EVALUATION OF PERSONAL RESPONSE SYSTEMS FROM A TEACHING PERSPECTIVE

by

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A dissertation submitted in partial fulfillment
of the requirements for the degree

of

Doctor of Education

in

Education

MONTANA STATE UNIVERSITY
Bozeman, Montana

April 2012

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of a dissertation submitted by

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This dissertation has been read by each member of the dissertation committee and has been found to be satisfactory regarding content, English usage, format, citation, bibliographic style, and consistency and is ready for submission to The Graduate School.

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April 2012

DEDICATION

I dedicate this work to my wife, Wendy and daughters Maggie and Jessie, who have been very supportive and understanding in this endeavor.

ACKNOWLEDGEMENTS

I want to acknowledge all of the support I have received from Dr. Marilyn Lockhart and the entire faculty within the College of Education, Health & Human Development at Montana State University. Their willingness to accommodate myself and the rest of my Billings cohort over the past five years has been a tremendous help and it is greatly appreciated. Any future success I have as a result of receiving my doctorate can be directly attributed to their involvement and dedication to this process.

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ABSTRACT

The purpose of this qualitative transcendental phenomenological study was to examine the usage, attitudes, and perceptions of personal response system (PRS) use by teaching faculty who had used the technology in at least one course at Montana State University (MSU) in Bozeman in the past six years. Fifteen faculty members who had used PRS in their teaching were interviewed on their usage, attitude, and perception of PRS use. The literature topics of effectiveness, teacher-student interaction, practices, faculty resistance, technical issues as well as assessment and feedback were incorporated into a protocol used during in-depth interviews. Overall, the results of this study were consistent with the literature. Faculty interviewed considered themselves among the first to adopt a new teaching technology, and had done so to address either increased class size or to formatively assess their teaching. Technical issues were minor and easily corrected through either technical support or peer support. Student registration was an issue, and the responses to this issue varied among faculty. Overall, faculty interviewed were satisfied with the technology and used it effectively based on the literature reviewed. Recommendations were made to encourage and expand the use of PRS and to remove the challenges experienced by faculty.

CHAPTER 1

INTRODUCTION

Personal Response System Use in Education

The popularity of the internet and mobile communication devices has changed the way people communicate and receive information (Subrahmanyam, Reich, Waechter, & Espinoza, 2008). The field of education is now experiencing an influx of students who have been using these technologies and are comfortable with them (Ogan, Ozakca, & Groshek, 2008). The predominant use of online and mobile technology in individuals' everyday life suggests that higher education should look into adapting these technologies for instruction to compliment or supplement traditional teaching methods that may have become dated. Students expect to see some technology in the classroom (Kingsley, 2007); however there is concern among educators as to the effectiveness of these technologies compared to traditional teaching practices (Papo, 2001). The effective use of such technologies is the key. Research by Fox, Rosen and Crawford (2009) indicates that using a new technology as a communication tool during class can be a distraction from the points of the lecture if they do not complement each other or work well together. There are many studies indicating that using interactive technology applications effectively can help students learn the subject matter better while also becoming more active and involved learners (Berry, 2009; Draper & Brown, 2004; Lamb, 1992). This change in teaching technique requires that faculty not only learn new technologies, but approach teaching and learning from the standpoint of developing learning skills along

with being well versed in their chosen discipline (Skiba & Barton, 2006; Vogel & Klassen, 2001).

One recent technology used in education is that of personal response systems (PRS), handheld electronic devices that allow students to respond to questions during class without speaking or raising their hand. These devices also allow multiple students to answer the same question at the same time and may also be known as electronic voting systems, electronic response systems, student response systems, audience response systems or clickers (Branzberg, 2008). Despite the varying terms for the technology, they all operate in a similar way. Students have a handheld electronic device that sends a radio signal to the instructor's computer workstation in the classroom. Students answer questions asked during class or projected on a screen in front of the class by clicking the appropriate button on the device. The instructor's workstation records the responses and, since each device is unique, the instructor knows how each student responded. While the device design and application can vary somewhat, the systems all operate on the same principle. The technology is limited to the specific application set by the instructor and students are either given a PRS transmitter during class or purchase one themselves. The goal of PRS is mainly to increasing interaction and participation. The literature reviewed indicates that students are more likely to participate during class using PRS than one using the typical lecture format and also tend to stay more on task (Stowell & Nelson, 2007; Caldwell, 2007; Kenwrigth, 2009).

A technology like PRS may give students who typically do not respond to questions in class a way to participate that is more comfortable to them (Beckert, Fauth,

& Olsen, 2009; Valkenburg & Peter, 2009). While there has been much research on PRS in the classroom from a student's perspective (Beckert, et al., 2009; Edelstein & Herbold, 2009; Kennedy & Cutts, 2005), there is an opportunity to take a closer look at the usage, attitudes, and perceptions of these systems from an instructor's perspective (Caldwell, 2007; Hatch, Jensen, & Moore, 2005; Ribbens, 2007).

Context

Montana State University (MSU) in Bozeman, Montana is an accredited land grant institution with enrollment at 14, 453and 1,122 total faculty members, 775 of those considered full-time including directors and department heads (Montana State University, 2012). MSU is a public research institution with the majority of students being undergraduates (Carnegie Foundation, 2011). PRS technology has been available for use at MSU since 2005 (Boswell, 2005). The specific brand of PRS used at MSU are called iClickers. According to former MSU Assistant Vice Provost Jeff Adams, in 2010 there were 3,800 iClickers registered for use on systems at MSU with over 6,000 units sold (personal communication, October 20, 2010). Students can purchase the units new at the MSU Bookstore for $35.10, with used units also available for $26.35 (M. Hardin, personal communication, January16, 2012). A student can use the same PRS in multiple classes, and several students could use a single PRS in different classes during the semester. Thirty-nine classrooms are equipped with dedicated PRS workstations, including every major lecture hall along with six portable units available. MSU currently does not track the number of faculty or courses that have used PRS; however according

to MSU Instructional Technology Project Director Ritchie Boyd over 50 out of the 1,122 MSU faculty and instructional staff have received some form of orientation or training, and the workstations used by instructors are currently available to faculty at no cost to their department or college (personal communication, October 20, 2010). The Office of the Provost and Vice President for Academic Affairs works with faculty to provide training in the form of seminars and informal consultations, and the Information Technology Center handles installation and registration of the classroom workstations and the student PRS transmitters (R. Boyd, personal communication, October 20, 2010).

The population for this study consisted of teaching faculty who have used PRS in their teaching at least once in the past six years. Comprehensive information on this population was not available; therefore possible participants were recognized based on course requirement records provided by David Knickerbocker, Book Operations Manager at the MSU Bookstore (personal communication, October 26, 2010) and an e-mail sent by MSU Instructional Technology Project Director Ritchie Boyd to faculty whom he had consulted on PRS use. Faculty will typically inform the MSU Bookstore of course required materials such as books or specific technology in order for the bookstore to have the necessary supplies for students in those classes. In this case, a list of faculty who had indicated the PRS system iClicker as a course requirement was compiled. Records from the MSU Bookstore only go back to Fall 2006, and one limitation of this data was that some instructors may not list PRS as a requirement for their classes. For example, records on sales from the MSU Bookstore indicate an occurrence in the summer of 2010 where sales of PRS exceeded course registration in PRS-required classes, which

according to Knickerbocker was an indication of an instructor using PRS in a course without listing it as a requirement with the MSU Bookstore (personal communication, October 26, 2010). Based on the available data, since Fall 2006 a total of 52 faculty members had registered PRS as a course requirement for one or more of the courses they taught. Due to this issue with the population data, the sampling also incorporated the snowball technique. Considering PRS technology has been at MSU since 2005, faculty who had used PRS technology should be in a position to discuss their experience with PRS technology in their classes in an informed way.

Problem Statement

There is a need for administration, teaching faculty and information technology staff to know how teaching faculty experience the use of PRS in their classes.

Purpose Statement

The purpose of this qualitative transcendental phenomenological study was to examine the usage, attitudes, and perceptions of PRS use by teaching faculty who had used the technology in at least one course in the past six years at Montana State University (MSU) in Bozeman, MT.

Research Questions

This study asked the following questions:

1. How and to what extent is PRS used by teaching faculty at MSU who have used the technology at least once in the past six years?

2. What are the attitudes of MSU teaching faculty on PRS use who have used the technology at least once in the past six years?

3. What are the issues regarding the use of PRS by teaching faculty at MSU use who have used the technology at least once in the past six years?

Significance of the Study

Information on the experiences of instructors using PRS in classroom teaching is of interest to administration and teaching faculty, along with information technology and technical support staff within higher education. This information could help faculty identify and develop courses that would benefit from PRS use along with guidelines on how the technology works best in teaching. Administration in higher education would be interested in the results of this study in order to determine if the technology is cost-effective and get insight on how faculty use PRS and their opinions on it. Information technology and technical support staff could benefit by learning more about faculty use and issues from a technological standpoint to aid in the support of PRS.

Literature Topics

A review of the literature on PRS technology revealed several topics in response to how the technology is incorporated into teaching methodology and specific issues that arise once the choice is made by an instructor to use a PRS in a course. While there are

several aspects of PRS use that are found in the literature, the topics of effectiveness, teacher-student interaction, practices, faculty resistance, technical issues as well as assessment and feedback were the focus of this research.

Effectiveness

The effectiveness of PRS use from the standpoint of the student is well documented. Some studies on PRS effectiveness in a large classroom setting have shown students perform better on assignments and exams than those in a non-PRS classroom (Balander, 2008; Brewer, 2004; Brickman, 2005; Poirier & Feldman, 2007) While PRS use appears primarily in large lecture classes, research by Brickman (2005) suggests that the technology can be used successfully in smaller classes as well. The literature reviewed on PRS indicates that students who use it become more active learners and develop not only a better understanding of the course material but also learning skills that can be used beyond the classroom (Bergtrom, 2006; Brewer, 2004; d'Inverno, Davis, & White, 2003). It was of interest to find out if faculty at MSU are using PRS in an effective way based on their assessment of class performance.

Teacher-Student Interaction

One effect PRS use has on teacher-student interaction is the immediacy of feedback on student knowledge of course content, which allows the instructor to interact with the student to help cover any areas in which the student is lacking (Bruff, 2009). This can help establish a better relationship between the teacher and the student. Research by Crouch and Mazur (2001) suggests a better use of in-class time for

instructors is to help students assimilate information from assigned readings rather than repeating that same information in the form of a standard lecture. PRS use can help the instructor identify areas that the class is struggling in and focus class time on exploring those topics immediately. The effective use of teaching technology in the classroom can help facilitate a relationship between the instructor and the student by creating an environment where both use the technology to achieve a common learning goal (Nardi & O'Day, 1999). While research has been done on effective interaction between students and instructors in the classroom (d'Inverno, et al., 2003; Draper & Brown, 2004; Knight & Wood, 2005), it was of interest to determine if PRS promote interaction outside the classroom with instructors (Hwang & Wolfe, 2010; Kenwrigth, 2009). Perhaps the interactive relationship created in the classroom due to PRS use contributes to more communication between students and faculty outside of class.

Practices

The key is not simply using PRS, but using it effectively. Research by Willoughby and Gustafson (2009) and Ribbens (2007) suggests PRS use needs to be consistent throughout the class and the scores generated using the system should be a relatively small percentage of the total grade to help encourage students use. Questions used with PRS need to be carefully designed in order to maintain interest and to use the technology in the best possible way (Lin, Reay, Lee, & Lei, 2009). Research by Caldwell (2007) and Beatty, Gerace, Leonard and Dufresne (2006) suggest some best practices in using PRS in both large and small classrooms and how to create class exercises to best utilize the technology. It was of interest to see how the practices indicated in the

literature compared to how faculty use PRS at MSU.

Faculty Resistance

The positive effects of PRS use seem to be very clear in relation to learning, yet with any change there comes some resistance. Often instructors fall back upon the tenant of academic freedom when faced with the prospect of using new technology in instruction (Fraley & Vargas, 1975; O'Neil, 2008; Ohmann, 2001). There is also an issue of faculty motivation to use new technologies. A study by Weston (2005) indicated that faculty would welcome using new technologies if there was some sort of incentive, either monetary or scholarly. If classrooms have instructional technology hard-wired and ready to use, instructors are more likely to both use it and be satisfied with the results (Song, 2003). There is also the issue of reliability with technology. Research by Jones (2000) indicated that faculty who use technology in teaching do not completely trust that the technology will always work. New technology can also be intimidating to students as well, which can create a threatening environment that discourages learning (Caine & Caine, 1991).

Technical Issues

As with any technology, there are technical issues that may affect the proliferation of use by an institution and instructors. Some issues with PRS include availability, support, reliability, customization, transferability, cost, set-up time and training (Hatch, et al., 2005). The technology also needs to be well-managed in order to deal with potential weaknesses in application. For example, a student could use another student's PRS

transmitter to answer questions so it would appear that the aforementioned student is in class, and instructors need to be aware and account for this (Herreid, 2006). Having adequate technical support in the form of training is also crucial to the successful use by faculty, whether that support comes from a specific department or through peer instruction by other instructors familiar with the technology (Hartman & Truman-Davis, 2001). It was of interest to explore the faculty perception of technical issues and support with their use of PRS at MSU.

Assessment and Feedback

Assessment is an important part of the education process, and it takes place with both the student and the instructor. Research by Brookfield (2006) found that students regard feedback from the instructor as an indication of their devotion to teaching; however quality feedback is harder to maintain in a large classroom simply due to the sheer number of students. One way an instructor demonstrates to students that they are interested in their progress is by being responsive when a student is struggling with a particular concept or theory (Grimmett & Neufeld, 1994). PRS allows for an instructor to see immediately how well a class understands a concept based on the number of correct responses to a PRS-formatted question. This provides immediate feedback and allows the instructor to adjust the class time to address areas that the students are struggling with.

These are all issues that instructors using PRS have to face, and it was of interest to learn how these issues are dealt with and how the attitude towards PRS is affected by the instructor's experience at MSU. A change in pedagogy, whether inspired by

technology or other influences, that results in a positive experience for students can also relate to a positive effect on teaching attitude. There is a cost vs. reward scenario in play when dealing with PRS that is highly dependent on the successful use of PRS in teaching and the level of technical stability and support of the system along with adequate training.

