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Mobile Applications in Supporting Open and Distance Learning Students' Research

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Abstract: Honours students, who are mostly new to research, require support in finding, selecting and sharing information resources to conduct research. Providing students with access to information resources becomes problematic in Open and Distance Learning (ODL), especially in developing countries due to constraints that are introduced by distance among the students, and between students and the supervisors. The constraints include isolation, lack of peer collaboration, the cost of Internet facilities, and time management for working students. Mobile applications could offer solutions, but the extant literature offers little guidance on the functional design of such applications. This design science research study presents a mobile tool with an interface for information access, information sharing and collaboration. The evaluation results show that the tool supports collaboration effectively by allowing students to access and share information. Besides the proof of concept, the theoretical contribution also lies in sharing the recommendations for improving the functionality of similar applications.

Keywords: Open and Distance Learning, Mobile Application, Collaboration, Information Sharing, Information Access

1. Introduction

Open and Distance Learning (ODL) in universities aims to provide access to the world of higher education by bridging the distance created by communication difficulties, economic, educational, geographical and social factors [10]. ODL provides flexible learning opportunities through learning environments that are process oriented and designed to promote discovery versus memorisation or mere repetition of content [5]. ODL provides accessibility, affordability and life-based education opportunities [23]. The 2020 health pandemic related to Covid-19 increased the importance of online learning and the interest in ODL. However, the nature of the ODL environment requires students to manage the diverse and often conflicting demands and responsibilities of work and family, along with their commitment to further education and learning [10; 35].

Many universities nowadays require students to complete research projects. In the South African context, this is normally done at Honours level. ODL requires such students to take increasing responsibility for the direction and management of their research [35]. Learning difficulties in research often have a negative impact on students' attitude towards and interest in research, as well as on their academic performance [36]. Some students experienced extreme difficulty when they could not move beyond their previous educational and cultural understanding to view their new learning research environment [35]. There are a variety of research difficulties for new researchers, from finding a gap in the literature to assessing sources [9]. Most ODL students who are new to research experience challenges in the development of the research proposals [20]. The problems included not knowing where to access the information and what to include in the research

proposals. This study presents the evaluation of a mobile tool to support the students specifically those new to the ODL research environment. While there are several existing mobile applications developed for social interactions, none of those were developed or tested for providing a service to ODL novice research students in terms of their information access needs and security requirements. Furthermore, the existing mobile applications do not have a standardized structure such as a share repository. The contribution of the study is to provide insight on the value added by the mobile application and recommendations for improving the functionality of similar applications.

The paper is structured as follows: Section 2 provides a literature review discussing terminologies, concepts and advantages within the scope of this study. Section 3 presents the research methodology applied in this study while Sections 4, 5, 6 and 7 present the data analysis, discussions, limitations, and conclusion, respectively.

2. Literature Review

2.1 Open and Distance Learning

ODL is described as an approach that focuses on opening access to education and training provision, freeing students from the constraints of time and place, and offering flexible learning opportunities to individuals or a group of students [33]. ODL is way of providing a learning opportunity that is characterized by the separation of teacher and student in both time and place [21]. ODL combines the principles of student centeredness, lifelong learning, flexibility of learning provision, the removal of barriers to access, the recognition of credit for prior learning and the provision of student support [32]. Furthermore, it extends learning participation to students from less privileged social groups who cannot access higher education due to diverse factors, such as financial constraints or domestic arrangements [4].

Academic support to ODL students is of the utmost importance [23]. ODL supports blended learning as it combines the advantages of both ways of teaching –traditional teaching and teaching with the use of technologies [33]. ODL promotes self-motivation and independency since ODL students rely on their own sense of personal responsibility and independence [8].

Despite these advantages ODL has constraints such as distance and time. This occurs when the physical distance does not permit direct interaction between the teacher and the student [12]. Interaction is one of the most challenging educational aspects to build into an ODL system [11] due to the students being off campus during regular time [12].

2.2 Mobile Application

Mobile applications (MAs) are application software designed and developed to run on mobile devices, e.g., smartphones, tablets, etc. [37]. With the rapid growth of these applications, users can interact and access many activities such as social media, electronic communications, online shopping, online learning and life information. MAs are found in the fields of education, entertainment, medicine, communication services, military systems and many other institutions [17].

In distance learning MAs enable collaboration, provide students with more control over the learning process and support the varying pace of the students [29]. MAs have been developed in different educational fields to encourage and facilitate distance learning, and increase the interaction between the students and teachers [16]. Table 1 presents examples of educational MAs and their purposes. However, no application found focused on the need to support information sharing for research collaboration in ODL. This need is not met by the existing technologies like learning management systems because of lack of capacity and

frequent downtime. Furthermore, email or other means of sharing information lacks the facility of providing access to the other students in the group.

