

Student response systems: a cure for lecturalgia?

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Resumo: A causa mais freqüente da 'lecturalgia' (palestralgia, em tradução livre) é a inabilidade dos estudantes em manter a atenção. Para enfocar este problema muitas universidades tem-se voltado para o sistema de resposta do estudante (student response system - SRS) para facilitar as interações. Os benefícios mais frequentemente apontados são a percepção da maior interatividade, engajamento e satisfação dos estudantes. Contudo, pouca pesquisa tem sido realizada com maiores seções de estudantes. A maior motivação deste estudo foi determinar se os problemas da palestralgia podem ser curados com o uso do sistema SRS para facilitar o aumento das interações e engajamento dos estudantes. Os resultados suportam os estudos anteriores. Adicionalmente, para os professores que estão empregando técnicas de ensino interativas, este estudo sugere que o SRS oferece maior eficiência e acuracidade.

Palavras-chave: técnicas de ensino interativo, palestras, motivação.

Abstract: The most frequent cause of lecturalgia (painful lecture) is students' inability to maintain attention (McLaughlin and Mandin, 2001). In order to address this problem many universities have turned to the student response system (SRS) to facilitate student interaction. The most frequently reported benefits of a SRS are that students perceive lectures to be more interactive, engaging, and enjoyable. However, little research has been conducted with large sections of education students. The general motivation for this study was to determine whether the ailment of lecturalgia can be cured by using SRS to facilitate increased interaction and engagement in large lecture classes of pre-service teachers. The results support previous findings. In addition, for instructors who are already using interactive teaching techniques, this study suggests that the use of a SRS offers greater efficiency and accuracy.

Keywords: interactive teaching techniques, lecture, motivation.

I MOTIVATION FOR STUDY

This study was motivated by the potential of a student response system (SRS) to address the inadequacies of the traditional lecture as epitomized by a noted lack of interaction. According to McLaughlin and Mandin (2001) these inadequacies often result in *Lecturalgia*, otherwise known as the painful lecture. Lecturalgia is characterized as a state of either heightened emotions (e.g. agitation) or suppressed emotions (e.g. apathy) by the lectured-to audience. The most frequent cause of lecturalgia is students' inability to maintain attention

(McLAUGHLIN and MANDIN, 2001). Considering traditional large lecture classes are typified by passive, one-way communication which makes it difficult for students to sustain concentration for long periods of time, it is not surprising that so many students and lecturers suffer from the ailment of lecturalgia.

Limited opportunities for interaction in the traditional lecture setting engender a host of problems regarding students' attention and motivation. It is not realistic, for example, to expect students to pay attention for an entire 60 to 90 minute lecture (BLIGH, 2000; SMITH

2001). In fact, the attention span of students in a lecture does not exceed 20 minutes after which the mind wanders involuntarily (SMITH, 2001). Scheele (2005) proposes that an activity change must follow if students are to maintain attention throughout an entire lecture and that learning in lectures needs to be reconceptualized as an active process.

Getting and maintaining students' attention has long been recognized as a prerequisite for learning, which is the ultimate goal of the educational experience. According to Gagne (1985) gaining student attention is the first of nine events necessary for learning. Another important factor that affects learning is the amount of engagement the learner has with the material. For example, when students actively engage with content they are more likely to recall information later and use that information in different contexts (BRUNER, 1961). Furthermore, interaction with peers and faculty has been shown to predict positive student learning outcomes (ASTIN, 1993; WENZEL, 1999).

In order to address the issues of attention and engagement in large lectures, many colleges and universities have turned to the SRS to facilitate student interaction, as was the case for the educational assessment course that is the focus of this study. Historically this course has been unpopular with students, many of whom undoubtedly suffered from the ailment of lecturalgia. The purpose of this study, which is part of a larger evaluation project, is to determine whether the SRS contributes to increased engagement and attention in large lecture classes and if this results in enhanced learning.