Research Design

This qualitative transcendental phenomenological study used semi-structured in-depth interviews to gather rich and descriptive data on the experiences of a sample of 15 teaching faculty who had used PRS technology at MSU in Bozeman, Montana in at least one course in the past six years. Faculty members were asked to describe their experiences and perception of factors involved in the use of PRS technology in their teaching. A transcendental method was chosen because the goal is to allow faculty to articulate their experiences rather than interpret them. The baseline of at least one course was chosen in order to gather a variety of experience in PRS use. The interview protocol was piloted by faculty at Montana State University-Billings (MSUB) who had used some form of PRS. Only teaching faculty who had used PRS for at least one course at MSU in the past six years were included in the research.

Definitions

For the purpose of this study, faculty were defined as those who taught a course at MSU regardless of discipline, rank, or experience. The faculty member may have been full-time, adjunct, a graduate assistant or shared teaching duties with other

responsibilities including research or administration. In this study, the PRS technology considered was the brand iClicker, which was the type used at MSU. Also, large class size is defined as classes with over 50 students.

Limitations

Research was limited to teaching faculty at MSU who had used PRS at least once in the past six years and were both willing and able to participate during the time of this study. Faculty were interviewed based on their availability, with five interviews conducted over the telephone and 10 completed in-person. PRS research is a fairly new area, especially research from a faculty perspective. Information on faculty who had used PRS was based primarily on those who had indicated the requirement of PRS when placing orders for course materials to the MSU Bookstore and through an e-mail sent by MSU Instructional Technology Project Director Ritchie Boyd to faculty whom he had consulted on PRS use. The data from the book store was only available for the past six years. As indicated in a conversation with David Knickerbocker, Book Operations Manager at the MSU Bookstore, not every faculty member who teaches informs the bookstore of their course needs. Therefore there may be faculty and courses that had used PRS at MSU which are not represented in the data provided by the MSU bookstore (D. Knickerbocker, personal communication, October 26, 2010). Due to this lack of complete population data, sampling also incorporated the snowball technique. Of the faculty interviewed, four were acquired via the snowball technique.

Summary

Personal Response Systems (PRS) are a technology that has been researched regarding its use and effectiveness from the students' perspective, however there is an opportunity to explore PRS use from the teachers' perspective. This qualitative transcendental phenomenological study used semi-structured interviews to explore the experiences and perceptions of a sample of 15 teaching faculty who had used PRS technology at MSU in Bozeman, Montana at least once in the past six years.

CHAPTER 2

REVIEW OF THE LITERATURE

Introduction

While research has been done regarding the effect of PRS use on student performance and attitudes in both large and small classes, there are few studies that touch on the use and effectiveness of these systems as observed and experienced by the instructors who use them. The literature reviewed on this subject focused on the basics of PRS and the effect on teaching methodology. This chapter explores the literature on PRS use and teaching with technology along with the concepts applied to such practices. The topics of effectiveness, teacher-student interaction, practices, faculty resistance, technical issues as well as assessment and feedback were identified in the literature as the main issues regarding PRS use.

Personal Response Systems (PRS)

Personal response systems (PRS) are wireless handheld electronic devices linked to a computer that allow the user to respond to a question with the click of a button. The devices send a radio signal to a computer workstation that records the response. The number of buttons and size on these devices varies by manufacturer; however the systems all operate in a similar fashion. These devices may also be known as electronic voting systems, electronic response systems, student response systems, audience response systems or clickers (Barber & Njus, 2007; Branzberg, 2008). In a classroom setting,

students can answer questions asked during class or projected on a screen in front of the class by clicking the appropriate button on the device. Each device has a unique electronic signature and each student is either assigned a PRS transmitter or required to purchase one and register it with the MSU system. This way the instructor knows which device is assigned to which student and can track how a particular student responds along with the class as a whole. This technology is limited to the specific application set by the instructor. Such devices have been around since the late 1960s in the United States (Littauer, 1972); however it was not until the 1990s that the cost and flexibility of PRS systems became accessible enough for wide-spread use in education (Judson & Sawada, 2002).

Effectiveness

There is much literature regarding the effectiveness of PRS use from the standpoint of student learning and participation. Some studies on PRS effectiveness in the large (>50) classroom setting have shown that students perform better on assignments and exams than those in a non-PRS classroom (Balander, 2008; Brewer, 2004; Brickman, 2005; Poirier & Feldman, 2007). While PRS have primarily been used in large lecture classes, research by Brickman (2005) suggests that the technology can be used successfully in smaller classes as well. The literature reviewed indicates that students who have used the technology in class become more active learners and develop not only a better understanding of the course material but also learning skills that can be used beyond the classroom (Bergtrom, 2006; Brewer, 2004; d'Inverno, et al., 2003).

Faculty using PRS have noticed that their students are more active, attentive, and pleasant to teach (Caldwell, 2007). Depending on the instructor's approach, PRS use can also lend itself to the idea of peer instruction, where students work together on problem solving as a way to reinforce the course material (Somers & Mazur, 1999). It can also allow for a cyclical approach to learning, where key concepts are reinforced and learning can be documented during the course of a semester (Laurillard, 2002). This concept is part of a learner centered approach to higher education. An instructor will have to make some changes to the way they teach a class if they incorporate PRS use. It would be of interest to find out if those changes, aside from the actual PRS use, are factors in any change in student learning. A prominent feature of PRS is the ability to present immediate feedback on whether the class understands specific course concepts. This can provide the instructor with a way of making adjustments in teaching to focus more on the concepts students seem to be struggling with (Burnstein & Lederman, 2006). Having this knowledge could make teaching more effective.

The field of education is advocating a shift from lecture-based instruction to a structure where the student is working in a collaborative environment, and learning is more active than passive. Suggestions for educational reform by Chickering and Gamson (1991) include creating an environment with the student at the center involved in active learning, increased student and faculty contact, frequent feedback and increased cooperation among students. PRS use can serve to affect all of these areas. Research by Brown (2004) indicates that students expect to see contemporary communication technology used during their education. Using teaching technology in the classroom can

get students more excited about learning than traditional methods (Sorensen, 1998), and a key part of student engagement is getting students more interested in the learning process (Oliver-Hoyo & Allen, 2005). A report by the Association for the Study of Higher Education (2007) indicated that student engagement in educationally purposeful activities is positively related to both grades and persistence in all types of students. Research by Donsong (2005) found that students in a fully interactive technology-based learning environment were more satisfied with their learning and performed better than both those in a traditional classroom and those in a less interactive e-learning environment. The reasons exist for instructors to incorporate a technology such as PRS into their teaching from the standpoint of improving student success; however the technology has to be used in an effective way.

Teacher-Student Interaction

One effect PRS use has on teacher-student interaction is the immediacy of feedback on student knowledge of course content, which allows the instructor to intervene and address any issues in comprehension immediately (Bruff, 2009). This can help establish a better relationship between the teacher and the student as a result of this active participation. Research by Crouch and Mazur (2001) suggests a better use of classroom time is assisting students in understanding course concepts from assigned readings rather than repeating that same information in a traditional lecture format. The effective use of technology in the classroom can help facilitate a relationship between the instructor and the student by creating an environment where both use the technology to

interact towards a common learning goal (Nardi & O'Day, 1999). While the value of interaction between students and instructors in the classroom has been well documented (d'Inverno, et al., 2003; Draper & Brown, 2004; Knight & Wood, 2005), some literature would suggest that PRS could help extend this relationship outside the classroom by creating the communication and trust during class activities (Hwang & Wolfe, 2010; Kenwrigth, 2009).

Practices

The key is for the instructor to use teaching technology in such a way that it works with their own teaching objectives and assessment of student performance (Duncan, 2005). This will vary from instructor to instructor and class to class depending on those objectives, and there are some schools of thought on how to use PRS effectively towards these goals. The literature reviewed contends that PRS use needs to be consistent throughout the class and the scores generated by the system should be a relatively small percentage of the total grade to help encourage student use and help eliminate any intimidation or hesitation in using the technology (Ribbens, 2007; Willoughby & Gustafson, 2009). Questions administered with PRS need to be carefully designed in order to maintain focus once the initial interest in the new technology fades (Lin, et al., 2009). The introduction of PRS in the classroom means that some change in course design and teaching are inevitable to suit the best use of the technology (d'Inverno, et al., 2003). Faculty should be careful not to jump into a technology simply because it is new and exciting. Schmidt (2004) suggests that instructors examine their teaching style,

assess preferred learning styles and study different teaching tools before incorporating new techniques and technologies into traditional instruction. The demographics of the student body should also be taken into account when considering changes using technology. There may be a significant difference between the technological savvy of students compared to their instructor (Waycott, Bennett, Kennedy, Dalgarno, & Gray, 2010). While the attitude of faculty towards technology use is moving towards greater acceptance and use (Mitra, Steffensmeier, Lenzmeier, & Massoni, 1999), faculty may be concerned that time spent in class using the technology will take away from lecture time. Some studies of PRS use indicate that time spent on PRS activities often does result in a decrease in total content coverage yet students learn the taught concepts better (Burnstein & Lederman, 2001). This would suggest that one best use of PRS is towards teaching course concepts that have traditionally been challenging for students (Draper & Brown, 2004). In fact, PRS use can cause students to become more emotionally vested in their responses and pay more attention to class discussion (Beatty, et al., 2006; Wit, 2003). Research by Elliot (2003) and Beatty (2004) indicate that some benefits of this shift from time spent on lecturing to PRS use not only include greater student comprehension, but more awareness by the instructor on areas of difficulty and can adjust the course accordingly. PRS can help create a learning environment where even a large lecture courses can become more student-centered rather than solely lecture driven (Poirier & Feldman, 2007).

Faculty Resistance

The positive effects of PRS use seem to be very clear in relation to learning, yet with any change there comes some resistance. While some core courses will have a universal syllabus for every class section, instructors still exercise some discretion in how to achieve course objectives. Often instructors fall back upon the tenant of academic freedom when faced with the prospect of using new technology in instruction (Fraley & Vargas, 1975; O'Neil, 2008; Ohmann, 2001). There is also an issue of faculty motivation to use new technologies. A study by Weston (2005) indicated that faculty would welcome using new technologies if there was some sort of incentive, either monetary or scholarly. The current state of academic funding would suggest that any incentives in the form of increased pay or decreased teaching and research load would be unlikely (Kantrowitz, 2010).

Accessibility and ease of use are also issues that contribute to instructional adoption of teaching technology. If classrooms have instructional technology hard-wired and ready to use, instructors are more likely to both use it and be satisfied with the results (Song, 2003). There is also the issue of reliability with technology. Research by Jones (2000) indicated that faculty who use technology in teaching do not completely trust that the technology will always work. New technology can also be intimidating to students as well, which can create a threatening environment that discourages learning (Caine & Caine, 1991).

Technical Issues

As with any technology, there are technical issues that may affect the proliferation of use by an institution and instructors. Some issues with PRS include availability, support, reliability, customization, transferability, cost, set-up time and training (Hatch, et al., 2005). The technology also needs to be well-managed in order to deal with potential weaknesses in application. For example, a student could use another student's PRS transmitter and answer questions and make it appear as if the latter student is in class, and instructors need to be aware and account for this (Herreid, 2006). Some technical issues can be solved with proper training. Having adequate technical support in the form of training is crucial to the successful use by faculty, whether that support comes from a specific department or through peer instruction by other instructors familiar with the technology (Hartman & Truman-Davis, 2001).

Assessment and Feedback

Assessment is an important part of the education process, and it takes place with both the student and the instructor. The two are symbiotic in nature as one can affect the other. When it comes to assessing students, not only is it of interest how a student performs in a class in the traditional sense of letter grades, but how well they have learned the course material. Research by Brookfield (2006) found that students regard feedback from the instructor as an indication of their devotion to teaching; however quality feedback is harder to maintain in a large classroom simply due to the sheer number of students. This may explain why much of the research on PRS use has taken

place in large lecture courses. One way an instructor demonstrates to students that they are interested in their progress is by being responsive when a student is struggling with a particular concept or theory (Grimmett & Neufeld, 1994). PRS allows for an instructor to see immediately how well a class understands a concept based on the number of correct responses to a PRS-formatted question. This provides immediate feedback and allows the instructor to adjust the class time to address areas that the students are struggling with. This is how PRS can work as an assessment tool.

The use of a technology like PRS in classroom teaching creates both an activity to promote learning and a tool to use in that activity. Activity theory considers learning as having three components: the student or learner, the activity, and mediating artifacts. This theory is based on research by Leont'ev (1978) and Vygotsky (1978, 1986) and has been used in the study of education and technology (Isssroff & Scanlon, 2002). The theory assumes that an activity is initiated by a need or motivation and that activity is made up of one or more actions, the completion of which satisfies the initial motive. The activity and the corresponding actions create the environment in which the motive can be satisfied (Karasavvidis, 2009).

This type of dynamic assessment of student learning follows along Vygotsky's (1978) theory on zones of proximal development (ZPD), which identifies difference between what a student can figure out independently and what they need help understanding. Part of this assessment involves documenting the resources used by the students and the instructor to aid in learning course objectives. PRS is one such learning tool that can help students transition into a zone where they no longer need assistance.

Modern subscribers to Vygotsky apply the theory of mediated action analysis as a way to evaluate those learning tools and how effective they can be helping students make connections to the material (Boettcher & Conrad, 2010; Bernhard, 2007; Hagstrom, Shadden, Knotts, & Glenn, 2003). These tools can be psychological, behavioral, or material, as is the case with PRS. Research by Ihde (1991) contends that all mediated perception is partially determined by technology, where technology provides a focus to specific aspects while helping to shadow others. Often in teaching the emphasis is placed only on concepts and ideas, with little or no consideration of the mediating tools (Bernhard, 2007). This is where some instructors struggle with the idea that any tools are necessary to effectively teach course concepts to students beyond their own expertise. Technology researcher Peter-Pall Verbeek (2005) claims that all contact humanity has with reality is mediated in some way and technology is one possible form of mediation. Chickering and Gamson (1991) consider active learning and prompt feedback as effective educational practices that influence student learning. Having a system that allows for immediate participation and acknowledgement by several students during a course could work towards higher student success. Also, using a teaching technology that not only can be used as a mediating device for the material but also has a built-in way to assess student performance and attendance would lend itself to the ideas of dynamic assessment theory very easily.

