Research Design to Evaluate an Academic Library's Orientation Program Applying Mobile Augmented Reality

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Contents

ABSTRACT

Despite the continuous efforts of academic libraries to develop various user-centered outreach programs, services and new processes, library anxiety still remains a threat to university students' full use of academic library resources. Meanwhile, a new generation of students, called the "Net Generation," has grown up with developed information and communication technology enter university and must be persuaded to turn to the library. To serve this new group of patrons better, libraries need to adopt new technologies. However, since an initial introduction cost and labor efforts are involved in the integration of the technology, identifying the right time for introduction and the right scope of innovation is essential but difficult. The study proposes a not-yet-well-known, novel experimental design, Regression Point Displacement (RPD), to evaluate an orientation program applying Mobile Augmented Reality (MAR) for STEM students. Since this RPD design requires only one treatment group, the model is expected to be the incomparable and rational way to evaluate the new MAR technology. In the context of an informal learning experience, the findings of the study will determine the effectiveness of an orientation employing the MAR technology.

Keywords: Mobile Augmented Reality, Regression Point Displacement, Orientation Program

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1. Introduction

As information and communication technologies and communication around libraries is evolving at a dizzying rate, academic libraries continue putting in "efforts that go into creating and implementing new processes, services, and programming" (Brown 2011, 312) to attract library users. However, *library anxiety* still remains an issue that blocks university students' full use of the academic library (Brown 2011; Carlile 2007; Kwon 2010; Mellon 1986). Many students are reluctant both to use academic libraries and to approach librarians, feeling fear or apprehension about using the library (S. W. Lee 2012). As a result, only a few students utilize library services to start their research. Furthermore, library anxiety hampers students' critical thinking skills, which is an important factor in their research success (Kwon 2010).

Meanwhile, as academic libraries are struggling to develop various user-centered programs and services to alleviate library anxiety, they have begun to encounter a new group of students called the "Net Generation." The Net Generation is a collective name for a young generation of students who have grown up with developed information and communication technology. In terms of library use, they rely heavily on web-based resources instead of the traditional library setting when they need to research a specific topic (Kwon 2010). In order to find advantageous ways to serve the Net Generation, libraries must start to think about new strategies and tools that the new patrons can access and still interact with library services (van Arnhem and Spiller 2014).

Mobile Augmented Reality (MAR) technology has been proposed as a desirable alternative solution. Although it has not been long since the MAR technology was introduced to be studied in a library realm, it is already known that the MAR is a powerful tool to integrate the library's resources into a user's gadget and to promote library use by enhancing interaction between libraries (or librarians) and users (Chen and Tsai 2012; Hahn 2012). In particular, the more recent studies have confirmed that young students make the best use of the MAR applications (Green, Lea and McNair 2014; Meredith 2015; Mulch 2014).

However, although academic libraries recognize MAR technology's impact, the decision making about the adoption of the new technology is not always easy under this environment of budget retrenchment and outsourcing services. Moreover, academic libraries should consider that even though they expend so many resources to equip the new gadgets and train librarians in the use of the innovative technology, it may not be the right time to adopt or users are not ready to embrace it at all. Therefore, identifying the right time for and the proper scope of technology adoption is very crucial not only to save resources, but also to maximize the innovation's usefulness.

The proposed study can be a starting point for further research in evaluating the new technology's effectiveness by initiating an examination of augmented reality programs in an academic library setting. The findings from the study present a new direction of reference and outreach service to academic libraries in order to reduce library anxiety. For Net Generation users, this model provides an up-to-date and rich learning experience. Establishing MAR's effectiveness can inform librarians or educators of the use of the new tool and bring an opportunity for them to apply it for informal learning. More broadly, the findings can provide the implementation for other informal learning organizations to adopt the MAR technology.