II LITERATURE REVIEW

The use of student response systems has been studied in a variety of subject areas including economics (ELLIOT, 2003), physics (BURNSTEIN & LEDERMAN, 2001), psychology (DRAPER, CARGILL & CUTTS, 2002), engineering (VAN DIJK, 2001), chemistry (BUNCE *et al.*, 2006), physiology (PASCHAL, 2002), nursing (HALLORAN, 1995), statistics (WIT, 2003) and education (HAVILL, 2007). In general existing research has shown that

student attitudes toward SRS are positive (FIES & MARSHALL 2006; JUDSON & SAWADA, 2002; Mc GEORGE *et al.*, 2008). According to Fies and Marshall (2006), the most frequently reported benefits of SRS are that students perceive lectures to be more interactive, engaging, and enjoyable.

The research related to SRS and engagement has shown that the use of a SRS increases the likelihood of active student engagement (VAN DIJK *et al.*, 2001). Instructors have frequently reported that students become visibly more active participants when a SRS is used in class (ELLIOT, 2003; TRESS *et al.*, 2003). In addition, students have reported that the likelihood of working on a problem presented in a lecture increases by fifty percent when answers are submitted by a SRS versus a show of hands (CUTTS *et al.*, 2004). An explanation for increased engagement is that when students commit to an answer it makes them become emotionally or psychologically invested in the question, which results in them paying better attention to the discussion that follows (WIT, 2003). Caldwell (2007) attributes increased student engagement to the SRS enabling students to participate without fear of public humiliation.

According to Caldwell (2007), there is "ample converging evidence" that suggests SRS can improve learning outcomes (p. 13). For example, Poulis *et al.* (1998) have reported that pass rates in a physics class increased from 57% to 70% when the SRS was used; however, in this study SRS use was conflated with active engagement techniques. Despite the promising findings of many SRS studies, the research is still plagued by a difficulty in identifying what causes these benefits (BOYLE and NICCOLE, 2003). There are no factors related to SRS use that consistently correlate with the benefits of SRS use (FIES and MARSHALL, 2006; ROSHELLE *et al.*, 2004). SRSs have been used in variety of ways, with a variety of question types, and for a variety of purposes making it difficult to identify what causes the effect (CALDWELL, 2007). It is also possible that a "Hawthorne Effect" (MAYO, 1977), whereby research participants temporarily change their behavior simply because they know they are part of a

research study, rather than because of the treatment itself, may have attributed to the reported results. This hypothesis is supported by Clark and Surgue's (1991) review of educational research that found uncontrolled novelty effects can cause an average of a 30 % standard deviation rise; however, this novelty effect decayed to small levels after 8 weeks, which suggests that studies that take place over longer periods of time could negate this effect.

Another limitation of existing SRS research is that there is little research that has been conducted with education students who are in large lecture classes. Overall existing SRS research studies have been relatively small and most of the research interested in large lecture classes has been in STEM (Science, Technology, Engineering, or Mathematics) disciplines (McGEORGE et al, 2008). This strong emphasis of SRS research in STEM disciplines may not paint a complete picture of how all students perceive SRS because, compared to students in other disciplines, STEM students may have different expectations for instruction or have varying levels of competency and comfort with technology (BOYLE and NICOL, 2003). Thus further research is required to determine if SRSs have the same impact on students in large lecture classes in other disciplines such as education.

III METHODOLOGY

1. Participants

A total of 207 students enrolled in two sections of an education assessment course were given the opportunity to use SRS in their classes for the duration of the term. Of the 207 students, 184 chose to participate in the study and use the SRS in class. Of those who used the SRS, a total of 108 (59%) completed the optional survey at the end of the term. No control group was used because the instructor felt strongly that denying one group the use of the SRS would put it at a disadvantage.