Evaluation of the Literature

There are definite advantages to using PRS in instruction if the technology is used effectively by faculty whose teaching methodology allows for it, or if faculty are willing to change their course parameters and teaching methodology accordingly. There is an assumption that by creating better students, the instructor becomes a better teacher and their attitude towards teaching is affected in a positive manner. It was of interest to talk to instructors who were experienced in using PRS to see if such an implied correlation exists and how other factors may affect their attitude even when PRS is used effectively. The concepts of effectiveness, teacher-student interaction, practices, faculty resistance, technical issues as well as assessment and feedback were prominent in the literature reviewed.

Summary

While there is much research on PRS and the effect on students, there is significantly less research from the faculty point of view. The main areas of effectiveness, teacher-student interaction, practices, faculty resistance, technical issues as well as assessment and feedback were identified in the literature as the main issues regarding PRS use. The hope of this study is to look at PRS from the perspective of faculty at MSU and determine if the topics found in the literature exist in their own experience.

CHAPTER 3

METHODOLOGY

Introduction

The purpose of this qualitative transcendental phenomenological was to examine the usage, attitudes, and perceptions of faculty at MSU who had used PRS in their teaching at least once in the past six years. To accomplish this, 15 participants took part in individual in-depth interviews regarding their PRS use and experience. This chapter describes how those participants came to this study and how the information was gathered and processed.

Problem Statement

There is a need for administration, teaching faculty and information technology staff to know how teaching faculty experience the use of PRS in their classes.

Purpose Statement

The purpose of this qualitative transcendental phenomenological study was to examine the usage, attitudes, and perceptions of PRS use by teaching faculty who had used the technology in at least one course in the past six years at Montana State University (MSU) in Bozeman. Information on faculty who had used PRS at MSU was obtained by records from the MSU Bookstore (D. Knickerbocker, personal communication, October 26, 2010) and an e-mail sent by MSU Instructional Technology

Project Director Ritchie Boyd to faculty whom he had dealt with personally regarding their PRS use informing them of the study. Based on that data, possible participants were contacted via e-mail and asked to participate in the study and to forward the invitation to other faculty they knew of with PRS experience at MSU. As a result, 15 faculty members agreed to be interviewed for this study.

Research Questions

This study asked following questions:

1. How and to what extent are PRS used by teaching faculty at MSU who have used the technology at least once in the past six years?

2. What are the attitudes of MSU teaching faculty on PRS use who have used the technology at least once in the past six years?

3. What are the issues regarding the use of PRS by teaching faculty at MSU use who have used the technology at least once in the past six years?

Research Design

This qualitative transcendental phenomenological study used semi-structured in-depth interviews to gather rich and descriptive data on the experiences of a sample of 15 teaching faculty who have used PRS technology at MSU in Bozeman, Montana in at least one course in the past six years. The time span of six years was chosen because the most complete data on the population of faculty who have used PRS came from the MSU Bookstore, and that data only included information from the past six years. Faculty

members described their usage, attitudes, and perceptions of PRS based on their experiences using PRS technology in their teaching. The interview protocol was piloted by faculty at Montana State University-Billings (MSUB) who had used some form of PRS in their teaching. The MSU Institutional Research Board reviewed the research proposal and deemed it exempt from review (Appendix A).

Research Paradigm

A phenomenological study was chosen because it focuses on the detailed understandings and experiences of a few specifically chosen individuals (Marshall & Rossman, 2006). Also, a qualitative study can explain the experiences of faculty in more nuanced detail than a quantitative method. The specific research methodology chosen is a qualitative approach using a transcendental phenomenological design. Phenomenological studies describe a similar lived experience of a phenomenon by several individuals (Creswell, 2003). This study used semi-structured in-depth interviews as the source for rich and descriptive data on the similar experience of teaching using PRS. Another reason that a qualitative method was chosen for this study was because the goal was to discover meaning and concepts in the form of themes within the data (Creswell, 2003; Neuman, 2006). The phenomenological approach also works best when the researcher is looking for an understanding of how things are related (Stake, 1995; Hoepfl, 1997). The goal in this study was to find understanding among similar situations in PRS use. A qualitative approach fits well because the goal was to create a better understanding of PRS use rather than a purposeful explanation based on quantitative data

(Stenbacka, 2001). The transcendental phenomenology was chosen because it focuses more on a description of the lived experiences of the participants rather than an interpretation of said experiences (Moustakas, 1994). While concepts found in the literature and the research questions were used to formulate the interview protocol (Appendix B), the focus of the research was on the experience of instructors at MSU who have taught using PRS in the past six years.

Researcher Positionality

The researcher does not work at MSU, and care was taken to ensure that those participating in the research had no connection to the researcher. Participants who either knew the researcher or at one point had been in a position to evaluate the researcher's work were not considered for the study. The researcher had never taken a course using PRS technology at the time of this research; therefore the researcher does not come into the project with any prior experience to cloud the issue. PRS research is a fairly new area, especially research dealing specifically with faculty rather than students. Based on this, the researcher did not have any personal experiences that might have affected the research, which is required by this type of phenomenological study (Husserl, 1931).

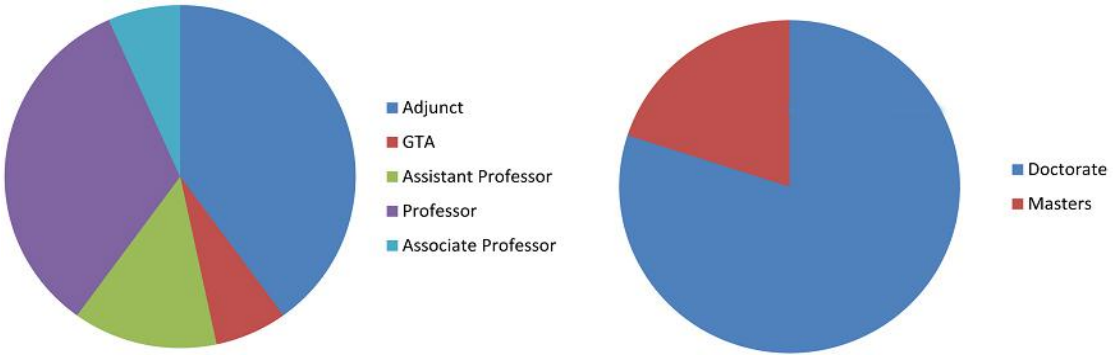
Participants

The population for this study included all faculty at MSU who had used PRS in their teaching at least once in the past six years. The exact number in this population is unknown; however the best information was derived from a list of teaching faculty at

MSU who had used PRS in at least one class in the past six years created by data provided by the MSU Bookstore (D. Knickerbocker, personal communication, October 26, 2010). In addition, the researcher learned that faculty who use technology in their classroom sometimes contact Ritchie Boyd, MSU Technology Project Director with questions and for advice. The researcher contacted Mr. Boyd and asked him to help contact those faculty whom he had consulted on iClicker use specifically. Mr. Boyd sent an e-mail to those faculty containing information on the study and contact information for the researcher (Appendix C), recommending that those interested contact the researcher directly. From this information, 52 faculty were identified as potential participants, with those who responded to Mr. Boyd's e-mail already being identified in the MSU Bookstore data. The reason MSU was chosen is due to proximity and access. Research was limited to teaching faculty at MSU who responded to the interview request. Out of the 52 instructors identified, 22 replied to the initial request for interviews and 15 were chosen based on their willingness to participate and availability. Research by Polkinghorne (2005) suggests that this range of interviews is adequate for a phenomenological study. As indicated in a conversation with David Knickerbocker, Book Operations Manager at the MSU Bookstore (personal communication, October 26, 2010), not every faculty member informs the bookstore of their course needs. Therefore there may be faculty and courses that had used PRS at MSU that were not represented in the data provided by the MSU bookstore. Due to this lack of solid data on population size, the sampling also included the snowball technique (Appendix D).

Of the 15 participants, six were in adjunct positions, eight in tenure-track positions and one was a graduate teaching assistant. Of those eight in tenure-track positions, two were assistant professors, one associate professor and five were full professors. Six of the 15 participants were female and 12 held a doctorate in their respective disciplines with the remaining three holding Masters degrees (Figure 1).

Figure 1. Academic Rank and Degree



The number of semesters of PRS use by participants ranged from 12 to one, with the number of classes ranging from five to one (Table 1). The receiving equipment (base unit) used was permanently mounted in the classrooms of all but one of the participants, who had a unit that had to be set up by the instructor for every class. Seven of the participants taught classes in the College of Letters & Sciences, with three teaching in the College of Education, Health & Human Development and one each from the College of Arts & Architecture, Agriculture, Engineering, Land Resources & Environmental Sciences, and Nursing. The average number of students enrolled in a class using PRS was 125, with the lowest number of participants at 16 and the highest at 280.

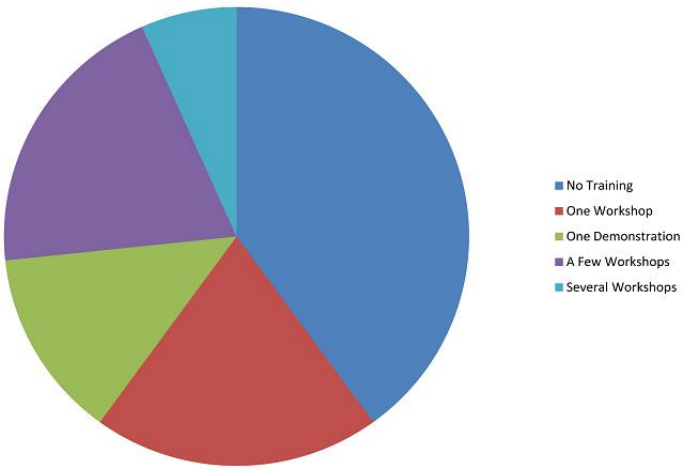
Table 1. Profile of Participants

RANK	GENDER	SEMESTERS USING PRS	PRS CLASSES	PRS CLASS ENROLLMENT	COLLEGE	EARLY ADOPTER	MID-ADOPTER	LATE ADOPTER	DEGREE
PROFESSOR	M	6	1	160-180	AGRICULTURE		X		D
PROFESSOR	M	12	3	30-200	ARTS & ARCHITECTURE			X	D
GTA	M	1	1	60	EDUCATION, HEALTH & HUMAN DEVELOPMENT		X		M
ADJUNCT	M	3	1	60+	EDUCATION, HEALTH & HUMAN DEVELOPMENT	X			D
ADJUNCT	F	4	1	50	EDUCATION, HEALTH & HUMAN DEVELOPMENT		X		D
ASSISTANT PROFESSOR	M	6	1	170-180	ENGINEERING		X		D
ASSOCIATE PROFESSOR	M	2	1	120-180	LAND RESOURCES AND ENVIRONMENTAL SCIENCES		X		D
PROFESSOR	M	1	1	200	LETTERS & SCIENCE	X			D
PROFESSOR	M	1	1	150-200	LETTERS & SCIENCE			X	D
ADJUNCT	F	3	2	200-230	LETTERS & SCIENCE		X		M
ASSOCIATE PROFESSOR	F	6	1	42-50	LETTERS & SCIENCE	X			D
ADJUNCT	F	10	5	100-210	LETTERS & SCIENCE		X		D
ADJUNCT	F	10	2	80-200	LETTERS & SCIENCE	X			M
ADJUNCT	M	12	2	30-280	LETTERS & SCIENCE	X			D
PROFESSOR	F	3	1	16	NURSING	X			D

Four of the six early adopters taught in the College of Letters and Sciences, and three held the rank of adjunct with one associate professor and two full professors. Those early adopters were split as three were males and three were females. Four had used the technology for over 10 semesters, with two of them indicating use in smaller (<50) classes. Seven of the participants taught in the College of Letters and Sciences, with three in Education, Health and Human Development and the remaining in Agriculture, Arts and Architecture, Engineering, Land Resources and Environmental Sciences and Nursing (Table 1).

Seven of the participants indicated that they had attended at least one training workshop on how to operate the iClicker PRS system at MSU, two stated they had attended a demonstration and six indicated they had received no training either formally or informally (Figure 2). Fourteen of the 15 participants indicated that iClickers were a required part of their course. In the one outlying case, the technology was used as a way for students to earn extra credit.

Figure 2. PRS Training



Each interview session began with a review of the Informed Consent Form (Appendix E) with the participant. Participants were also asked if the interview audio could be recorded for future transcription. After they agreed to the terms of the study and signed the form, the interview began. The semi-structured nature of the interview protocol (Appendix B) allowed for flexibility in the types of questions asked, and all faculty stated that they were willing to be contacted later if additional clarification was needed.

In addition to the interviews, instructors were asked to provide course syllabi in order to validate their PRS use and compare data provided in the interviews with information in their own syllabi regarding how PRS was used in their course. Golafshani (2003) suggests this is a sound way to check validity in qualitative research. This research does not serve to make assumptions or predictions as to the usage, attitudes, and perceptions held by faculty who had used PRS at MSU; rather it is an exploration of faculty experience with PRS as they relate to those areas. Only faculty who had taught using PRS in the past six years at MSU were considered for this study, and the experiences of faculty outside of MSU were limited to those explored in the literature reviewed. Content and face validity were addressed by piloting the interview protocol with faculty at MSUB and using the literature reviewed to help identify areas to explore.

Data Collection Procedures

The initial data on faculty use of PRS at MSU was acquired through course information provided by David Knickerbocker, Book Operations Manager at the MSU

Bookstore (personal communication, October 26, 2010) and an e-mail sent by MSU Instructional Technology Project Director Ritchie Boyd to faculty whom he had consulted on PRS use. Faculty who responded to Mr. Boyd's e-mail were incorporated into the list of potential subjects from the MSU Bookstore data. Those possible participants were sent an e-mail invitation detailing the study and asking for their participation along with a request to forward the e-mail to any faculty they know of who had also taught using PRS (Appendix D). Of the 22 who responded to the initial request, 15 were willing and able to participate in the study. From May to October 2011, the researcher conducted semi-structured in-depth interviews with those 15 faculty members to gather rich and descriptive data based on an interview protocol with MSU Institutional Review Board (IRB) approval (Appendix A). It was explained to all subjects that their participation was completely voluntary and that they could decide to withdraw their participation at any time, and those who chose to participate were asked to complete a consent form detailing the research and their rights in the process (Appendix E). The researcher recorded the audio from those interviews with the subjects consent. Ten interviews were in-person, and five conducted via telephone.