This study's purpose is two-fold:

1) To help academic libraries determine the right time and proper size of a Mobile Augmented Reality (MAR) program in which they can introduce new services to the Net Generation students by suggesting a model that evaluates their orientation program by applying a MAR program for students in science, technology, engineering, and mathematics (STEM).
2) To increase awareness of this emerging MAR technology by introducing one of the many feasible services for academic libraries.

This study proposes a model to evaluate the effectiveness of the orientation program using the MAR by employing a quasi-experimental design called Regression Point Displacement (RPD). The research will apply the MAR in a library orientation program for freshmen in order to address the following research question: "To what extent does the application of the MAR impact academic library newcomers' task performance in a library?"

2. Previous Studies

This proposed study employs the library anxiety scale as a pre-test and the participants' task performance as the post-test. Ever since Mello (1986) coined the term "library anxiety," the subsequent studies have discerned that this psychological uneasiness diminishes students' library use and their critical thinking. Although diverse ways to alleviate this anxiety have been studied, there is no consensus yet.

As a possible solution, augmented reality is a new technology that libraries have actively discussed and studied in terms of its application. These studies have found that libraries can benefit from

using this technology. However, several challenges, such as the lack of resources and a labor shortage, are obstructing the introduction of augmented reality technology in libraries.

2.1 Library Anxiety

The term *library anxiety* was coined by Mellon (1986) in order to describe students' sense of anxiety and fear when they approach an academic library and librarians for the first time. Due to users' insufficient confidence in and lack of familiarity with using the library, they feel inadequate when using libraries (Brown 2011; Mellon 1986). Mellon (1986) analyzed students' descriptive writings about their experiences with academic libraries and concludes that this feeling of apprehension is provoked by "the size of the library, a lack of knowledge about where things were located, how to begin and what to do" (p.162). Carlile (2007) has enumerated students' feelings related to library anxiety:

- feeling confused, embarrassed, frustrated, overwhelmed, threatened, and lost;
- fear, phobia, worry, and nervousness;
- negative and self-defeating thoughts;
- a sense of unease and discomfort; and feeling helpless, inadequate, incompetent, intimidated, and unsure. (p.131)

Based on Mellon's research, Bostick (1992) validated the case of library anxiety and developed the Library Anxiety Scale (LAS) by applying a self-report questionnaire to measure five dimensions: barriers with staff, affective barriers, comfort with the library, knowledge of the library and mechanical barriers (p.79). The final version of the LAS consists of 43 questionnaires, and its Cronbach's alpha coefficient is 0.80. Although there have been various attempts to modify the LAS, it remains the scale that library researchers frequently use (Carlile 2007).

Since appearing into the research, an influence of library anxiety has been studied frequently. S. W. Lee (2012) determined that students with less experience with the library present more library anxiety, and the amount of library use and library anxiety are directly proportional to each other. The author also added that even though the students may hold a positive opinion about the library, it does not mean they use library services or resources. Kwon (2010) even found that library anxiety hampers students' critical thinking skills.

In order to alleviate library anxiety, various methods have been discussed. The highly recommended

method for reducing library anxiety is to improve individual librarians' approachability (Carlile 2007; Mellon 1986). Positive, approachable, helpful and friendly interpersonal contact with reference librarians turns out to be the key to solving the problem related to library anxiety. van Scoyoc (2003) supported the idea that contact with librarians can help users to have less library anxiety. The author determined that, although both library staff-led bibliographic instruction and computer tutorials work to alleviate library anxiety, bibliographic instruction enables students to have lower anxiety. Moreover, Brown (2011) has suggested a virtual reference service as an alternative way to reduce library anxiety. Not only does a virtual reference service attract new users by allowing millennial users to have more reach points, but it also makes it easier to have collaboration or partnerships.

At present, there is no agreed-upon method to alleviate students' library anxiety. Because academic libraries are constantly seeking new users and their characteristics and their needs differ, the librarians must develop new solutions for their users. In terms of the methodology, previous studies on library anxiety have mainly used a survey (Kwon 2010; Mellon 1986; S. W. Lee 2012). The Library Anxiety Scale that was developed by Mellon (1986) is the most frequently used scale, although there have been several attempts to modify it.