Table 1 Mobile Applications in Education

Name	Purpose
UCLA	Provides access to library databases and catalogues [7]
VocBlast	Helps university students learn technical vocabulary [3]
SciPro	Supports and facilitates autonomous learning in higher education [1]
ThinknLearn	Has the educational purposes of increasing students' experience as well as deploying them in technical inquiry practices [2]
MobileEdu	Improves the pedagogical experiences of students [25]

2.3 Usability

Usability is one of the most important aspects of quality for any kind of product [26]. Usability is defined according to the International Standardisation Organisation as ''the *effectiveness*, *efficiency* and *satisfaction* with which specified users can achieve specified goals in a particular environment" [18]. *Effectiveness* is the completeness and accuracy with which users achieve a certain goal [26]. *Efficiency* refers to the amount of resources a user spends to reach a task goal. (e.g., task completion time). Both effectiveness and efficiency represent different kinds of performance measures [31]. *Satisfaction* is considered as an attitude towards the product and it is a subjective measure that is typically collected in usability tests by means of questionnaires [18]. In ODL institutions usability plays a major role since students work in isolation, and under time constraints. The effectiveness, efficiency and satisfaction of MAs were evaluated in this study.

3. Methodology

The methodology used was the design science research (DSR) approach, which is primarily concerned with research into design as science [15]. The intent of DSR is to create an artifact through a balanced process that combines the highest standards of rigour with a high level of relevance [24]. Hevner, March, Park, and Ram [15] introduced seven guidelines that were followed in developing and evaluating the mobile application. The application (Figure 1) was developed using Java Studio, PHP, and CSS programming languages.

A pilot study using two Honours project students tested the research design, determined the reliability and validity of the research methods, and clarified the instructions. During the pilot study, the participants could not complete the given tasks because the mobile application could not upload the electronic file. The main study was conducted in the research area for postgraduate students (honours, master's and doctoral students) at the University of South Africa (UNISA) main campus. This enabled credible real-life participation since it was the UNISA honours students' usual study environment. Thirty Honours project students (13 females and 17 males) participated by using the mobile application to access information, collaborate, and share the information.

The quantitative data generated from the PSSUQ was analysed using the Statistical Package for Social Science (SPSS) but here only the qualitative evaluation is discussed. Qualitative data were generated from the structured post-interview questions because each participant had to answer a predefined set of questions. Qualitative data analysis involves the making of inferences about data by systematically and objectively identifying special characteristics within them [14]. Thematic analysis was used to identify patterns or themes within qualitative data [6].