Validity

The information provided by the MSU Bookstore, responses to the e-mail sent by MSU Instructional Technology Project Director Ritchie Boyd, and by faculty who referred other teachers at MSU who they knew had taught using PRS helped ensure the validity of the sample. The pilot interviews conducted at MSUB added dependability to

the interview protocol and its relationship to the research questions and literature topics. Course syllabi were evaluated to help authenticate the indicated use of PRS by the faculty interviewed. Research by Patton (2002) states that such means are a good way to ensure trustworthiness. A confounding variable that could impact validity is that there may be faculty using PRS that were not part of the information from the MSU Bookstore and there is no way to know how those faculty would have responded. Because this is a qualitative study, the objective is not to make generalizations that relate to the population.

Analysis

Once all the interviews were completed, the researcher transcribed the interviews and referred back to the words, phrases, and ideas identified during the interview sessions. The researcher then conducted a text search using the 'find' function of MS Word within each completed transcript for those noted words, phrases, and ideas. Interview transcripts were analyzed both individually and collectively to find statements that described faculty experiences using PRS and those statements were used to develop themes as required by a transcendental phenomenological approach (Moustakas, 1994). Category schemes were developed based on the research questions, and data relating to each question was compiled into individual documents for each scheme. The researcher then searched those individual documents for reoccurring words, phrases, and ideas as well. Information from these documents was then summarized and organized to better relate to the research questions and reduce data. The researcher also identified quotes from the subjects that helped to illustrate the themes on a more personal level.

Categories from the literature were used to help organize the research data. Cases where the participant's experience deviated from the majority were also included in the summary of data. The goal was to provide a better overall understanding of the experience of faculty who had used PRS at MSU.

Summary

This qualitative transcendental phenomenological study used semi-structured in-depth interviews to gather rich and descriptive data on the usage, attitudes, and perceptions regarding PRS of a sample of 15 teaching faculty who had used PRS technology at MSU in Bozeman, Montana in at least one course in the past six years. The sample was derived from information provided by the MSU Bookstore and the MSU Instructional Technology Director on faculty who had taught using PRS, along with referrals from those faculty members of others who had taught using PRS. The interviews were guided by an interview protocol piloted by faculty at MSUB. Course syllabi were used to help ensure validity along with information provided by the MSU Bookstore on courses that had required PRS in the past six years. Interviews were recorded and transcribed, and those transcripts were analyzed to find themes and statements that help to articulate faculty experience using PRS.

CHAPTER 4

RESULTS

Introduction

This qualitative transcendental phenomenological study used semi-structured in-depth interviews to gather rich and descriptive data on the usage, attitudes, and perceptions regarding PRS of a sample of 15 teaching faculty who had used PRS technology at MSU in Bozeman, Montana in at least one course in the past six years. Those interviews were recorded, transcribed and examined to seek out common themes and descriptive explanations of their experience. Course syllabi were also requested of the interview subjects and reviewed to compare their indicated use of PRS technology to what they indicate in their syllabi and to also confirm their use of PRS. This chapter describes the results of that examination and presents the results according to the themes that emerged: 1) motivation for PRS use, 2) PRS training, 3) configuration of PRS technology, 4) classroom application, 5) course adjustments, 6) perception of effectiveness, 7) class size, 8) issues with PRS use and concludes with an overall faculty assessment of the technology.

Problem Statement

There is a need for administration, teaching faculty and information technology staff to know how teaching faculty experience the use of PRS in their classes.

Purpose Statement

The purpose of this qualitative transcendental phenomenological study was to examine the usage, attitudes, and perceptions of PRS use by teaching faculty who had used the technology in at least one course in the past six years at Montana State University (MSU) in Bozeman. Fifteen faculty members who had used PRS in their teaching over the past six years were interviewed on their usage, attitude, and perception of PRS use. Faculty who had a course listed as using PRS based on information provided by the MSU Bookstore as well as those referred by the MSU Instructional Technology Director and other faculty were asked through a combination of e-mail and phone calls to participate in an interview on their PRS experience.

Research Questions

This study asked the following questions:

1. How and to what extent are PRS used by teaching faculty at MSU who have used the technology at least once in the past six years?

2. What are the attitudes of MSU teaching faculty on PRS use who have used the technology at least once in the past six years?

3. What are the issues regarding the use of PRS by teaching faculty at MSU use who have used the technology at least once in the past six years?

Reporting of Results

The results of this study are presented based on the order in which the technology would be applied to teaching, beginning with the motivation for PRS use, PRS training, configuration of PRS technology, classroom application, application with course content, course adjustments, perception of effectiveness, class size, issues with PRS use, overall faculty assessment and meaning. The goal was to show the path taken by faculty using PRS from adoption to application using their own unique experiences and quotes as points of interest By their willingness to talk about their teaching as well as the passionate way they spoke, it was obvious that they felt teaching was at the core of their role as an academic. It could be seen that this passion was behind their search for more effective ways to teach.

Motivation for PRS Use

The interviews started out with some background information on the participants, but quickly moved into their reasons for both considering and adopting PRS into their teaching. Five main reasons were given as the motivation for PRS use; 1) large class size, 2) formative assessment, 3) early adopter of technology, 4) peer influence and 5) demonstration of PRS technology on campus.

The main reason given by 14 of the 15 faculty for their use of the iClicker system at MSU was to address what they considered a large class. In the one outlying case, PRS was used in a class with 16 students. The classes in question were either traditionally large or had suddenly grown in size either due to course popularity or a reduction in

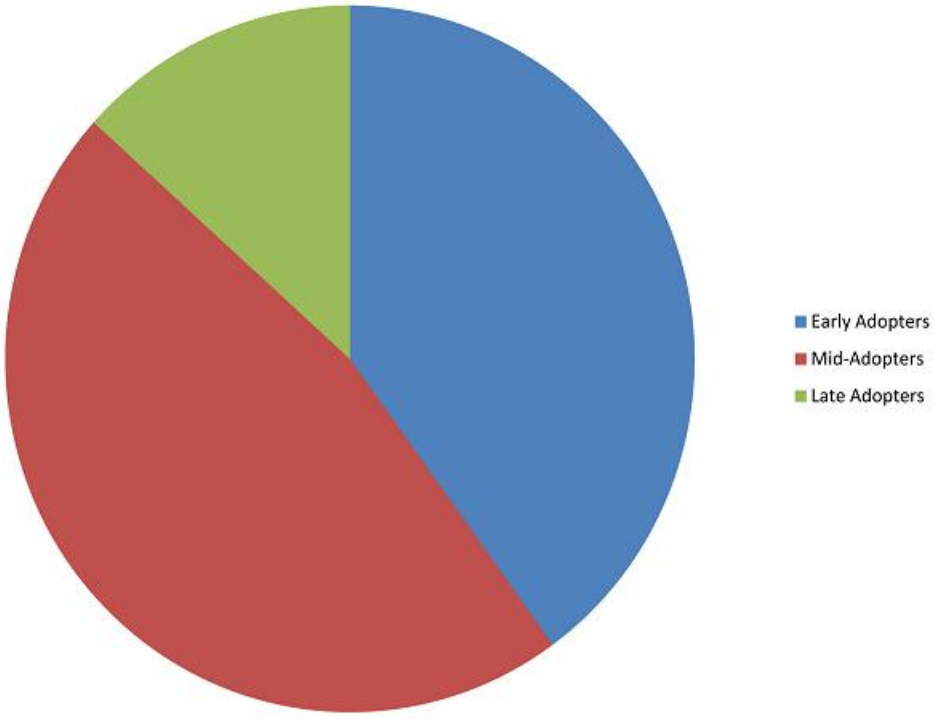
possible electives and/or section offerings in a particular discipline. For example, one instructor saw their class grow from around 40 students one semester to over 100 the next.

Thirteen of the 15 faculty members interviewed indicated formative assessment as one of the main reasons for adopting the technology. This again relates back to their passion for teaching and their thirst to find new ways to engage their students. That engagement becomes a challenge as class sizes grow, and one faculty member reflected on how they balance the need for good formative assessment with growing class enrollment:

> With 300 students, I lose so many students. They won't come see me but are frustrated. (With) the freshman it's hard to know, realize how hard they have to work to get it and they make it part way through the semester and then they just give up because they're so far behind. So again, it's a way for me to try to engage them right off the bat and keep them in class paying attention; giving them points if they're paying attention.

When asked about their adoption of technology, the majority of respondents considered themselves either early or mid-adopters of all types of teaching technology (Figure 3), and those faculty all indicated that there interest in technology was a contributing factor in their adoption of the iClicker system. It was no surprise to discover this, as it became clear that many of the faculty interviewed were either among the first PRS users at MSU or were inspired by such users, with one faculty member indicating that they actually piloted the technology for MSU.

Figure 3. Adoption of Teaching Technology



Seven of the faculty interviewed stated that they became interested in using PRS technology through workshops held at MSU, and two indicated their influence came through a demonstration of the technology held on the MSU campus.

All but one participant stated they had sought counsel from fellow faculty who had experience in the technology prior to using it, with that one remaining faculty member having piloted the technology at MSU. In one case the instructor interviewed was assigned a class section that had used iClickers in the past and because it was a late section addition, decided to keep the technology and seek out faculty members who had taught the section before for guidance. All had stated falling back on a peer group of PRS users in times when they had a question or needed advice, as well as consulting with

MSU Instructional Technology. Here one faculty shared their own motivation for PRS use:

> Part of the reason I wanted to use the clickers was to change my own patterns and sort of refresh what I was doing. To deal with something and a new technology that sounded like it had some promise and people it had some success with. So I guess I like to fool around with new technology and trying to incorporate movies, music clips, things that energize me because I have to stay energize more and stay on my toes more rather then I just pull my lecture out and give it, so it has kept me energized.

The community of faculty who use iClickers in their teaching seems to be close-knit, as all but one subject indicated other faculty within the study as someone they had consulted prior to iClicker use. Academic freedom was actuall a positive factor in PRS adoption, as faculty were allowed to administer their course in their own way as long as the course objectives remained intact.

PRS Training

None of the faculty interviewed received what they described as 'formal training' on how to operate the iClicker system, however seven indicated they had attended informational workshops on the technology at MSU and only one of them stated that they had attended several, however none could recall the exact number. Two stated having seen only a demonstration of the technology, and six stated they had no form of training whatsoever, which begged the question; how did they become confident in the technology with limited to no training? All participants indicated that the hands-on operation of the iClicker system was very simple and did not necessarily require what

they would consider ‘formal training,’ and all had only positive responses in regards to the availability of assistance from MSU Instructional Technology.

Configuration of PRS Technology

Fourteen of the faculty interviewed had the iClicker receiving unit, or base station, securely mounted in their classroom on a permanent basis. This is the piece of technology that receives signals from the students’ iClickers and then sends that data to the instructor’s computer to allow them to record and display that information to the class using either a projector, smart board or computer screen. The base stations were purchased, installed and supported by MSU at no cost to the individual instructors or their academic departments. This was stated by those faculty as a positive factor in their adoption of the technology. Only one faculty member interviewed used a portable base station available for check-out through MSU Instructional Technology. While that faculty member was allowed to keep the unit all semester, they stated that it did require some simple set-up time at the beginning of each class.

Classroom Application

Attendance

Ten of the faculty interviewed used the iClicker to monitor attendance, with nine of them indicating that attendance was factored into the final grade. None of the respondents used the technology solely for taking attendance. Five faculty interviewed stated that they did not take any form of attendance in their classes.

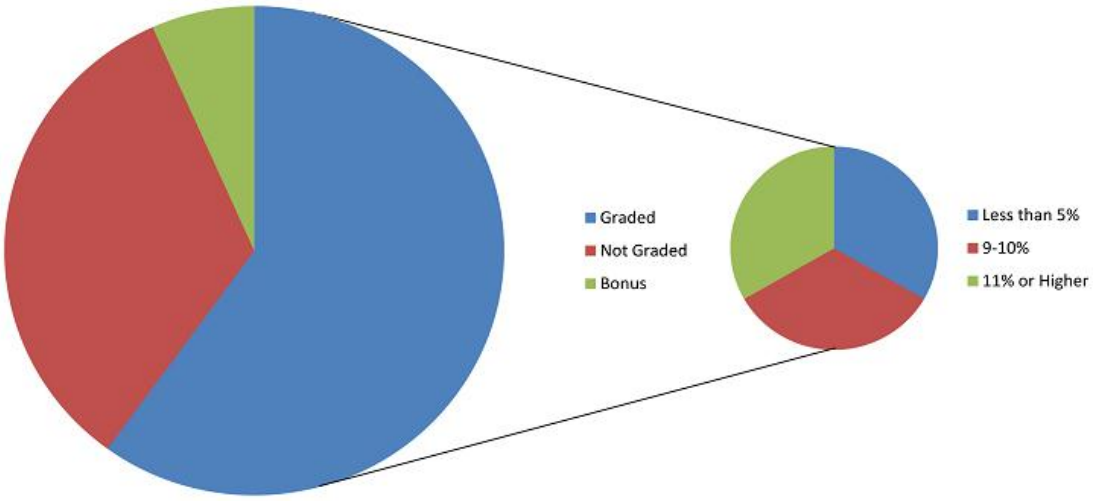
Grading

Nine faculty interviewed stated they did use the results of iClicker assessments towards a grade item other than attendance. In these cases, students were presented with a multiple choice or true/false question in class, and their response was recorded by the base station and saved in a Microsoft Excel file on the instructor's computer.

Of those nine respondents who used iClickers for a grade item beyond attendance, the percentage of the grade determined by iClicker use was less than 5% in three cases, with one of the remaining cases at 9%, two at 10% and one at 15% with the remaining two cases stating the percentage varied between 11% and 15% (Figure 4)..

In one case, the technology was used as a way for student to earn extra credit. The students used the iClickers to answer questions in class, and their correct responses were recorded and added to their total points at the end of the semester. In this way, students were not penalized for incorrect responses or no response at all. Their attendance and participation was also recorded but not used as a grading factor.