2.2 Augmented Reality

2.2.1 Definition and Practical Uses

Augmented reality (AR) refers to the technology that presents virtual information dynamically to be overlaid onto a real world environment in real time (Azuma 1997; K. Lee 2012). The AR technology creates a link between the real objects and the virtual world seamlessly. Azuma (1997) lists the three requisites for augmented reality: to combine the real and virtual; to be interactive in real time; and to be registered in three dimensions (p.356).

There is a strong presumption that AR has improved teaching and learning not only in formal but also informal learning environments (Green et al. 2014). In education, in particular from kindergarten to grade 12 (K-12), there have been numerous studies using augmented reality technology in various subjects including science, language arts and visual arts; these studies have reported the positive impact of augmented reality on student engagement and learning (Green et al. 2014). Besides education, numerous studies have demonstrated AR's effectiveness in various settings, such as museums and industries (Chen and Tsai 2012; Damala et al. 2008). This verification of the success of AR technology can serve as evidence that MAR integration will be effective

within libraries.

2.2.2 Augmented Reality and Library Services

Although augmented reality is not an aged technology in the library arena, numerous ideas have been published about the subject, and there is a considerable number of studies already investigating the technology's integration into the library service. The use of this technology is not limited to only the most innovative librarians; rather, there is an increasing awareness of augmented reality. For example, the Association of College and Research Libraries (ACRL) promoted awareness of augmented reality by publishing "Keeping up with Augmented Reality" (Spina 2014).

The creative and experimental services of augmented reality are continuing to develop for libraries. To maximize the convenience for library users, augmented reality can provide the immediate benefits of 1) identifying building services and collections, 2) easing library navigation using graphical overlays and attention funnel, and 3) scanning the textual document using optical character recognition (OCR) technology and providing relevant library resources for this document (Hahn 2012). For librarians, AR offers 1) a physical book stacks browsing service to know the digital items and historical circulation records, 2) a facial recognition service to recognize the user's face, and 3) a simpler visual cue replacing the catalogue number; all of these features are expected to simplify management work (Boonbrahm and Kaewrat 2014; Hahn 2012; Shatte et al. 2014). Current studies are still at their early stage and primarily focus on suggestions for the new service models. In fact, most of them have not yet tested the effectiveness of their introduction of augmented reality technology in a scientific way.

There are several studies suggesting augmented reality technology for users. In particular, there are an increasing number of studies in applying a protocol for younger generation users. Mulch (2014) reported the example of an augmented reality project in a high school library. The author employed the technology in the school library orientation for newcomers, and revealed that students consider it helpful, informative and fun. The author also confirmed that adding augmented reality technology into the orientation program brought a change in the perception about the school library, and students began to regard the library as a fun and informative place to stay.

Meredith (2015) developed three user cases. For the reader's advisory, the author suggested that the intermediary service apply augmented reality to help children to browse library materials by showing a 3D image or streaming video. Also, an automatic recommendation system to find read-alike books and to show/overlay the relevant information to children is plausible. Lastly,

in order to answer directional reference questions for children employing augmented reality, it is necessary to provide them with a 3D map, voice search function, multimedia direction to the physical content and digital content exhibition. The service examples, such as adding speech-to-text to display and to visualize sounds within a specific space, are efforts to strengthen the role of augmented reality technology for library users with disabilities (Meredith 2015). Mulch's study, has at least one limitation to its analysis of the results of introducing augmented reality technology. The study articulates the changes that the librarian felt while the author was applying augmented reality and gauging the reaction of the students. As mentioned, the Net Generation students are relatively comfortable with all new technologies, and therefore it is difficult for readers to know how many changes are caused by augmented reality technology and how to test the effectiveness of this new technology.

