strong>4.45</strong></td>
</tr>
</tbody>
</table>

Table 3: Overall reaction of participants to the eight items

6. Conclusion, limitation, and Future Work

This study started with conceptualization of designing a mobile app as a social media platform to facilitate cost-effective peer-led learning for diabetes management, then followed by the information System Research (ISR) framework, and ended with the development of a prototype. Our study has especially focused on following design science guidelines (i.e., ISR framework) on the development of a mobile app based on a social networking platform for diabetic knowledge sharing. In the ISR framework, we iteratively refined the app by vetting the recommendations and feedback given by the participants and experts to fulfill the needs of the users as well as the objective of the app. Following the ISR framework, the ‘Social Exchange Theory’ was used as the theoretical foundation to design the artifact.

This study demonstrated some interesting insights about the users’ preferred features (Table 1) for knowledge sharing and peer-performance sharing. The findings show that the users have demonstrated positive response and acceptance to this app (Table 3), which has positive practical and theoretical implications for researchers, health professionals, diabetic patients, and stakeholders. Such a positive response from the participants at the prototype stage of this app has motivated the researchers to explore the scope for developing beyond a prototype version and implementing full-scale adoption by creating awareness.

The major limitation is that the app has not been formally tested yet in accordance with any comprehensive assessment checklist such as the mERA checklist developed by World Health Organization (WHO). Therefore, a future study can be conducted for evidence reporting, based on mERA checklist, on the effectiveness of peer-led learning for diabetes management through mobile app intervention. Moreover, the hypotheses proposed based on ‘Social Exchange’ theory in the Rigor Cycle of the ISR framework are yet to be tested and proved. Another significant limitation of this study is that we have not collected any information regarding the diabetic health literacy of the participants to understand how that affects the peer-led learning using this app. With that regard, another future study can be carried out to analyze the quality of the posts and contents shared by the users on peer-led learning using the app. A cost-benefit analysis of peer-led learning on this app is yet to be conducted. Finally, the evaluation of this app needs further study as the preliminary assessment was conducted using non-generalizable sample participants.

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