Figure 4. Grade Accountability



Student Engagement

All faculty interviewed used the iClicker system as a way to get students engaged and active in the course material during class and as a way to break up the lecture material. One faculty member compared their class to their own young children in regards to their attention span and their need to be engaged in an interesting way in order to maintain focus. Another faculty member recalled how they start to see their students' eyes 'glaze over' after about 15-20 minutes of lecture, and they used the iClicker often to simply break away from lecture and reengage the class. One faculty member stated that the iClickers provided a way to get those students who do not typically raise their hand in class to engage in the learning process:

> You're going to get those students that are active and engaged students that are going go ahead and raise their hands and say 'Yes' and be willing to talk and share response, but there's a huge portion of the class that are not going to do that.

One faculty member shared a story on how they posted the simple question "Are you here?" as way to register student attendance. The possible responses were Yes, No, and Maybe. Since the iClicker system allows for more than three possible responses, some students selected a fourth choice even though one was not given. The instructor then went back and added a fourth response as a joke, and the class exploded in laughter. Even though it was a simple attendance question, the faculty member was impressed by how such a simple application created active student engagement.

Assessment

Testing. Four of the faculty interviewed used questions presented via the iClicker to take the place of a portion of what would traditionally be points on part of a test. In those cases, the total points available in the class did not change, only how those points were acquired. What had traditionally been a question asked in a written quiz or exam now took the form of an in-class iClicker question. Issues such as lost or stolen iClickers, dead batteries and faulty registration have been cited as the reasons for not making iClicker questions a graded item, but that is covered more in-depth later in the study.

Formative Assessment. All but two participants stated they used iClickers as a form of formative assessment of their own teaching. One participant made this observation on how using the iClicker has aided in gauging their teaching effectiveness:

> Every teacher does this; we go 'Are there any questions?' And in a big lecture, three (front) rows might ask the question but nobody behind that does because to them it's like watching TV. So if nobody asked the question your assumption is everybody understands, and that's the worst assumption the teacher can make so the iClicker question gives you an opportunity to see what percent of students understand this concept.

The concept of instant feedback also became prevalent among participants. All faculty interviewed stated that students seemed to like being able to find out immediately if they got a question correct or see if they were in the majority of students who responded a certain way. As one faculty member stated:

> It's really kind of fun, because I almost feel like the students are waiting to find out what everyone else thought. It is a little bit like a game show, so they like to see that immediate feedback. Sometimes I'm really surprised. I ask them a question where I

> think, well maybe an educated person today would not think this, and the students would be giving me something way out of bounds. It gives me a point to really teach them something in that moment… it's better than a test where you have to wait.

Class Participation and Discussion

One aspect of the iClicker system is that it allows an instructor to assess the knowledge of the class in an anonymous way. The ability to survey student knowledge and share those results almost instantly with the class was used by all faculty interviewed, and eight also used the technology to stimulate discussion either formally in small groups or informally. This was accomplished by asking a question based on personal beliefs or attitudes and using the resulting data to begin an in-class discussion.

> The best I could do to try to get them to read is ask very simple questions, but it did give me some idea of whether they read it or not. But the way that was most effective for me was trying to move beyond that simplistic kind of scatter gram and think about, well how can we start discussions with it and I found that actually quite fruitful because I could ask questions that didn't really count toward their grade. More nuanced questions and then, when you put this scatter gram up on the board, people would see that, well 30% of the people in class agreed with them and 40% agreed with somebody else, and that was a really good jumping off point to discussions.

One faculty member shared that their students even got upset if a class went by without having an iClicker-based question. Another faculty member related using the iClicker system as one way to bridge the generational gap between themselves and their students:

> This generation is not like my generation was. We watched TV a little and read a lot. This generation watches a lot of short videos in their life. The way they think is much more incremental, so my job is to find a way that teaches to the way that they learn.

Frequency of PRS Use

Faculty interviewed used an average of 3 Clicker questions per class (Table 1). While 10 of the 15 faculty interviewed taught in the Sciences, there was no indication in the data of a relationship between PRS effectiveness and discipline.

Course Review

Thirteen of the 15 faculty interviewed stated they used iClickers as a way to review course material from the previous class meeting or towards the end of class on concepts covered in class. The technology was used as a way to repeat important concepts or ideas, as one faculty member stated:

> I kind of feel like the clicker gives us a little bit more of a dialogue. Instead of just me talking to them or where I can respond to what they've said, I feel like that opens you up a little more for more than to ask questions, so if feels kind of safe.

In-Class Interaction

The iClicker system is by design an interactive system; the instructor presents questions to solicit individual student responses. In this regard, the interaction is implied when iClickers or any PRS technology is used in teaching. Because of this, the focus of the interviews shifted to how interaction had changed due to PRS use; did the instructors feel that the interaction had changed compared to interaction prior to PRS adoption or other classes they taught that did not use the technology? Only one faculty member stated that every class they had ever taught involved some form of PRS and in one case the technology had always been used in the instructor's class because the class was new and designed with PRS in mind. In the remaining instances where the technology was

introduced into a class for the first time, all respondents indicated that the in-class interaction increased simply because all students were given an opportunity to interact with the material. Considering that the iClicker system used was limited to single responses, no faculty made a comparison to longer, more in-depth spoken interaction Therefore, the quantity of interaction increased however the issue of quality was not discussed. That interaction was considered unique based on how the technology worked, as described by one participant:

> I put up a bar chart (showing the correct answer and the class responses), and it is always fun because the students are just waiting, you hear someone yell 'Oh, Man!' or 'Yea!'

The PRS system was used as a way to give a voice to all students, whereas the traditional scenario of students raising their hands is limited due to time and the comfort level of the student. Some students simply do not feel comfortable raising their hand in a class and speaking. Use of the iClicker system had the effect of leveling the playing field in regards to student interaction. One faculty member made this observation on how the technology had a positive effect on their classroom atmosphere:

> You can mess with some social boundaries in a classroom because I think there are a lot of societal or structural boundaries in a classroom that we don't think about much and that lend themselves to certain types of learners. So the clicker can actually be an act of liberation in my opinion, which is a lot to think about. It is a heavy burden for a little $30 electronic gadget.

While the types of responses are limited simply because the current iClickers used at MSU allow for a maximum of six single responses, one instructor stated that they had been able to use the technology as a way to get anonymous feedback on a sensitive discussion issue:

> The one time they worked the very best for me was to ask an anonymous question and say 'How many of you heard the word 'Nigger' used in a pejorative sense in the last week, last month, last year and so on. Fifty percent of the people had heard it in the last week, so I threw up the scatter gram and I was just amazed, flabbergasted frankly. But that set off one of the best discussions we ever had and there is no way I could've asked that by having people raise their hand, but you could do it anonymously and be honest.

Non-Classroom Interaction

One questioned asked of faculty interviewed was whether they thought that their use of iClickers contributed to teacher-student interaction outside of the classroom. None of the faculty interviewed indicated that they could see any increase in such interaction.

Course Adjustments

All faculty interviewed indicated that some adjustments had to be made to their course to incorporate iClicker use, and the two faculty with courses that had always used PRS agreed that the nuances of the system had to be considered during course creation. As one faculty member stated:

> I had to adjust the time because even when I just used two questions at two minutes per question and maybe another minute of explanation that's three minutes per question so that's over 10% of my class time that I'm spending on the clickers rather than going over material, so I had to adjust material I teach. So if there is any fluff, a bullet I can leave out to try to get that time back. Or maybe you just don't teach as much material, maybe I don't tell an additional story about something…it's a matter of shifting where learning takes place; working on questions alone. I wanted them working on more questions in class rather than listening to a lecture and then going away and working on problems and struggling with it.

Three faculty members stated that they had seen textbooks in their disciplines that came with questions formatted for a PRS system; however they were hesitant to use those questions due to issues with correctness and application to their specific teaching objectives.

Perception of Effectiveness

While all of the faculty interviewed believe the way they were using iClickers in their class was effective, they also all agreed that there are probably better ways to use the technology that they were either not aware of or had not tried because they did not have the time. Perceived effectiveness relates back to the individual results expected from PRS use. In all cases, faculty were satisfied that their intended goal for PRS use was reached. One faculty member stated how the technology was effective in bringing students back on task:

> If you are really watching your students, it is obvious when they check out and so clickers …that's one way. When I choose to ask the clicker questions is when I see the majority the class start to check out, and when I asked the question and asked them to talk about it, they're engaged right away.

One faculty member interviewed stated they felt the technology was an effective way to repeat important concepts:

> My belief is that you need 20 or 30 repetitions to knock that (subject matter) in your head, so those iClickers can provide several of those repetitions and hopefully they're repeating something they've seen in the reading or lab or other places.

Participants used the technology to survey whether the class understood course material and identify areas that needed additional focus. Focusing on areas of learning

rather than grading can help the instructor see what information students are struggling with and it can help the students see if they truly understand the material. As one faculty member stated:

> I feel like I have helped the students. I am not sure it's changed my teaching effectiveness; I think it's changed the learning effectiveness. I think it's made the students more aware of what they know and what they don't know and that's really important for them, because they think they know everything they leave the class going 'I have absorbed everything (the instructor) has said.'

Fourteen of the 15 faculty interviewed stated they would continue to use iClickers in their teaching, which speaks to the perceived effectiveness. It is highly unlikely that an instructor would continue to use a new technology that they felt was ineffective, and in one case where the faculty member was considering not using the technology their reason dealt with registration issues rather than effectiveness.

Class Size

Three faculty members interviewed used the technology only in courses with typical enrollment below 50 students, with two others having experience using PRS in both large (>50) and small (≤50) enrollment courses. Those who did use the technology in the smaller classes indicated that their use was to stimulate class discussion and anonymously survey the class on their knowledge or attitude on a subject, which would then lead to a discussion. Those instructors that used the technology only in a large class (>50 students) indicated that it provided a way for informal learning assessment, something that is more easily done in a smaller class. Often an instructor can gauge knowledge or understanding of a concept in a small class by watching how the student

behaves in class or by simply asking them a direct question. In a larger class it is a challenge because not every student can be directly asked a question or have an opportunity to respond to a class question. There may be a point of diminishing returns in regards to PRS use and class size, however that particular point was not universally definable among those interviewed. One faculty member stated where they draw the line on PRS use in regards to class size:

> I think there's a threshold, for me at least, where it becomes feasible to use or the efficaciousness of clickers becomes positive…I would guess that number might be at 60 or above. I've had classrooms with anywhere from 40 students to 180 now and it seems to me that I lose… there's a disconnect with the transition from conversation to lecturing at about 60 individuals in a room.

Considering the limitation on the types of questions (single response) the current iClicker system at MSU allows, there was no clear difference when comparing disciplines with question type among those interviewed. However in one case the faculty member discussed how with their smaller class the subject being taught was considered along with class size in their decision to limit PRS use to only their larger class:

> It feels like it makes more sense in the large class because I have no easy way of interacting with each individual student and that huge classroom, whereas a class of 30 I can interact with them very easily. And the classes themselves are very different, to use the clickers to make sure that certain concepts are gained especially when we're doing calculations to make sure they are understanding the calculations. I want them to have done a calculation right there in front of me in class to see if they got it right and have the opportunity to ask questions and watch me work it through as well. So the whole process whereas we generally have the time and the smaller class, sometimes it feels redundant, but my other class doesn't have a lot of calculations it's a constant question so it just feels different and truly hard to explain.

Those who had used the technology in both large (>50) and small (≤50) enrollment courses stated that the difference in application was based on what was being assessed. In the smaller class, the system allowed for students to determine what they believed to be the correct answer in an anonymous way as to not discourage them but to also address what areas of the problem needed to be explored in more detail. The focus in the smaller class was more on problem solving; the focus in the larger class was more on surveying knowledge. One faculty member stated some of the things they had considered regarding using the technology in one of their smaller classes:

> I might consider using them (in a smaller class) and seeing. I guess partly because I know those other students who aren't going to say anything in class at all regardless whether you have a question or not or go to the professor after class. As a student I was so, if I did miss class or had to ask a question it would scare the daylights out of me or if the professor called on me, so I might think about using it for that just because that way every student is engaged regardless what the personnel that they have, and I believe that that's valuable.

Issues with PRS Use

While considered an effective teaching tool by all participants, it was not without its issues. The main issues with PRS use as indicated by those faculty interviewed fell into the categories of technical concerns and teaching concerns. The technical concerns were 1) registration issues, 2) importing results into the Desire2Learn course management system, and 3) receiving signals from another class using the system close by. The teaching concerns were 1) limitation of student response type, 2) student unit cost and 3) academic dishonesty.

Technical Concerns

All faculty interviewed stated some technical concerns with the iClicker registration system. Montana State University has its own website where student are required to go to register their iClicker, however the iClicker company also has a website for registration. If the student does not register their iClicker with the MSU site, the instructor does not know that a particular unit is registered to a student. A student could go all semester submitting their responses but not have their name tied to the unit in their hand. Also, the student units need to be registered each semester they are used and sometimes the students do not realize this. Three faculty interviewed dealt with this issue by posting a list of names associated with iClicker units in their classes and told students to contact them if they had been using the units but their name did not appear on the list. One faculty member stated that, even if a student came in at the end of class and noticed that they had no points relating to their iClicker, they could still receive points by sending the faculty member their iClicker identification number. All responses are recorded on the system via the identification number. The faculty member could go back and assign all points related to that identification number to the student. The faculty member who shared this was one of the last interviewed, therefore the other subjects were not asked if they knew of such a procedure. The one faculty member who was considering ending their use of iClickers indicated registration issues as the main factor, however that person was one of the first interviewed.

The iClicker system allows for user data from activities in-class to be sent directly to the Desire2Learn (D2L) course website if the instructor so desires. All participants

stated complications with using the iClicker system with the course management system D2L as a deterrent to use, and only four participants even attempted the task. One of them stated that their issues with importing results into D2L were quickly resolved with help from MSU technical support. One faculty member stated that the registration and moving of data from the iClicker system to the D2L course management system may be enough to discourage its use by some, but also stated that faculty should know about this issue before adopting the technology:

> My first impression is that it is too complex for most people to deal with. The set-up is complex, accessing the data is complex just from a user standpoint… it is really complex. It is hard to get going but once you use it, it is a steep learning curve. But it is a pretty cool tool and has a lot of capabilities that I don't even know about yet.