Green et al. (2014) suggested four augmented reality strategies that school libraries can employ for the projects: create, curate, locate and gamify. School libraries offer the project for students, teachers or parents to create video, animation, image or text that utilize the augmented reality. Also, the augmented reality can be an effective way to curate various materials in a specific topic, such as civil war or farm animals. The locate strategy involves using the GPS capacities to generate additional information based on the location data. Lastly, the gamify strategy encompasses all three of these strategies by transforming projects to game formats. This study only provides new models for children in a library setting and thus does not discover how much the new technology contributes to their library use or literacy development. This study is quite comprehensive when discussing the current use of augmented reality in school libraries and enumerates and categorizes many potential service strategies.

As noted, prior studies have suggested new approaches that librarians can apply for the new generation during an initial phase. However, more practical research is required to help librarians decide on the right services for the targeted users.

2.2.3 Prior research vs. the proposed study

While previous studies have recognized various augmented reality programs, they have yet to mention the difficulties of users' studies need to apply augmented reality. First, the studies evaluate the programs by users are by no means common. According to Gabbard's study (2008), only 2% of augmented studies include a user-based study and this underutilized area creates a tremendous gap between the development of this technology and its interaction with people. Second, the users' hugely differing knowledge about augmented reality can have a decisive effect

on evaluating a program (Damala 2008). Given that the library setting is no exception, a study to test the effectiveness of augmented reality has not been done yet.

While a wealth of literature has affirmed that augmented reality has a strong possibility of improving the library/user relationship, many libraries have been slow to accept the best practices outlined in this literature because of the challenges and frustrations associated with augmented reality. The expense of 3D programs and a need for professional designers are addressed as constraints of augmented reality (Green et al. 2014).

In practice, having a proper device for each user and a learning curve are pointed out as difficulties. Moreover, adopting augmented reality technology in libraries can be difficult because of a lack of resources, uncertainty of emerging technology and undefined standards (van Arnhem and Spiller 2014).

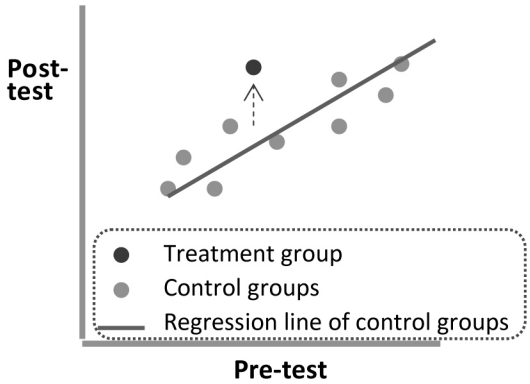
In this study's design, the researcher proposes an experiment model, Regression Point Displacement (RPD), to overcome the weaknesses of the previous studies. This new RPD model can evaluate an augmented reality experiment objectively by applying statistical analysis. Moreover, the RPD model offsets the impact of individual participant's previous experience and knowledge about augmented reality by grouping all participants randomly. The requirements of small number of devices and experimenters is another strong point of this study.

3. Methodology

In order to evaluate the library orientation program with a small outlay and less workforce, this study proposes a novel quasi-experimental design approach, called Regression Point Displacement (RPD), which "is premised on a regression model in which an outcome for the one treatment group is compared to that of a control population" (Linden, Trochim and Adams 2006, 410). The RPD model evaluates a treatment effect by comparing the pre-/post-test scores of one or more treatment groups to the regression line that is determined by the pre-/post-test results from multiple control groups. The estimated effectiveness of a treatment is measured by the vertical displacement of the treatment group. When this displacement is statistically significantly apart from the regression line, a treatment effect is presumed.

In this model, the unit of analysis is a group of participants in order not only to reduce variability of the data as aggregating to the group level, but also to improve the statistical power comparing to each unit of analysis (Linden et al. 2006; Trochim and Campbell 1996). For this reason, in

Figure 1, which visualizes the concept of RPD, each dot indicates a group of participants instead of a single person. The red dot demonstrates that there is one treatment group and the blue marks indicate the nine control groups creating the blue regression line.