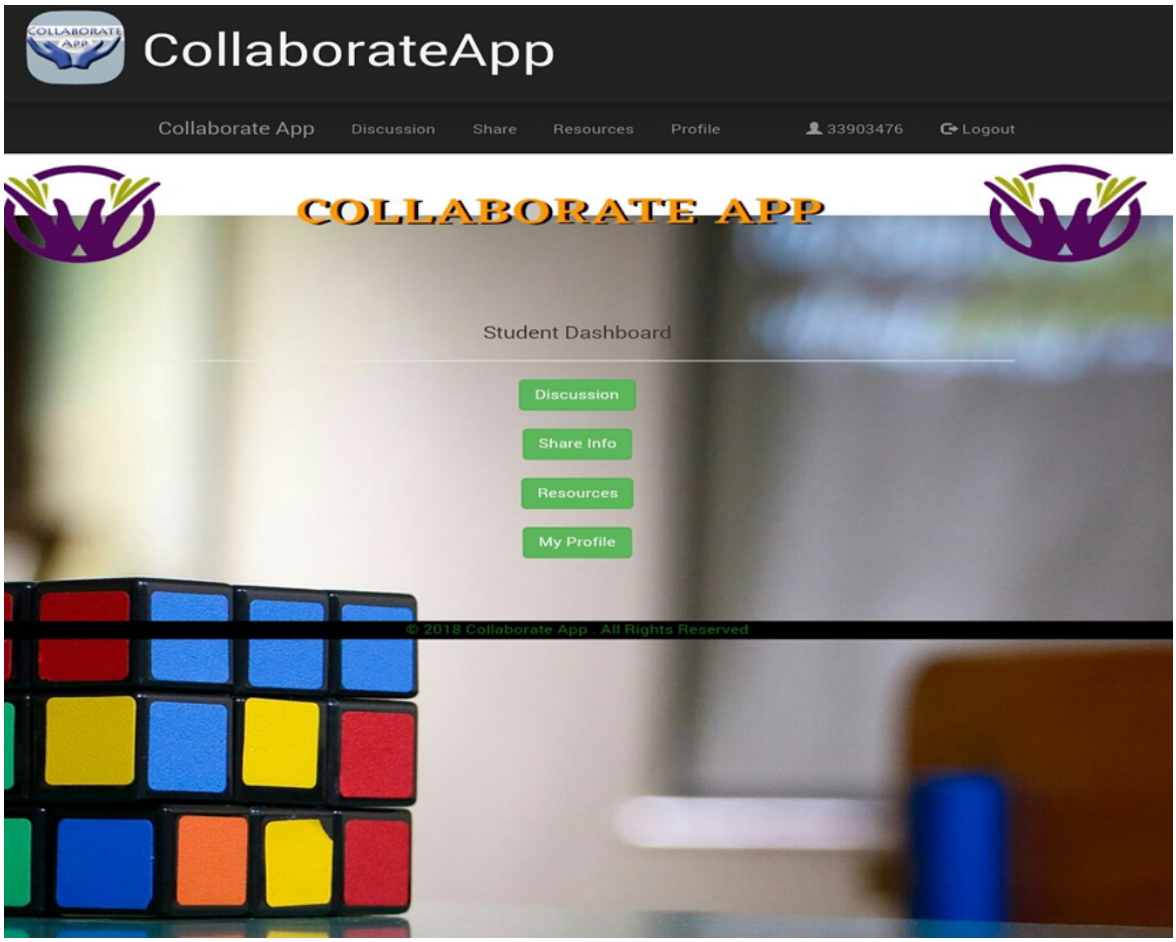

Figure 1: The displayed tabs of developed mobile application.

4. Data analysis

Analysis using thematic analysis involving the six phases is discussed below:

Phase 1: **Familiarization and Immersion** We observed and noted the interaction of the participants with the mobile application during the usability testing. We listened to audio recordings and read the transcripts several times.

Phase 2: Coding We generated labels for important features of the data relevant to the main research question. The generated codes are in Table 2. We coded every data item and ended this phase by collating all codes and relevant data extracts. The codes are presented to show the number of participants who mention, agree or support these. For example, two participants agreed with the notion expressed by code "easy to understand"; this is presented as "easy to understand x 2".

Phase 3: Searching for themes All codes that belonged together were grouped in meaningful patterns in the data relevant to the research question. The researcher grouped the codes together and generated the following themes:

- Share information
- Collaboration in research
- Complete task effortlessly
- Assistance in using mobile application
- Recommendations mobile application
- Encouragement uses of the mobile application
- Discouragement uses of the mobile application
- Improvement of the mobile application

Table 2: Generated themes and codes for qualitative analysis

Theme: Share information **Codes** ➢ Easy to share information x 1 ➢ Cost-effective in share information x 1 ➢ Share electronic files and the links of videos x 4 ➢ Upload not a difficult task x 1 ➢ Share the information with other students x 30 ➢ Agree for share information x 3 0	**Theme: Collaboration in research** **Codes** ➢ Agree with collaboration in research x 30 ➢ Information (files), articles x 7 ➢ Easy to use and direct x 2 ➢ Collaborate with fellow students x 16 ➢ Access information x 27	**Theme: Complete all tasks effortlessly** **Codes** ➢ Agree with complete all task effortlessly x 29 ➢ No much work to do x 5 ➢ Not agree with complete all the task effortlessly x 1 ➢ Server or internet connection problem x 1	**Theme: Assistance use of mobile application** **Codes** ➢ Agree that assistance is needed to use mobile application x 21 ➢ Disagreeing that assistance is needed to use mobile application x 9 ➢ Skills ➢ Computer Knowledge ➢ User manual x 30
Theme: Recommendations mobile application **Codes** ➢ Recommending that mobile application can be used x 30 ➢ Sharing information (articles) publications, exchange of ideas x 10 ➢ Disagree x 0	**Theme: Encouragement use of the mobile application** **Codes** ➢ Encouraging the use of mobile application x 30 ➢ Share information x 8 ➢ Clear and straight forward x 13 ➢ Lack of internet data x 1	**Theme: Discourage use of mobile application** **Codes** ➢ Not discouraging the use of mobile application x 3 ➢ Agree - Lack of functionality and resources x 3 ➢ Cost of data x 3 ➢ Knowledge x 3 ➢ Interface x 1 ➢ Neutral x 4	**Theme: Improve mobile application** **Codes** ➢ Agree to improve mobile application x 29 ➢ Sharing of information x 2 ➢ Functionality x 19 ➢ Application good x 2 ➢ Neutral x 1 ➢ Improve servers x 1