Three faculty members stated having an issue with receiving responses from another class in close proximity to their class; however in those cases the issue was quickly resolved through technical support on campus. One faculty member stated they would like to see the delay between when student respond and when the results appear reduced. In most cases that delay was approximately 5 seconds, and it was indicated as an issue by only one participant.

All faculty interviewed had a back-up plan for class if the iClicker system failed. The possibility of a technical failure was also a reason for limiting the worth of iClicker questions towards the final grade by the six participants who did not tie it to a grade item.

Teaching Concerns

All participants indicated that the technology can have some clear advantages towards student learning; however they also stated that if the technology was not used in the best way it could have a negative effect on learning. One such concern was how using the technology in a relatively small class may take away from the intimate nature of such a setting:

> I really want to promote a real conversation the class and that's my one sort of hesitation about the clickers is sometimes I feel like if they were to be used in that smaller setting, you know you have to use it very specifically in a small class setting in order to not make students feel like they can just click in an answer instead of engaging in a discussion.

Question Limitations. Two faculty stated the limitation of the types of questions they could ask using the iClicker as a disadvantage. They said that being able to ask questions that required a more in-depth answer would be a welcomed improvement in the technology; the current system only allows for up to six choices for students to respond to. This restricts the type of questions that can be asked to those with single response answers. An instructor could not ask for descriptive responses with the current system:

> The one thing I wasn't so happy about is that that the kinds of questions I could ask about the readings, and I could not ask very sophisticated questions so the best I could do to try to get them to read is ask very simple questions, but it did give me some idea of whether they read it or not.

Cost. The issue of cost was not identified as a major issue to anyone interviewed, as the technology is free to use by any faculty who chose to at MSU. However all did state that they were very aware of student costs in their courses in the form of required

textbooks and possible lab fees. The MSU Bookstore currently sells iClicker transmitters (the device the student purchases) for $35.10 new and $26.35 used (M. Hardin, personal communication, January16, 2012). Relative to other course costs, the faculty interviewed did not feel this cost was excessive especially considering that the student could use their iClicker transmitter in more than one class.

Academic Dishonesty. Faculty interviewed were asked if they had any concerns with academic dishonesty as it relates to PRS use. Because the transmitter units students use are small, it is possible that one student may use more than one and register points for a student that is not in class at the time. Based on course information in syllabi provided by 10 of the faculty interviewed, all but one syllabi referenced the Student Code of Conduct at MSU and only one specifically stated the use of another student's iClicker as a form of academic dishonesty. Two faculty stated that they do survey the room during iClicker use and either confiscate transmitters or simply call the student out in such cases, but the remaining 13 participants did not feel that it was a major concern for them. As one faculty member stated:

> Quite honestly, it doesn't matter to me if somebody never comes to class and somebody else brings their clicker. My syllabus says if you're caught with two clickers you automatically fail the class…if somebody wants to go that much trouble is fine with me. It is their education, they are paying for it. If they don't get anything out of it, I really don't give a damn.

While nine faculty interviewed did tie iClicker use to a grade item, the percentage for which that item attributed to the total final grade was small enough that a student could not pass the class solely based on their successful iClicker use.

Overall Faculty Assessment

In general, faculty interviewed were very pleased with the technology. All but one participant indicated that they would use the technology again and some even stated that they could not imagine teaching their class without using iClickers. In the one case where the faculty member was considering abandoning the technology, registration issues were cited as the reason. All faculty interviewed stated they had a positive experience the first time they used the technology in teaching. As one faculty member explained:

> I think there is something joyful about playing and everyone having a turn to play and we did it on the first question, we just played and it was unintentional. But I think if I had even premeditated that it would be a good thing because it is a really good way to figure something out is to play with it. It is how most people learn things. It's how kids learn anything from playing house to a play toolset.

None of the faculty interviewed received any sort of incentive, either financially or with reduced courseload, to adopt PRS to their courses. All faculty stated that that having the technology provided to them by MSU Instructional Technology at no cost was a positive factor towards their incorporating it into their teaching.

While all participants indicated that the iClicker system was very straightforward and easy to use, they did recognize that some faculty may be intimidated by the thought of bringing such a technology into their teaching. One faculty member reflected on their experience the first time they used the technology:

> I was apprehensive, but I didn't have to be. I made a mistake or two I think the first few times, which I readily admitted to the class and they were okay with that and so that I don't think it detracted as long as I didn't get all upset about it.

One faculty member had this to say in regards to their apprehension when considering adopting the technology:

> It simply scared the daylights out of me before I started using it. I thought that, I was 'Oh my God, I'm going to have to create all these questions for my students and then I'm going to have to be able to on my toes to address that and for some reason that was really intimidating. It's natural, you do it anyway. You do it when students ask questions, so it's nothing new but it sounds new.

With the one exception of the faculty member who was considering abandoning the technology due to registration issues, the remaining 14 faculty stated that they had a better understanding on what concepts their class understood and could adjust their teaching to address weak areas based on iClicker use. This adjustment meant that often the total material covered in class had to be reduced, but all faculty stated that the adjustment was worth the trade-off. As one faculty member stated, they had shifted where learning happens from outside the classroom to within by having students answer problems in-class via the iClicker system so they could help student work out problems:

> I know where they really get thrown off. There is material where (the student) will say 'It makes so much sense,' but when they go back to work a problem, the same one, they can't find the first step, and so this gives them a chance to work it right then and there.

Fourteen of the faculty interviewed believed the benefits of the iClicker system outweighed any issues and stated that they would keep using the technology until another technology came along that could achieve the same results in a better way. Again, the one outlying opinion was due to issues with registration.

Summary

This study asked following questions: 1) How and to what extent are PRS used by teaching faculty at MSU who have used the technology at least once in the past six years? 2) What are the attitudes of MSU teaching faculty on PRS use who have used the technology at least once in the past six years? 3) What are the issues regarding the use of PRS by teaching faculty at MSU use who have used the technology at least once in the past six years?

The main motivation for PRS use by faculty interviewed was to engage a large enrollment class. Training on the system was varied, with most having little to no formal training yet conceding that the system was very easy to use and that any questions were promptly answered by MSU Instructional Technology or peer support. All but one faculty member interviewed used a system that was hard-wired in their classroom on a permanent basis.

The classroom application focused mainly on student engagement and formative assessment, with any association to a graded item remaining small in most cases including attendance. Courses did need adjustment as the addition of PRS questions took time away from lecture; however faculty interviewed conceded that it was a valuable trade-off. All faculty interviewed felt their PRS use was effective but admitted they should examine other methods of use as well. The majority of classes taught by faculty interviewed were large enrollment classes with over 50 students per section.

Issues with the technology consisted mainly of student registration concerns with other technical concerns easily resolved through either peer support or MSU Instructional

Technology. Teaching concerns focused on the limitation of the types of questions that could be administered through the current system and academic dishonesty; however the latter was addressed by not tying a lot of course points to PRS use. Overall the faculty interviewed were pleased with the technology and indicated that it met the desired objective.

CHAPTER 5

CONCLUSIONS

Introduction

The purpose of this study was to examine the usage, attitudes, and perceptions of PRS use by teaching faculty who had used the technology in at least one course in the past six years at Montana State University (MSU) in Bozeman. Fifteen faculty members who had used PRS in their teaching over the past six years were interviewed on their usage, attitude, and perception of PRS use. This chapter reviews the research questions and methods, summarizes the answers to the research questions, compares the results to the literature reviewed, interprets the results and makes recommendations while discussing the overall significance and how it may impact further research.

Research Questions

This study asked the following questions:

1 How and to what extent are PRS used by teaching faculty at MSU who have used the technology at least once in the past six years?

2. What are the attitudes of MSU teaching faculty on PRS use who have used the technology at least once in the past six years?

3. What are the issues regarding the use of PRS by teaching faculty at MSU use who have used the technology at least once in the past six years?

Participants

The research focused on faculty at MSU who had used PRS technology in their teaching at least once in the past six years. It was not possible to determine the total number of faculty and their names in the population; however information was provided David Knickerbocker, Book Operations Manager at the MSU Bookstore (personal communication, October 26, 2010) based on his records of faculty who had informed the bookstore that PRS transmitters (the device students use) were a course requirement. Those records only included data from the past six years. In addition, the researcher learned that faculty who use technology in their classroom sometimes contact Ritchie Boyd, MSU Technology Project Director with questions and for advice. The researcher contacted Mr. Boyd and asked him to help contact those faculty whom he had consulted on iClicker use specifically. Mr. Boyd sent an e-mail to those faculty containing information on the study and contact information for the researcher (Appendix C), recommending that those interested contact the researcher directly. Data from the MSU Bookstore provided the researcher with the names of 52 faculty, and those who responded to Mr. Boyd's e-mail were already part of that list. Those on that list received an e-mail invitation detailing the study and asking for their participation and also asking them to forward the e-mail to any faculty they know of who had also taught using PRS (Appendix D). Out of the 52 instructors identified, 22 replied to the initial request for interviews and 15 were both available during the time of the study and willing to participate.

Methods and Data Collection

The researcher used a qualitative transcendental phenomenological approach in this study. From May to October 2011, the researcher conducted semi-structured in-depth interviews with15 faculty to gather rich and descriptive data using an interview protocol approved by the MSU IRB (Appendix B). It was explained to all subjects that their participation was completely voluntary and that they could decide to withdraw from the study at any time. Those who chose to participate completed a consent form describing the research and also gave their consent to have the interview audio recorded. The researcher conducted ten of the interviews in-person and five via telephone. The interviews were scheduled and administered based on the availability of the subjects and the researcher. The participants described their experiences using PRS and information on the environment and context in which those experiences took place. As the interviews progressed, the researcher noted reoccurring words, phrases, and ideas. Course syllabi were used to verify that PRS was a course requirement and to confirm information provided by the MSU Bookstore.

Data Analysis

Once all the interviews were completed, the researcher transcribed those interviews and referred back to the words, phrases, and ideas identified during the interview sessions. The researcher then conducted a text search using the 'find' function in MS Word within each completed transcript for those noted words, phrases, and ideas. Interview transcripts were analyzed both individually and collectively to find statements

that described faculty experiences using PRS and those statements were used to develop themes as required by a transcendental phenomenological approach (Moustakas, 1994). Category schemes were developed based on the research questions, and data relating to each question was compiled into a separate document. The researcher then searched those documents for reoccurring words, phrases, and ideas. Information from these documents was summarized and organized to better relate to the research questions and reduce data. The researcher also identified quotes from the subjects that helped to illustrate the themes on a more personal level.

Categories from the literature were used to help organize the research data. Cases where the participant's experience deviated from the majority were also included in the summary of data. The goal was to provide a better overall understanding of the experience of faculty who had used PRS at MSU.

Answers to Research Questions

This section answers each of the questions in this study.

Research Question 1: How and to What Extent are PRS used by Teaching Faculty at MSU who have used the Technology at least Once in the past Six Years?

All faculty interviewed used the PRS technology iClickers primarily to foster student engagement, with all but three of those cases in classes with over 50 students. The technology was also used by 13 participants for formative assessment. Questions were restricted to single answer responses due to the limitation of the iClicker version used, however all faculty used iClickers to ask questions in every class and at several

points during the class. Faculty interviewed used an average of 3 iClicker questions per class (Table 1). Ten also used iClickers to monitor class attendance, however none used it solely for that purpose.

In cases where iClicker responses contributed to a percentage of the final grade, the amount of the percentage was kept deliberately small to lessen the negative impact if the technology either failed or was not used properly.

All faculty interviewed used iClickers to 1) measure student knowledge, 2) increase student engagement and 3) increase teaching effectiveness. These goals were all related, as questions asked via iClicker served as both a form of engagement and a way to measure knowledge. The results of those questions were then used by faculty to make adjustments during class time on concepts that appeared to be difficult for the majority of students based on their iClicker responses. This related directly to teaching effectiveness.

Research Question 2: What are the Attitudes of MSU Teaching Faculty on PRS Use who have used the Technology at least Once in the past Six Years?

All faculty interviewed believed that the technology was effective towards the goals of measuring knowledge along with increasing both student engagement and teaching effectiveness. As a survey tool, the technology was successful in gauging what the students knew or did not know on a particular subject. As a formative assessment tool, it was successful in determining what areas of the content students struggled with and where class time had to be adjusted to address that shortcoming.

All faculty interviewed admitted being fascinated with new teaching technology and open to new approaches and concepts that might make them better teachers. Their adoption of PRS technology related to this attitude; however all were cautious and critical when first using it. The faculty interviewed were pleased with the technology and the simplicity of its use, and all but one indicated that they would continue to use the technology in their teaching. Even in that one case, the reasons behind the possible abandoning of the technology had nothing to do with its effectiveness or the attitude of the instructor but rather with registration issues.

Research Question 3: What are the issues regarding the use of PRS by teaching Faculty at MSU who have used the Technology at least Once in the past Six Years?

The issues discussed by all faculty in this study fell into the categories of technical and teaching concerns. Technical problems included challenges with student registration of their transmitter unit in the MSU system. Often students were confused as to what website to go to because both the iClicker company and MSU have a website for registration. Faculty stated that sometimes students would register their transmitter on the iClicker website and neglect to do the same with MSU. This would result in a student using the transmitter in class and the instructor not having a record of the student using a unit. This caused serious consequences in cases where the iClickers were used to monitor attendance or count towards a graded item. While this could easily be corrected even after the course had ended by the instructor reconciling the results recorded for the

student's iClicker with their name, it was still a significant problem that all faculty reported having dealt with.

In the area of teaching difficulties, faculty indicated that their courses had to be adjusted to allow for iClicker questions and responses. While this trade-off was considered a worthy exchange by those interviewed, the limitation of single-response answers and the potential for academic dishonesty were the main concerns identified. Faculty stated that they addressed their academic dishonesty concern by one of two strategies: 1) making any graded item associated with the iClicker use too small to have a tremendous impact on the final grade or 2) not factoring it into the final grade at all. In cases where iClicker questions were tied to a larger portion of the final grade, faculty addressed academic dishonesty by referring to the MSU Student Code of Conduct or putting a statement in the course syllabus indicating that using another student's iClicker would be considered academic dishonesty and would be subject to the same process as any other form of academic dishonesty. Also, those faculty stated that they would survey the room to see if students were using only one iClicker and recounted taking units away from those students using more than one. In those cases, the faculty member would discuss the incident with the students involved and determine what they thought was an appropriate course of action based upon the circumstances and MSU policies.