〈Figure 1〉 Visualization of the Single Treatment Group Regression Point Displacement

In order to conduct the RPD study, the very first job to be done is to construct a regression line applying the results from the multiple control groups' pre-/post-tests. Then, the researcher needs to identify the pre-/post-test scores of the treatment group. The final process for the model is to calculate the vertical displacement of a treatment group's post test score from the regression line.

The statistical model of Analysis of Covariance (ANACOVA), which is used for RPD, is: Yi = β0 + β1Xi + β2Zi + ei (Linden et al. 2006, 421). In this model, each variable has a distinct meaning: Y_i = the post-test value for unit I; X_i = the pre-test value for unit I; Z_i = 0 if the X, Y pair is for a control unit, and 1 if the X, Y pair is for the treated unit; β_0 = intercept term; β_1 = linear slope; β_2 = the treatment effect (vertical shift from the regression line), and e_i = the residual. The researcher can identify the treatment effect clearly when there is a statistically significant p value in the β2 coefficient (Linden et al. 2006, 421).

The several strengths of the RPD model confer a number of benefits upon this study. First of all, the RPD model only requires one or very few treatment groups. Thus, under the situation where only a single group is available to have a treatment/intervention, the model could be usefully employed (Wyman et al. 2014). This ability to compare one situation or site against other comparison targets, in particular, is useful for policy making or evaluation. Additionally, for the model, it

is not necessary for researchers to have the equivalent pre-/post-tests. The RPD design does not involve the same two measures; yet, if there is a stronger correlation between pre-/post-test scores, the statistical power becomes stronger. Lastly, the greater statistical flexibility of the model is beneficial for researchers. To calculate the regression line, the model assumes the data set follows a linear pattern. However, in case the data turn out to follow a nonlinear pattern, researchers can add polynomial terms for statistical analysis. Although the RPD is still an emerging quasi-experimental design, this method has often been used in medical studies because of its efficiencies that increase its statistical results despite having a low number of participants (Wyman et al. 2014). Linden, Trochim, and Adams (2006) used this model to evalutate their healthcare pilot program, and Wyman et al. (2014) evaluated the model for suicide prevention training (QPR) in 32 schools. No similar study has been found in library research.

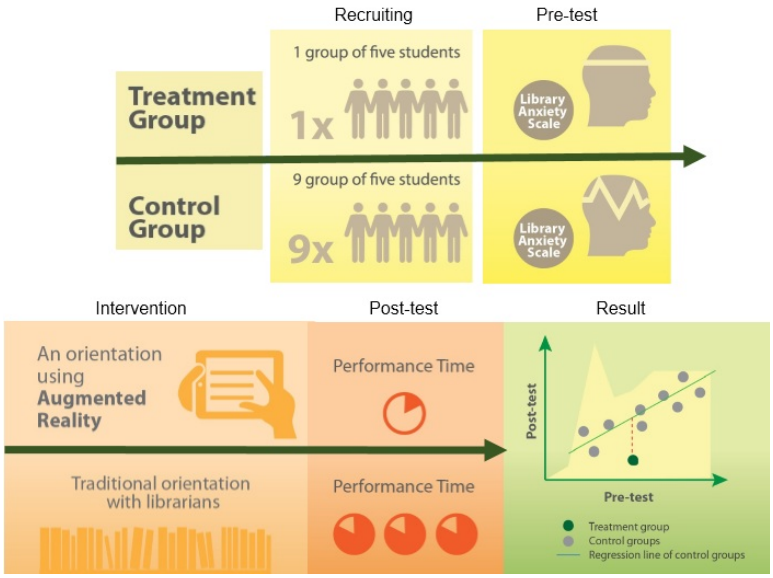
4. Experiment Design

This study develops a quasi-experiment design employing the Regression Point Displacement (RPD) model to evaluate a library orientation program using Mobile Augmented Reality (MAR). Table 1 presents the holistic approach of the designed model.