Phase 4: Reviewing themes The themes were reviewed and further combined based on their relationships. The grouped themes are as follows:
Usability – (Complete task effortlessly, Assistance in using mobile application, and Encouragement uses of the mobile application)
Internet connection – (Discouragement uses of the mobile application)
Knowledge and functionality – (Recommendations mobile application, and Improvement of the application). The reviewed themes are presented as follows:

- **Usability** – this determines the efficiency, effectiveness, and satisfaction of the mobile application.
- **Information sharing** – allows the students to share the information amongst themselves.
- **Internet connection** – determines the functionality of mobile application on internet
- **Collaboration in research** – allows students to participate through discussion forum.
- **Knowledge and functionality** – provide the functionality of the mobile application.

Phase 5: Refine the themes

Usability The participants expressed satisfaction with the effectiveness and the following made comments about how the application helps to collaborate in the research environment. *P4: "The mobile application is effective because we can access information from our fellow students, and also to interact with them since we are studying in distance learning".*

Information sharing The significant part of information sharing is that the participants considered that sharing information through the mobile application is a motivation to support each other. Notably, the Share Information tab of the mobile application enables them to share the relevant electronic articles and the links. *P12: "I feel much supported since my fellow students can share relevant electronic articles and their links with me."*

Internet connection The participants indicated that the mobile application requires the use of internet. *P27: "Improve the internet and make sure the server does not affect the students while using it". P29: "Resources not being easily accessible because of downtime internet."*

Collaboration in the research environment Both information access and information sharing form part of collaboration. This is facilitated through the mobile application. The participants identified the mobile application interface as useful as it helps them to collaborate through the discussion forum. After the participants shared the information, they made comments about the discussion forum. *P9: "The mobile application is easy to use as it helps us to navigate and express our ideas on discussion forum platform. I believe this kind of features are needed in the space of research environment."*

Functionality and knowledge The mobile application has functionality that enables students to share knowledge with each other. The participants felt that the mobile application functionality encourages collaboration and accessibility of shared information. *P29: Easy to access available resources to encourage collaboration amongst the users. P26: I think the students will be able to interact to each other and share whatever information usable to each individual.* For these participants, the usability of mobile application functionalities was a solution to their information access problem as they would be able to access information and share the knowledge.

5. Discussion

Other studies discussed and mentioned certain MAs developed and used in higher education recently, some of them while this study was being conducted. The findings confirm the usefulness of MAs in supporting learning but none of these applications addressed the challenge of developing a mobile application to support students in an ODL environment.

The results of this study show that the mobile application provides continuous information access to users regardless of geographical location and time. The evaluation of the application confirmed that students found the mobile application useful for supporting information access. Furthermore, participants indicated that the mobile application helps them to interact and collaborate with each other in terms of general support and staying connected to overcome isolation. The findings from the usability evaluation tasks indicated that the participants were generally of their opinion that the mobile application is usable in the ODL research environment. The participants reported that using the mobile application helped in overcoming some of the research constraints in the ODL environment. It addresses the students' needs for information sharing and information access, and can serve as a tool that brings together formal and informal learning, in order to produce flexible collaborative learning in ODL research environment.

6. Limitations

A limitation of the study was that the usability testing was conducted in the research area for masters and doctoral students only at the UNISA main campus. Since UNISA is a distance learning institution, it was difficult for researchers to get access to all the honours project students. We did manage to get 30 students to participate in this study but it would have been better to involve more students and to do so over a period of time.

7. Conclusion

The contribution of this study to the body of knowledge is the design and construction of a knowledge sharing and collaboration artifact for research students in ODL. The artifact provides a solution to existing information sharing and collaboration constraints that affect students in ODL. The application clearly addresses specific needs such as isolation, lack of interaction, expensive technologies i.e. broadband, and time management for working students for learning not addressed by Learning Management System. Through the interview questions, participants specified that they most enjoyed sharing their own ideas and collaborating with peers. The mobile application designed in this study can be applied outside the ODL context, i.e. at residential universities. Furthermore, there is a need to replicate this research with larger numbers of participants and also to extend the evaluation of the mobile application. Considering the fact that the lecturers are involved as supervisors of honours project students, they could also be involved in interacting with students through the mobile application. As the participants suggested, the mobile application should have more functionalities. Future studies can investigate the use of mobile application for all postgraduate research students in the ODL environment.

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