Comparison to Literature

The results of this study are consistent with the literature and relate directly to the major concepts surrounding PRS use. The following section is organized based on the categories found in the literature.

Effectiveness

The use of PRS technology by faculty interviewed was consistent with the types of effective use described in the literature. While no faculty member interviewed could document a correlation between iClicker use and improved student performance, they frequently reported adjusting the course during class to address concepts the class struggled with and believed that this improved learning of the material. This was also found in research by Duncan (2005) indicating that teaching technology can be an effective way to focus teaching time on the material that needs the most explaining. Three participants used the technology only in a small class ($\leq$50), and in one of those classes the enrollment was typically 16. While this was not the norm among participants, it does coincide with research by Brickman (2005) that suggests the technology could be used effectively in a smaller class. In the case of the smaller class, the instructor in this study used the technology as a way for students to participate anonymously and related that the device worked quite well in the small class, where a student may still have anxiety toward participation. The literature reviewed suggests this as one possible small classroom application for PRS (Beckert, Fauth, & Olsen, 2009; Valkenburg & Peter, 2009).

When introducing a new technology or teaching approach in a classroom, one concern is whether the technology is reliable and easy to use (Hatch, et al., 2005). This was also a concern among faculty in this study. The ease of in-class use of the iClicker system was cited in every interview as a positive factor in its adoption. As for reliability, all faculty stated that they had a back-up plan for lecture material in case the iClicker system failed. Also, the way graded iClicker questions related to the final course grade in the majority of cases relates back to concerns over reliability.

Some faculty may be intimidated by a new technology, and the literature reviewed indicates that some of this intimidation stems from the fact that students tend to be more familiar with new technology than their instructors (Waycott, et al., 2010, Hatch, et al., 2005; Song, 2003). However this was not a prominent theme in the study as those interviewed were comfortable with technology.

All faculty interviewed stated that one of their main reasons for using PRS was the ability to survey student knowledge and share those results almost instantly with the class. Eight indicated that they also used the technology to stimulate discussion either formally in small groups or informally. This corresponds with research by Bruff (2009) and Caldwell (2007) on how effective the devices are at creating an active learning environment.

Another benefit recounted by all faculty was to reinforce course concepts that were in the reading and the class lecture, which ties in to literature reviewed on the importance of repetition to help students understand tough concepts (Burnstein & Lederman, 2006; Laurillard, 2002).

All faculty declared that it was important to create questions and activities that used PRS in the most effective way. In most cases, faculty used the technology to survey whether the class understood the material and identify areas that needed additional focus. In class adjustments were made accordingly. Several authors describe today's classroom as one in which students learn in the classroom rather than on their own outside of class (Crouch & Mazur, 2001; Poirier & Feldman, 2007). The use of iClickers by the faculty of this study created an immediate in-class learning environment for students.

While no faculty in this study were given any monetary incentive or class reduction for time to develop their courses for iClicker use, all stated that having the technology available through MSU Instructional Technology at no cost to them was a positive factor towards their incorporating it into their teaching. This finding is in agreement with that of Hatch, et al., (2005) who found that cost is often a factor in faculty deciding whether or not to adopt a new technology.

Teacher-Student Interaction

While the use of iClickers by faculty interviewed at MSU did create more interaction during the class period, there was no indication that such interaction carried beyond the classroom. The use of this technology to test knowledge and to formatively assess teaching effectiveness during class time appeared to work towards a more interactive class environment. The use of iClickers as a beginning for class discussion was also an indication of teacher-student interaction being increased by the technology. Five of the faculty allowed students to work together to answer questions using the iClicker during class, however even when students were asked to respond to a question

on their own there was an opportunity to make that process more interactive. This discovery is consistent with research by Somers and Mazur (1999) on how a collaborative teaching environment can increase teacher-student interaction.

Practices

The use of iClickers by faculty at MSU is consistent with the practices described in the literature. Faculty who did tie a grade item to their iClicker use kept the percentage of the final grade related to iClicker use relatively small, and this is supported as a good practice in the literature (Ribbens, 2007; Willoughby & Gustafson, 2009). This allowed some flexibility in cases where the technology failed either because of dying batteries or students simply not bringing their transmitter to class. All faculty interviewed stated that they had a back-up plan for lecture time if the technology as a whole ever failed completely during class. A study by Jones (2000) also found that faculty who use technology in teaching do not completely trust that the technology will always work.

All faculty stated they used iClicker questions in every class meeting. The students were expected to bring their transmitters to class and be prepared to use them. One faculty member shared that their students even get upset if a class goes by without having an iClicker-related question. Literature reviewed on this topic also indicated that students not only expect to see some technology or multimedia used in their classes, but if a specific technology is required they expect it to be used often (Brown, 2004; Sorensen, 1998).

All faculty interviewed agreed that some adjustments had to be made to their course to incorporate iClicker use. This meant that more time was spent on preparing

class lectures and adjusting what topics would be covered based on the addition of iClicker questions. This was reflected in the literature reviewed, which indicated the need for careful consideration on course adjustments when adopting a new technology (d'Inverno, et al., 2003, Burnstein & Lederman, 2001). The limited types of questions that could be asked with the iClicker system (single-response) required careful crafting on the part of the instructor, and the literature reviewed also indicated this as an important step in adapting a new technology into the classroom (Lin, et al., 2009).

One topic from the literature dealt with the ability to repeat course concepts or present them in different ways so that students have more opportunity to absorb the course material (Laurillard, 2002). All faculty in this study stated this as one use of the technology.

Twelve of the 15 participants used iClickers in a large class (>50), which the literature indicated as the most popular venue for PRS use (Caldwell, 2007). One interesting aspect discovered regarding PRS use was how it related to class size. While in a smaller class students can more effectively be 'called upon' by the instructor and the class time can accommodate a small discussion easier, if a student in that small class is not comfortable speaking even to a small group, there may be an application for such technology in those smaller (≤50) courses. This was the case in the one instance where enrollment in a class using iClickers was 16, and it is consistent with research by Brickman (2005).

Faculty Resistance

One hesitation of faculty to adopt a new technology that is cited in the literature is that of reliability (Hatch, et al., 2005). Those interviewed address their concerns of reliability by having a back-up plan for class if the iClicker system failed. This was also listed as a reason for limiting the worth of iClicker questions towards the final grade. This idea is in agreement with the literature reviewed (Ribbens, 2007; Willoughby & Gustafson, 2009).

Weston (2005) reports that faculty may be resistant to incorporating new technology when there is a lack of incentive in the form of a workload reduction or increased pay. The majority of respondents considered themselves either early or mid-adopters of teaching technology and indicated that as influencing their adoption of the iClicker system.

Caine and Caine (1991) wrote that in order to minimize faculty resistance to using new technology, it must be easy to learn. All faculty in this study stated that the iClicker system was easy to learn and to use by both themselves and their students.

Technical Issues

Student registration issues were the main technical concern among the faculty in this study. Other minor technical issues brought up in this study were quickly resolved either through MSU Instructional Technology support or with help from other peers who were familiar with the technology. As for the registration issue, there seemed to be some confusion as to how to correct such issues on the instructor's end and a variety of solutions used by those who faced those issues. All faculty interviewed had relied on

their peer group of PRS users in times when they had a question or needed advice, as well as consulting with MSU Instructional Technology. Hartman and Truman-Davis (2001) specify the importance of a good support system when faculty consider adopting a new teaching technology and faculty in this study stated they experienced such an environment.

Assessment and Feedback

The benefit of instant feedback and formative assessment also became a theme among participants as far as how the technology created interaction during class. The literature reviewed indicated that formative assessment is related to greater student understanding (Chickering & Gamson, 1991; Bruff, 2009), which 13 faculty in this study cited as one reason they adopted PRS. Faculty interviewed stated that students seemed to like being able to find out immediately if they got a question correct or see if they are in the majority of students who responded a certain way. Research by Brookfield (2006) points out that students view such feedback as a positive factor in their assessment of teaching effectiveness. This instant feedback is also an indication to students as to how interested their instructor is on their understanding of course material (Grimmett & Neufeld, 1994). The literature reviewed also found that using teaching technology in the classroom can get students more excited about learning than traditional methods (Sorensen, 1998).

Conclusions

Based upon the data gathered, the researcher concludes that using the iClicker PRS technology at this institution has been an overall positive experience for faculty in this study with numerous reported positive outcomes. While those interviewed were mostly pleased with the PRS system iClicker, three concerns brought up by all were 1) cost to the student, 2) single response limitations and 3) student registration.

Recommendations

Qualitative research such as this is often judged by its transferability, meaning how well it can be applied to similar situations (Newman & Benz, 1998). Transferability does not involve broad claims, but invites readers of research to make connections between elements of a study and their own experience (Marshall & Rossman, 2006). With that in mind, this researcher suggests that faculty may want to adopt PRS as a way to create a classroom environment where every student can participate and where the instructor can test knowledge and make adjustments to the course material at all stages based on that information.

Based on the results of this study the following recommendations are made:

1. Encourage faculty to incorporate PRS in their teaching. Faculty in this study indicated that the iClicker PRS technology was effective towards their goals for its use in all class sizes. Encouragement could come in the form of promoting the technology through offering additional workshops and distributing promotional materials emphasizing the positive factors for adoption revealed in this study.

Those factors were 1) formative assessment, 2) student interaction in large classes, 3) ease of use (no need for formal training), and 4) student engagement in active learning of course content. Offering workshops in which faculty who are experienced in their use and who can testify as to the device's benefit may help to encourage others to incorporate iClickers into their classes. These workshops could be at the university level and at the college or department level.

2. Create a formal peer group of PRS users. Faculty in this study reported that having a strong group of faculty to consult with when issues arose was a positive factor in their continued use. This formal peer group could meet face-to-face on a regular basis or be part of an online forum. Because these faculty are comfortable with technology, an online forum may be ideal as it also allows for asynchronous discussions and access by faculty outside of the peer group.
3. Offer workshops on how to effectively draft questions for PRS use. Faculty in this study stated that questions had to be created in a way that utilized the format (single response) effectively while also keeping students engaged in the subject matter and focusing on course content. Therefore, sessions detailing the best practices for creating PRS questions could be of value to all faculty regardless of their PRS experience and class size.
4. Increase PRS availability in all sizes of classrooms. While 39 of the larger lecture halls at this institution have the systems hard-wired permanently, this study and the literature reviewed indicate that there are applications for smaller classes.

Also, faculty in this study stated having the system already set up in their classroom as a positive factor towards its adoption.

5. Inform faculty of student registration issues. All faculty stated having issues with students registering their iClicker correctly, and this study found that some faculty had discovered ways to correct this. Informing faculty on this issue and possible ways to address it could also promote adoption and help new users avoid this difficulty.
6. Inform faculty of issues importing results into the Desire2Learn (D2L) course management system. While importing results into D2L it is not required for iClicker use, all faculty stated this as an issue, and only four even attempted it. Faculty could be informed through workshops and peer support on this issue and ways to address it.
7. Upgrade to a PRS system that allows for longer form answers. One complaint found in this study of the current iClicker system is that it is limited to single answer responses. The iClicker system has a new version (iClicker 2) with alphanumeric functionality (i>clicker 2 classroom response system, 2011). The use of this upgraded system would allow for instructors to ask more open-ended questions and students to ask questions anonymously. Also, instructors could measure student understanding anonymously during class through their responses and make adjustments to the lecture in order to address areas of concern, either with additional lecture or discussion.

Overall Significance

Faculty

With expanding enrollment and budget reductions being common among state institutions of higher education, the result is that a smaller number of faculty are trying to reach more students in larger classrooms. A technology like PRS is one way to get students engaged in cases where the instructor cannot make a connection with every student in the class. It can also be a way for an instructor to better use their limited time in class to focus on material that the majority of students are struggling with. This research is an indication that if this technology can be used effectively and efficiently by faculty, it can assist in the education process when the teacher-student ratio keeps increasing. Faculty considering using PRS can see how it is being used by their colleagues and help anticipate some issues that may arise. Also, they would know that there is an active peer group available to assist them.

Administration

This study serves as an indication to the administration at MSU on how teaching faculty experience the use of PRS in their classes. Their usage, attitudes, and perceptions of PRS technology, specifically the iClicker system, would suggest that the continued support of such a technology is worth the effort as class sizes increase. Administrators at other institutions can examine this study and get a better idea of how the technology is used along with the attitude and perception of its use by the faculty working at MSU. This could be helpful information when considering funding such a technology.

Technical Support

The literature reviewed suggests that faculty will try out a new technology if the support is in place, if the technology is easy to use and the benefit to students outweighs any additional student costs (Mitra, Steffensmeier, Lenzmeier, & Massoni, 1999). That support needs to go beyond that of a technical support department, and having a strong peer group of users to rely upon can be an effective way to promote effective use and encourage other faculty in similar class situations to try a new teaching technology. Those who work in technical support at MSU can refer to this study when addressing the need for future system upgrades and improvements. Adopting the iClicker 2 system is a step in the right direction based on this study.

Teaching Technology Growth

As other forms of PRS are introduced using the existing technology available in tablet computers and smart phones, an examination of the processes involved from both the student and teacher perspectives is important so that time and resources are not wasted to accomplish something that can be done in a less complicated way. Educators like those involved in this study are the types that work ahead so that the discipline as a whole can be more effective, and their point of view is worth exploring for that reason.

Implications for Future Research

Since this is a qualitative study, the transferability of any findings is at the discretion of the reader (Newman & Benz, 1998; Marshal & Rossman, 2006). That being stated, it would be worth pursuing a longitudinal study on a class that has used PRS to see

if there was any significant effect on student performance. It would also be advantageous to do a comparative study on a class with one section incorporating PRS and the other using more traditional teaching methods. A study researching whether that engagement and assessment correlates to improved student learning would be of interest.