〈Table 1〉 The Designed Model to Evaluate the Orientation Program Appling MAR

	Pretest	Treatment	Post-test
Treatment group	Library Anxiety Scale	An orientation using MAR	Performance Time
Control groups		A traditional orientation with librarians	

The library anxiety of the treatment and control groups will be determined by taking a survey using the library anxiety scale as a pre-test. The nine control groups will have a traditional orientation with librarians, and the treatment group will be allowed to use MAR technology to become familiar with the library. Figure 2 demonstrates procedure of the experiment.



〈Figure 2〉 The Overview of the Experiment

The components of the design are detailed below.

■ **Intervention**: The MAR service, overlaying virtual information onto the real object in real time, will be developed using the *Layar* (Layar 2015) creator program. Layar is one of leading augmented reality development programs and the virtual information can be seen via any smart device using the Layar app (Green et al. 2014). On the marker images, multiple augmented reality pages can be triggered, and each campaign contains a file that can hold multiple pages. Although the content of augmented reality will remain the same as that incorporated in a traditional orientation program, the augmented reality will be provided at the point of each user's desired location. This treatment will accommodate three primary types of MAR: 1) to locate the physical place and section, 2) to provide the additional information for library services in 3D, and 3) to offer the URLs, link to a specific web page or download a program or content. The maps that are selected for the experiment will overlay 3D images of the room and provide users with the MAR application descriptions about each section. To provide the supplementary information about library services, each piece of equipment will contain a sign demonstrating how to use or reserve the equipment and explaining any required fee policy. The sign in front of a printer or scanner, for example, will review operation of the augmented reality on an electronic device and the price or circulation policy. Lastly, the augmented reality program will enable libraries to provide additional outside links. For instance, when participants scan the sign on the door of a study room, the

MAR application links to library's study room reservation web page without any delay, allowing the users to reserve the room immediately. At this moment, the application can offer the web page or textual announcement for reservation regulations as well.

■ **The Pre-test**: The pre-test will be the Library Anxiety Scale, which was developed by Bostick (1992). This test will refer to the university undergraduate students' fear and reaction to library services before they actually use them or have any experience with them. The Library Anxiety Scale has 43 statements to identify five factors: barriers with staff, affective barriers, comfort with the library, knowledge of the library and mechanical barriers. Since five students will participate the experiment at once, the researchers will assign five library PCs, and these five students will take their pre-tests using the designated PCs.

■ **The Post-test**: After all groups go through an orientation, the post-test will measure actual participants' task performance; the unit of measurement will be the time spent on the task. Once participants demonstrate their understanding of instruction, they are assigned a library PC. Participants will perform the six personal activities, and they are free to use the PC while conducting activities. One of the research team members observes participant performance and reports the time that the participant spent on each activity, measured from when they start the activity to when they submit the output. The outputs will be different according to the activity. They can be physical objects such as copy pages, or electronic submission pages. When researchers record the time, they exclude the additional time for the output either to upload or to print out. If a participant spends some time waiting his/her turn to use the technology or to fix technical problems, the researcher should also exclude the waiting time.

All participants will perform six activities: 1) locating a book having a specific key word on the title; 2) locating *Time* magazine; 3) making a color copy of the first page of the Time magazine; 4) making a color scan of the copy; 5) requesting librarian instruction on reducing library anxiety at a certain time; and 6) reserving a study room for the designated time. The tasks required to locate a book and magazine, according to each participant, will be slightly different in order to allow all five students to conduct the activities simultaneously. The researchers will yield six different amounts of time for each activity and these six periods of time enable the researchers to create six separate RPD graphs. Having six different activities can reduce *mono-method bias* (Shadish, Cook and Campbell 2002). When researchers present the independent variable only in a limited way, there can be a bias because of that particular method. In this study, the researchers

can control this bias by collecting the amount of time for various activities. Also, applying two different pre-/post-tests can control *testing* threat (or pre-test sensitization) (Shadish et al. 2002). Since the participants' experience in taking a specific test or examination can improve the test scores, it is important to apply two different test scales in this study.