2. Context of SRS Use

The education assessment course is not particularly popular with students. It is a

mandatory 9-week condensed course that has a high workload. It is also one of the few education courses that require students to apply math skills and interpret statistical analysis. Many students see the content of the education assessment course as 'dry' and as one respondent said, "most students strongly dislike this course (XXX) and everything to do with [it]." Both sections of the course in this study were taught by the same instructor whose main purpose for incorporating the SRS was to increase the level of interaction during the lecture to combat *lecturalgia*.

In previous offerings of the course, the instructor had incorporated the use of questions to facilitate interaction but had relied on a show of hands to get the students' responses. It was hoped that the ability to capture and share the results visually would engage more students and provide a clearer focus for discussion. Other goals included modeling technology integration for the pre-service teachers, checking for student understanding throughout the lecture, and permitting students to see where they stood in comparison with their peers.

Each section met for 1 hour and 50 minutes twice a week over a nine week period. The instructor reported using the SRS in all but one of the 9 topic areas covered during the term with the number of SRS questions ranging from 2 to 15 questions per topic. Since the main goal was to use the SRS data as a springboard for discussion and thereby increase student collaboration and interaction, many of the questions were designed to elicit discussion on controversial topics and preconceived ideas about assessment prior to instruction.

3. The Survey

The general motivation for this study was to determine whether the ailment of *lecturalgia* can be cured by using SRS to facilitate increased interaction and engagement in large lecture classes of pre-service teachers. Since McLaughlin and Mandin (2001) characterize *lecturalgia* as a state of either heightened emotions (e.g. agitation) or suppressed emotions

(e.g. apathy), student perceptions and attitudes were the focus of the survey questions.

The survey was made up of a total of 17 questions. These included 3 open ended questions and 14 Likert-type scale items (Tab. 1) that focused on student perceptions and attitudes regarding a number of factors related to the SRS use. For the purpose of this paper, we are only focusing on the items directly related to the issues of attention, engagement and perceptions of learning. Many of the questions were inspired by Havill's (2007) previous study of students' reaction to SRS use in a Middle Eastern university (p.7) and Draper and Brown's (2004) 2 year review of student views regarding SRS use (p.86). The Likert-type scale questions were based on a five-point scale, with 5 being a response of *Strongly Agree* and 1 representing *Strongly Disagree*. Most questions were phrased so that *Strongly Agree* represented a positive reaction to the use of the SRS in the lectures, for example, *The iClicker questions helped me to focus and pay more attention in lectures*. An example of a question where *Strongly Agree* represented a negative reaction to the SRS

would be, *The iClicker questions would have been just as useful if they had been presented in class without the clickers*. The three open-ended questions gave participants the opportunity to identify relevant issues that were not anticipated in the survey questions and to provide details regarding their responses to the closed items.

The survey was administered at the end of the course and was completed at the same time student evaluations of the course and instructor were completed. It was made clear that the SRS survey was optional and could be handed in blank if students chose not to complete it.

IV RESULTS

1. Survey Results

The survey results for the Likert-type scale questions are presented in Table 1. The 14 items are listed in the first column of the table, while the mean and standard deviation of participants' responses to each item are shown in columns 2 and 3 respectively. For each item five standard Likert-style responses were provided (1=strongly disagree, 2 =disagree,

Table 1: Education Students' Responses to SRS Survey (N=108)

	Survey Question	Mean (n=108)	Std. Dev. (n=108)
1	I liked knowing how the entire class responded to the iClicker questions.	4.17	0.81
2	I liked the fact that my responses were completely anonymous.	4.17	0.84
3	The iClicker questions allowed me to engage directly with the content being presented.	4.00	0.82
4	The iClicker questions helped me to focus and pay more attention in lectures.	*3.83	*0.92
5	The use of iClicker questions in this course should be continued in the future.	3.62	1.07
6	My level of class participation increased because of the use of iClickers.	3.49	1.20
7	I enjoyed the lectures more because of the iClicker questions.	3.40	1.13
8	The iClicker questions helped me to improve my learning.	3.25	1.03
9	The iClicker questions helped me to build a solid understanding of core concepts.	2.95	1.01
10	My experience of the questions and student response system helped me to improve my performance in the mid-term exam.	2.57	1.13
11	I would be willing to spend \$35 to use an iClicker in a future class.	*2.41	*1.19
12	The iClicker questions encouraged me to attend lectures more regularly.	2.38	1.01
13	I think that the iClicker questions took time that would be better used for presenting information.	*2.59	*1.07
14	The iClicker questions would have been just as useful as they had been presented in class without the clickers.	2.63	1.24

Note: items with an asterisk denote that there were 107 responses (N=107) because one student left the survey item blank.