Summary

The results of this study are consistent with topics found in the literature. Faculty interviewed who use the iClicker PRS system at MSU tend to be early to mid-adopters of new teaching technology. All but three used the technology in classes with over 50 students. The sample for this study included teaching faculty from a variety of academic ranks and disciplines, with the majority holding doctorates. The average number of semesters using PRS was five, and all but one participant had the base unit (receiver) hard-wired in their classroom. The majority of participants had little to no training on iClickers at MSU; however all stated that the technology was easy to use. The majority of participants considered themselves among the first to adopt this new technology at MSU.

While most faculty interviewed did tie the use of iClickers to a grade item, the points associated with it were not enough to have a significant effect on the final grade. The reasons indicated for low grade association were the potential for academic dishonesty and system reliability. All interviewed used the technology beyond simply taking attendance, however ten also used it specifically for taking attendance. The main use of iClickers among the participants was to 1) test student knowledge, 2) foster

discussion either formally or informally and 3) assess their own teaching. Some adjustment to course material had to be made to accommodate the iClicker questions; however all faculty interviewed felt it was worth the adjustment. This relates to a shift to learning taking place in the classroom rather than when the student is studying independently (Crouch & Mazur, 2001; Poirier & Feldman, 2007). All faculty felt their use of iClickers was effective but admitted they could be doing more with them. The issues of 1) student cost, 2) question limitation and 3) student registration were cited as concerns among the faculty interviewed. Some faculty stated they had some other minor technical issues when they started using the technology, but their issues were quickly resolved either through support from MSU Instructional Technology or their peers.

Chapter Summary

The purpose of this study was to examine the usage, attitudes, and perceptions of PRS use by teaching faculty who had used the technology in at least one course in the past six years at Montana State University (MSU) in Bozeman. The intent was to give voice to the thoughts of educators on the technology as a way for those who acquire and administer the technology to know better the situations these faculty experience. As educators in an environment where the student body is both growing and changing, finding ways to become more effective and reach more types of learners is important.

The chapter compared the findings to the literature and found that the results were, overall, consistent. The chapter made seven recommendations. These recommendations were to 1) encourage faculty to use PRS, 2) create a formal peer group

for faculty support, 3) offer workshops on creating effective PRS questions, 4) increase PRS availability in all classrooms, 5) inform faculty of student registration issues, 6) inform faculty of D2L data importing issues, and 7) upgrade to a PRS system that allows for longer form responses. Suggestions for future research included a longitudinal study focusing on student performance in a course using PRS and a comparative study between different sections of the same course; one using PRS and one not.

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APPENDICES

APPENDIX A

MSU INSTITUTIONAL REVIEW BOARD APPROVAL

MONTANA
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INSTITUTIONAL REVIEW BOARD

For the Protection of Human Subjects
FWA 00000165

960 Technology Blvd. Room 127
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MEMORANDUM

TO: Rocky Dailey and Marilyn Lockhart

FROM: Mark Quinn, Ph.D. Chair
Institutional Review Board for the Protection of Human Subjects

DATE: April 19, 2011

SUBJECT: *"Evaluation of Personal Response Systems from a Teaching Perspective"* *[RD041911-EX]*

The above research, described in your submission of April 19, 2011, is exempt from the requirement of review by the Institutional Review Board in accordance with the Code of Federal Regulations, Part 46, section 101. The specific paragraph which applies to your research is:

___ (b)(1) Research conducted in established or commonly accepted educational settings, involving normal educational practices such as (i) research on regular and special education instructional strategies, or (ii) research on the effectiveness of or the comparison among instructional techniques, curricula, or classroom management methods.

_X_ (b)(2) Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures or observation of public behavior, unless: (i) information obtained is recorded in such a manner that human subjects can be identified, directly or through identifiers linked to the subjects; and (ii) any disclosure of the human subjects' responses outside the research could reasonably place the subjects at risk of criminal or civil liability, or be damaging to the subjects' financial standing, employability, or reputation.

___ (b)(3) Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures, or observation of public behavior that is not exempt under paragraph (b)(2) of this section, if: (i) the human subjects are elected or appointed public officials or candidates for public office; or (ii) federal statute(s) without exception that the confidentiality of the personally identifiable information will be maintained throughout the research and thereafter.

___ (b)(4) Research involving the collection or study of existing data, documents, records, pathological specimens, or diagnostic specimens, if these sources are publicly available, or if the information is recorded by the investigator in such a manner that the subjects cannot be identified, directly or through identifiers linked to the subjects.

___ (b)(5) Research and demonstration projects, which are conducted by or subject to the approval of department or agency heads, and which are designed to study, evaluate, or otherwise examine: (i) public benefit or service programs; (ii) procedures for obtaining benefits or services under those programs; (iii) possible changes in or alternatives to those programs or procedures; or (iv) possible changes in methods or levels of payment for benefits or services under those programs.

___ (b)(6) Taste and food quality evaluation and consumer acceptance studies, (i) if wholesome foods without additives are consumed, or (ii) if a food is consumed that contains a food ingredient at or below the level and for a use found to be safe, or agricultural chemical or environmental contaminant at or below the level found to be safe, by the FDA, or approved by the EPA, or the Food Safety and Inspection Service of the USDA.

Although review by the Institutional Review Board is not required for the above research, the Committee will be glad to review it. If you wish a review and committee approval, please submit 3 copies of the usual application form and it will be processed by expedited review.

APPENDIX B

INTERVIEW QUESTIONS AND PROTOCOL

Study Question	Interview Question	Literature Topics
How and to what extent are PRS used by teaching faculty at MSU who have used the technology at least once in the past five years?	How many of your classes use PRS? What got you interested in using it? How many students are in your PRS classes? Tell me specifically how you use PRS in your class. Describe the interaction surrounding your PRS classes. Is there a difference in how PRS is used in a smaller class compared to a larger class? How have you adjusted your course and teaching due to PRS use? Do you feel you are using PRS in the most effective way in your classes? What course objectives or teaching goals do you use PRS to help meet?	1 1 2 4 3 2 4 5 4
What are the attitudes of MSU teaching faculty on PRS use who have used the technology at least once in the past five years?	What have you experienced in terms of PRS use in your teaching? Did you speak with other faculty about PRS at MSU or any other institution? What was your initial impression of PRS technology before you used it in class? What are your thoughts after using PRS?	1-6
What are the issues regarding the use of PRS by teaching faculty at MSU use who have used the technology at least once in the past five years?	What contexts or situations have had an influence or affected your experience using PRS in your teaching? How would you describe your PRS training? How is PRS configured in your classroom? From a technical standpoint, have you had any concerns or issues using PRS? From a teaching standpoint, have you had any concerns or issues using PRS? How would you compare your teaching a course before using PRS and after? Are there any other issues or concerns you have in general regarding PRS?	1-6 4 6 6 4

Literature Topics:
1=Demographic & Background information 2=Class Size 3=Teacher-Student Interaction 4=Best Practices 5=Effectiveness 6=Technical Issues

APPENDIX C

INVITATION FROM MSU IT PROJECT DIRECTOR

MSU iClicker users,
I am forwarding a request from MSU Department of Education graduate student Rocky Dailey to participate in his research study on clickers, for which he has received approval from the department and MSU's IRB.
Please note that I will not in general forward casual requests for information to MSU's clicker users, but I feel (and I hope you agree) that the kind of information Rocky will be gathering has considerable value to our institution and our teaching faculty. See the Study Overview below for details.

The title of the study is:

"Evaluation of Personal Response Systems from a Teaching Perspective"
- A research study on the usage, attitude and perception of personal response system (PRS) use.

An important note about the study:
"Your participation is confidential and voluntary, and no personal data exists in the documentation of this study other than your institutional e-mail address, which is not coded or correlated to the results. If you agree to participate, you will be asked to be interviewed on your PRS experience. The interview would last about one hour and would be arranged at a time convenient to your schedule."

Rocky's invitation letter reads in part:

"This letter is an invitation to participate in a research study. As a doctoral student in the Department of Education at Montana State University, I am currently conducting research for my dissertation on the usage, attitudes and perceptions of personal response systems (PRS) by faculty who have taught with such systems at Montana State University in Bozeman, Montana at some point over the past five years. The particular type of PRS used at MSU is the brand iClicker.

Based on data collected by the MSU Bookstore and faculty referrals, I understand that you have experience teaching with this technology. If I am incorrect, I apologize for the correspondence. Please let me know if you received this e-mail in error.

If you know of other faculty members who have used iClickers at MSU, I would appreciate it if you could forward this correspondence to them as well. Thank you in advance for your consideration.

Study Overview

The purpose of this qualitative transcendental phenomenological study is to examine the usage, attitudes and perceptions of personal response system (PRS) use by teaching faculty who have used the technology in at least one course in the past five years at Montana State University (MSU) in Bozeman. Fifteen to 20 faculty members who have uses PRS in their teaching will be interviewed on their usage, attitude and perception of PRS use. The literature themes of effectiveness, practices, technical issues and teacher-student interaction will be incorporated into a protocol used during in-depth interviews. Interview transcripts will be analyzed to find statements of significance and themes that help to articulate faculty experience using PRS. A composite description of usage, attitudes and perceptions of PRS will be developed in order to provide a better overall understanding of the experience of faculty who have used PRS at MSU."

If you wish to participate in the MSU clicker study, or to learn more about the study, please contact Rocky directly:
rocky.dailey@msu.montana.edu

APPENDIX D

INVITATION TO PARTICIPATE

Dear *(insert person's name):*

This letter is an invitation to participate in a research study. As a doctoral student in the Department of Education at Montana State University, I am currently conducting research for my dissertation on the usage, attitudes, and perceptions of personal response systems (PRS) by faculty who have taught with such systems at Montana State University in Bozeman, Montana at some point over the past six years. The particular type of PRS used at MSU is the brand iClicker.

Based on data collected by the MSU Bookstore and faculty referrals, I understand that you have experience teaching with this technology. If I am incorrect, I apologize for the correspondence. Please let me know if you received this e-mail in error.

If you know of other faculty members who have used iClickers at MSU, I would appreciate it if you could forward this correspondence to them as well. Thank you in advance for your consideration.

Study Overview

The purpose of this qualitative transcendental phenomenological study is to examine the usage, attitudes, and perceptions of personal response system (PRS) use by teaching faculty who have used the technology in at least one course in the past six years at Montana State University (MSU) in Bozeman. Fifteen to 20 faculty members who have uses PRS in their teaching will be interviewed on their usage, attitude, and perception of PRS use. The literature topics of effectiveness, practices, technical issues and teacher-student interaction will be incorporated into a protocol used during in-depth interviews. Interview transcripts will be analyzed to find statements of significance and themes that help to articulate faculty experience using PRS. A composite description of usage, attitudes, and perceptions of PRS will be developed in order to provide a better overall understanding of the experience of faculty who have used PRS at MSU.

Your Involvement

If you agree to participate, I will follow up with you to set up a time when we can meet to conduct the interview. The preference is to conduct all interviews in-person, however we can also make arrangements to talk via telephone or video conferencing as it best fits your schedule. I will be scheduling in-person interviews starting in late April 2011.

The interview would last about one hour and would be arranged at a time convenient to your schedule. To ensure the accuracy of your input, I would ask your permission to record the interview audio. It would also be helpful if you would be willing to provide some examples of course material you have that indicates how iClickers have been used in your courses, however once again that will be based on your permission.

Participation in this study is entirely voluntary and there are no known or anticipated risks to participation in this study. You may decline to answer any of the questions you do not wish to answer. Further, you may decide to withdraw from this study at any time, without any negative consequences, simply by letting me know your decision. All information you provide will be considered

confidential unless otherwise agreed to, and the data collected will be kept in a secure location and confidentially disposed of in six years' time.

Your name and the name of your department will not appear in any publications resulting from this study unless you provide express consent to be identified and have reviewed the text and approved the use of the quote. After the study is complete I would be glad to send you a copy if you so desire.

Contact Information

If you have any questions regarding this study, or would like additional information about participation, please contact me at 406 545-8673 or by email rocky.dailey@msu.montana.edu.

I assure you that this study has been reviewed and received ethics clearance through the Institutional Review Board at MSU. However, the final decision to participate is yours. If you have any comments or concerns resulting from you participation in this study, please contact Cheryl Johnson with the Institutional Review Board at 994-4706 (*cherylj@montana.edu*).

Thank you in advance for your interest and assistance with this research.

Yours very truly,

Rocky Dailey
Ed.D Candidate
Montana State University
Department of Education

APPENDIX E

CONSENT FORM

CONSENT FOR PARTICIPATION IN HUMAN RESEARCH AT
MONTANA STATE UNIVERSITY

Evaluation of Personal Response Systems from a Teaching Perspective

You are being asked to participate in a research study on the usage, attitude and perception of personal response system (PRS) use. You have been chosen because you work in higher education and have taught courses using PRS technology. No specific personal information will be asked on the survey and only general demographic information to be used for comparative analysis.

Your participation is confidential and voluntary, and no personal data exists in the documentation of this study other than your institutional e-mail address, which is not coded or correlated to the results. If you agree to participate, you will be asked to be interviewed on your PRS experience. The interview would last about one hour and would be arranged at a time convenient to your schedule. To ensure the accuracy of your input, I would ask your permission to record the interview audio. It would also be helpful if you would be willing to provide some examples of course material you have that indicates how PRS have been used in your courses, however once again that will be based on your permission.

You have the right to say no, and you may change your mind at any time and withdraw. You may choose not to answer specific questions or to stop participating at any time. Only general demographic information that you provide during the survey will be used for comparative analysis of the responses. Your name and the name of your department will not appear in any publications resulting from this study unless you provide express consent to be identified and have reviewed the text and approved the use of the quote

There is no compensation for your participation, and there are no foreseen risks for participating in this study. Any contact information will be kept confidential and secured in locked cabinets or in password protected computers. No one outside the researcher will have access to your information. Your privacy will be protected to the maximum extent allowable by law. If you have any questions on the research you can contact the researcher, Rocky Dailey at (406) 545-8673 or rocky.dailey@msu.montana.edu.

If you have additional questions about the rights of human subjects, please contact the Chair of the Institutional Review Board, Mark Quinn at (406) 994-4707 or mquinn@montana.edu.

Thank you for your time and consideration.

AUTHORIZATION

I have read the above and understand the discomforts, inconvenience and risk of this study. I, _____ *(name of subject)*, agree to participate in this research. I understand that I may later refuse to participate, and that I may withdraw from the study at any time. I have received a copy of this consent form for my own records.

Signed: _____ Date: _____