One thing that should be noted is that, since the treatment in this study may not be the only representation of constructs, there might be confounding variables. Participants' current cognitive schemas, such as knowledge, expectations and values, preexisting experience and emotions such as familiarity, anxiety or sentiment, can also affect the performance. However, this study assumes that the confounding variables will be controlled by the large number of groups, which are randomly assigned.

■ **Participants and Groups**: For this initial research, the participants will be freshmen from a large state university who are majoring in the academic disciplines of science, technology, engineering and mathematics (STEM). Since the RPD model applies aggregated and mean-level data, as stated above, the unit of analysis is a group of 20 students; the aggregated students' average time on each task will be recorded and utilized for statistical analysis.

By way of illustration, an academic library provides four orientation sessions per day over the course of ten days. Five students will be randomly chosen from each session, resulting in 20 students per day. The mean scores from the 20 participants' pre-test and post-test results will establish the single unit of analysis. Among the ten orientation days, the researchers randomly select one day to recruit the treatment group. Students on that specific day will receive treatment, the MAR orientation, instead of a traditional orientation. On the nine remaining days, the pre-/post-test results from the nine groups of students will construct the set of control groups. Using random assignment, *selection* can be reduced.

As mentioned above, the treatment group will be educated with the MAR program in a general way—such as location of the collections or library services—as well as in a specific way—such as instruction about how to use a scanner. The control groups will receive the traditional orientation that is precisely same as the MAR one, but is led by librarians.

■ **Methods**: In order to achieve a better treatment effect, the researchers will provide the optimal materials for the experiment. Signs for augmented reality will be at least 8.5 by 11 inches in size, so that participants know the exact locations/points where they can apply the MAR applications. The researchers will introduce all signs, including directories/maps and book stacks, so that partic-

ipants can use all related technology and tools to maximize the MAR effectively. In order to not only ensure implementation of the independent variable, but also to prevent *compensatory equalization bias*, the five researchers will be members of the MARS research team. They understand the study thoroughly, let participants know about the activities, handle technology problems and can measure the performance properly by completing a training program. In this case, the researchers created a handbook during a pilot test. Because it utilizes the five experimenters, the design reduces *mono operation bias*. Each researcher observes one participant; whenever that participant completes one activity, the researcher records the time and accuracy.

■ **Threats to the model**: *Selection by history* and *instrumentation* can be problematic in this model since each group can have different eternal events. For example, some participants may encounter missing books or the possibility of technical problems. In particular, Layar is working with an internet connection, so providing a continuously stable Wi-Fi service is crucial for this experiment. Also, each group can be administrated differently. Therefore, both the formal training for the five researchers and the pilot study can be done before the experiment.

Since the five researchers will observe participants' performance, experimenter expectancies or resentful demoralization can matter, too. In particular, for the MAR group, the participants may be motivated by the innovative treatment (*novelty and disruption effects*). Or vice versa, the fact that control groups do not have any treatment can cause the participants to be resentful or demoralized (Shadish et al. 2002).

Although there are several ways to adjust, if there is no linear relationship, this model needs additional statistical processing. In order to prevent this effort, the recruitment pool will be limited and the participants will be chosen in a specific arena: science, technology, engineering and mathematics (STEM) in one university. An unintentional side effect of this experiment design is that the freshmen who are not familiar with the library can be embarrassed by the time-pressured tasks and being with an observer. This unpleasant experience may lead them to feel more anxiety. In other words, there can be a negative unintended variable.

In terms of external validity, this design is limited in the following ways: generalizability across persons, since it is only tested on the STEM freshmen in one university; setting, since it occurs in one center library; treatment, which is mobile augmented reality service; and outcome, which is measured in performance time.

5. Expected Results and Implications

As mentioned above, Lee (2012) identified that students with high library anxiety use library services less often. Lee's research finding has very important implications for this proposed study. This study assumes that there will be a linear pattern between library anxiety and library use, which in this study is indicated by activity performance.