3=neutral, 4=agree, 5=strongly agree). The sequence of the items listed in the table does not reflect the actual order of the questions in the original survey because the responses have been reordered from the most to least positive means. Note that questions 13 and 14 are listed separately because, for those questions, a low mean indicates a positive attitude towards the use of SRS.

2. Perceived Effect on Attention, Engagement and Participation

The items addressing student perceptions of the effect of the SRS on attention, engagement, and participation fall into 3rd, 4th and 6th place in the ordered list of question means. The results of these items are shown in Figure 1. In general participants agreed that the SRS allowed them to engage directly with the content being presented (M=4.00) and that it helped them focus and pay attention in lectures (M=3.8). There was only moderate agreement that participation level increased because of the SRS (M=3.49) and the Standard Deviation for this question was 1.20 compared to .82 and .92 for the other two, suggesting that there was a wider range of opinions on this item.

3. Perceived Effect on Learning

An impetus for using the SRS to enhance student engagement was the belief that it would translate into enhanced learning for students. This was measured by asking students their perception of the impact of the SRS

on their learning in items ranked 8th, 9th, and 10th. As shown in Figure 2, the results of all three items consistently indicate that students did not perceive the use of the SRS to significantly improve learning. Students elaborate on reasons for this in their responses to the open ended questions. The students' perception of the limited impact on learning was supported by the final grades. When the marks for this and the previous term were compared, there was no significant difference.

V. OPEN-ENDED QUESTION RESULTS

From the 108 completed surveys, 92% had responses to the open-ended questions. The three open-ended questions that were included in the survey were as follows:

- 1) Imagine that iClicker questions had not been used in this course. How would that have changed your educational experience?
- 2) Please add any reasons for your agreement or disagreement with the previous statements about the use of iClicker questions in this course, in the space below.
- 3) Please add any other comments or suggestions for improvement about the use of iClicker questions in this course, in the space below.

In the analysis of the opened-ended questions a research assistant descriptively coded

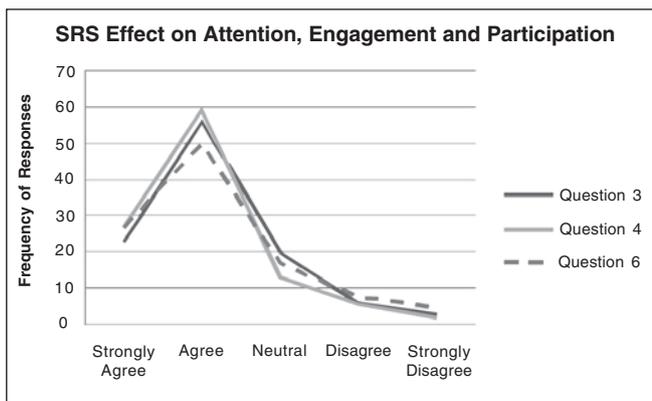


Figure 1: Distribution of students' responses to survey items 3, 4 and 6.