The purpose of the study is to evaluate the orientation program using the MAR technology. In order to assess the MAR technology's effectiveness, the treatment group is supposed to spend less time completing activities after having the MAR orientation, while the control groups require substantially more time. By analyzing the time that participant groups spend on each activity, the findings of the study will determine whether the MAR orientation program would improve student performance. Moreover, the study will create the six types of RPD graphs, and the graphs will decide the most or relatively effective activities to apply to the MAR.

In addition to the evaluation function, this experiment can provide library users with a differentiated informal learning experience. As Mulch (2014) has reported, the adoption of the new technology itself can entertain students and help them to have a positive reaction toward the library and library services. Further, the approach employing the augmented reality can encourage an academic library to create or promote the reference or outreach service at the right time and with the appropriate scope of technology.

From the perspective of designing research, the proposed model can be applied to various topics and models. The RPD model can be applicable to public or school libraries as well. In fact, as more research about introducing emerging technology to the Net Generation is published (Green et al. 2014; Meredith 2015; Mulch 2014), the model can represent a huge opportunity for those kinds of libraries. This model also can be employed when libraries need to evaluate the new technology or innovation. Because the initial investment of cost and labor is always burdensome to libraries in which the tightened budgets is an issue, having empirical evidence that the new technology makes a difference can encourage the library to innovate. Also, it is expected that the model can spark derived ideas of other experience models. To vary participant level, an individual level's randomized experiment can be suggested and this model can be tried in different places or times with different groups. To extend the time level, wait-listed designs or multiple baseline design at different times can be presented.

Last but not least, there are more potential and additional benefits from this study that academic librarians can employ in other ways. These librarians can do the following:

(1) *Determine the new students' library anxiety via their pre-test results*. The score of the five dimensions (barriers with staff, affective barriers, comfort with the library, knowledge of the library, and mechanical barriers) can be meaningful for academic librarians in identifying the students' main reasons for hesitating to use the library and improve specific services to diminish the students' anxiety.

(2) *Learn the activity that the students in the control group spend most time doing from among the six activities*. Although the amount of time for each activity is not comparable to the others, at least they can be a useful dataset for librarians to recognize the toughest or easiest activity for Net Generation students.

(3) *Analyze the relationship between the control group students' library anxiety and their performance*. Although this study assumes that there will be a linear regression between the two tests, the study results will confirm this relationship. Depending on the pattern of the relationship, librarians can differentiate their services. For example, after the librarians ascertain the pattern that shows the two variables are directly proportional to each other, then they can initiate new services for a target user with a higher level of anxiety. For example, if the pattern describes a quadratic graph, then the librarians can figure out an upcurve range that maximizes the students' performance. The librarians can also concentrate their resources on those students within this range in order to provide more effective benefits to them.

(4) *Discover the performance of each activity according to the level of library anxiety and this result can then be tailored to the specific service targeting a specific user group*. For instance, if the higher library anxiety group spends more time requesting librarian instruction, then the librarians need to offer more services for these students in accessing web instruction for which they do not need to physically meet with the librarians.

6. Conclusion

In closing, it is worth echoing the assertion from Vandegrift and Varner (2013), who said "reframing the library as a productive place, a creative place engaged in producing and creating something - whether that be digital scholarly works or something else entirely - will open the door to allow the library into the life of the user" (p.73). Libraries have been dealing with interdisciplinary information and working with various scholarships. With the ever-changing nature of technology,

libraries are groping for a new manner for users to access and interface with library collections, facilities and services. "This study aims to provide a method of evaluating this new technology and how it can positively affect library/user interaction."

The goal of this study is to propose one practical experiment method that can be used to evaluate the orientation program using augmented reality. In future projects, the researcher will apply this prototype to determine how the orientation process is effective and useful for the newcomers to receive formal and informal learning about libraries.

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