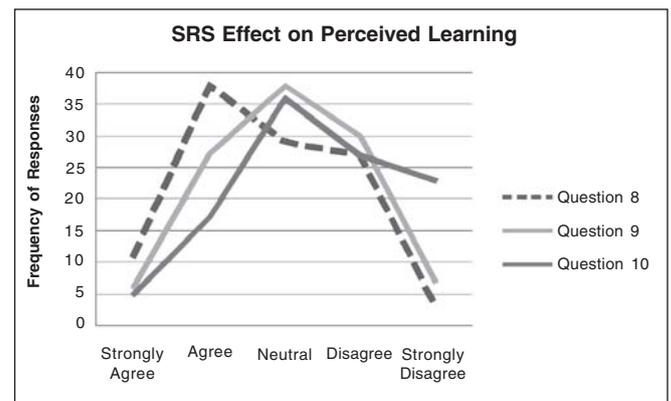


Figure 2: Distribution of students' responses to survey items 8, 9 and 10.

the student responses into general categories and subcategories. To identify reoccurring themes a tally of the main ideas which emerged were recorded. The two researchers then independently reviewed the data to check for validity and eliminate bias. Any discrepancies in coding were discussed and changes were mutually agreed upon. The analysis of the responses resulted in several coded themes, which are listed in Table 2.

Within the theme of Engagement and Participation, 29 students elaborated on why they felt positively about the use of the SRS in the class. By far the most frequently mentioned reason (n=24) was that it made the class more interesting. Of these, about half identified how visual data contributed to interactivity and

interest. For example one student wrote “the benefit was the visual graphs, [which are] not easily constructed by more conventional classroom sampling.” A few students (n=5) expressed their belief that the anonymous nature of the responses contributed to increased participation.

Student feedback was addressed in 29 comments. The ability to place one’s standing in relation to others in the class was perceived as a benefit of SRS use because it provided direction and focus for studying (n=7). A number of students (n=7) indicated that the SRS data effectively prompted conversations in the classroom. In addition, five students appreciated the process of voting and receiving immediate feedback.

Table 2: Themes identified in student responses to the open-ended questions of the SRS survey

Open-ended Question Response Themes	Number of students
Engagement and Participation	
Visual SRS data made class more interactive and interesting	13
SRS made class more interesting	11
Anonymity encouraged participation*	5*
Student Feedback	
Knowing standing in relation to the class provided direction and focus for studying	7
Feedback prompted conversation	7
Appreciated process of voting and receiving immediate feedback	5
Effect on Learning and Types of questions	
SRS had little effect on learning, but would have if questions had tested knowledge and not just opinions	5
Different types of questions preferred (did not describe type of question)	2
Questions not difficult enough	2
Efficiency and Accuracy	
More material covered because polling allowed quick review of questions	8
Information gathered by SRS more accurate than raising hands	7
SRS data helped keep class discussions focused	5
Exercises completed more quickly with SRS	5
Anonymity	
SRS allowed anonymous contributions	7
Anonymity encouraged participation*	5*

Note: an asterisk denotes that this item is classified under two themes.

There were nine comments related to the effects on learning and question types. These focused on the content or the structure of the SRS questions. In general students suggested that knowledge questions could have had a more positive impact on learning than the opinion based questions that were used to encourage discussion. For example one student stated that learning was not impacted because "we didn't use it to test our knowledge, but only to get our opinions."

An unanticipated theme that emerged from the open-ended questions was one of efficiency and accuracy with a total of 25 comments. A number of students felt that the information collected was more accurate (n=7) and that the data collected by the SRS helped focus class discussions (n=5). A total of 13 comments suggested that some activities were completed more quickly than they would have if they had been done without the SRS. When elaborating on how the class would have been different without the SRS one student indicated that the "iClicker activities would have gone much slower so we would either have wasted a lot of class time or would not have been able to do the exercises."

VI DISCUSSION

The main purpose for utilizing the SRS in these large lecture classes was to increase student engagement and maintain student attention throughout the lecture. The results of the survey clearly demonstrate that generally students perceived the use of the SRS to allow them to engage directly with the content and help them focus and pay attention in class. For example one student indicated that, "iClickers made class more interesting and interactive. Normally it is hard to involve students in university type lectures and iClickers seemed to do this." A number of students indicated that the anonymity of their answers contributed to their willingness to participate: "I know I would not have 'voted' with my hand. I am an introvert and I don't like attention. I also know I would not have been as truthful with opinions in front of my peers." Other

students noted the ability to address different learning styles: "the iClicker questions served to better engage the students. It appeases the kinesthetic learners as well as the visual and aural learners (kind of like getting up for a stretch to awaken the body)." A number of students commented on how the use of the SRS made the class more interesting. One very enthusiastic student wrote: "I was very disappointed when 2 hours would go by and we would not have a chance to iClick."

It is interesting to note that unlike many other SRS studies, the integration of the SRS did not require the instructor to make a pedagogical shift in teaching, as the instructor used interactive lecture techniques prior to using the SRS in the class. Questions which previously had been handed out to students or projected on overhead with a show of hands were now entered into the SRS and the technology was used to tally responses and to display results. In the written comments students acknowledged that the SRS made many of the activities more time efficient. This view was shared by the instructor who commented early in the semester how much more quickly some of the activities were being completed. The finding that the SRS saved valuable time in class is in contrast with other studies which suggest that integrating SRS questions takes up more class time (Burnstein and Lederman, 2001). While the move from direct lecture to the use of a SRS often results in a loss of time for content delivery, it seems that for those instructors who already use interactive lecture techniques, the SRS may offer greater efficiency. More research is required however, to quantify this observation.

Although this study supports the hypothesis that the SRS can facilitate engagement and increase attention, the results did not show that this translated into greater perceived learning for the students. For example one student stated that the SRS, "made the class more interesting but whether or not it improves learning, I don't know." Overall, students reported that the SRS did not influence learning outcomes one way or the other. A compa-

parison of final grades to those of the previous semester suggests that student perceptions were correct. The fact that the grades for both semesters were comparable could be attributed to similar overall teaching strategies. The same instructor taught the classes both terms using the same lecture material, classroom activities, assignments and exams. The only difference was the use of SRS to facilitate pre-existing classroom activities. Whereas, in some classes where the use of a SRS coincided with a shift from traditional lecture to interactive learning activities, grades have been found to improve (HAKE, 1998). This suggests that it may be the shift to active learning that has the greater influence on performance while the technology serves to facilitate the process making it more efficient.

While students felt that the use of the SRS did not enhance their learning, many recognized the potential of the SRS to enhance performance on exams. For example, five students indicated that they thought the SRS could have improved learning, had the questions focused more on content knowledge questions rather than opinion questions. Other students felt that in order to improve learning the SRS questions should be more similar to the types of questions they would encounter on their exam. This suggests that they didn't see a match between the SRS questions and how they were assessed. In fact, the instructor's purpose was not to practice exam questions, but rather to address lecturalgia by making the class more interesting, engaging and motivating. As Caldwell (2007) pointed out, SRS questions can take many forms and serve different purposes. Thus, it may be that using SRS questions to practice problems or for formative assessment will have a greater impact on exam performance than questions designed to find out more about

students or to increase or manage interaction. More research is needed to help clarify the relationship between the type of question used and learning outcomes.

VII SUMMARY

The results of this study indicate that the use of a student response system in combination with appropriate pedagogical practices may indeed represent a cure for lecturalgia by increasing student engagement and helping maintain student attention. Increased engagement can be attributed to increased interest levels and the ability of students to participate anonymously in a non threatening way. Although the use of a SRS increases student engagement, this does not necessarily translate into improved learning. In this case the SRS potential to improve learning may have been limited by the fact it was used primarily with increasing student engagement and attention in mind. The SRS was found to be efficient and could possibly save valuable class time for large lecture classes that already utilize interactive lecture activities.

Based upon the findings in this paper it is suggested that future research on SRS focus on:

- quantifying the observation that the SRS seems to save time to complete interactive learning activities
- exploring the relationship between different types of SRS questions and their effect on learning
- exploring the impact of different uses of SRS on learning
- exploring the effect of anonymity on student participation and learning.

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