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Christiansen, Steven, G. ***Development of the In-Class Structured Laptop Use Measure***

Abstract

Laptops are frequently used in university classrooms. Though laptops can disrupt classroom learning, structured laptop classrooms—in which laptop activities are integrated into lecture—have been shown to improve student academic outcomes. Despite this, no standardized measure exists to determine the degree of structure in laptop classrooms. The purpose of this study was to develop and validate the In-Class Structured Laptop Use Measure (ICSLUM), which is intended to measure a classroom's degree of laptop structure. The ICSLUM is moderately valid, being associated with on-task behaviors, lack of off-task behaviors, engagement and attentiveness, and course grades. The ICSLUM is also reliable, with an overall reliability estimate of .90. The components of the ICSLUM indicate that structured laptop use consists of several variables, including classroom activities and student and instructor behaviors. Thus, in addition to its intended purpose, the ICSLUM can measure certain student and instructor behaviors, such as a student's on-task behaviors or an instructor's regulation of laptop use. The ICSLUM is also usable as an alternative to student evaluations of teaching, as it might be less susceptible to students' biases regarding instructors. Finally, the ICSLUM provides a standardized measure of structured laptop use, allowing further research on this topic.

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Chapter I: Literature Review

The purpose of this study was to create and validate a measure that can be used to determine what degree of structure a laptop classroom has. No measure has been found that can determine how well a class integrates laptop activities into its curriculum, and researchers so far (e.g., Kay & Lauricella, 2011; Zhu, Kaplan, Dershimer, & Bergom, 2011; Trimmel & Bachman, 2004) have had to rely on their knowledge of the class to determine how structured that class's use of laptops is. As such, it is currently difficult for researchers to determine the degree of structure of a laptop classroom unless they are knowledgeable of how the class was taught. Furthermore, it is difficult to compare results across studies due to the fact that different authors use different operational definitions of laptop integration. For these reasons, it is beneficial to have a standardized instrument that determines degree of in-class laptop structure. The development and validation of such a measure was the purpose of this study.

This study was motivated by the fact that several universities across the United States have started requiring that students own laptops (such as Winona State University and the University of Wisconsin—Stout). There have been mixed responses to the introduction of laptops into the classroom, with some researchers (e.g., Yamamoto, 2007) and instructors believing that they are harmful to students' education (Baker, Lusk, & Neuhauser, 2012; Fried, 2008) while other researchers (e.g., Trimmel & Bachmann, 2004) have found that they can benefit students in the classroom. These differences in the findings necessitate a closer look at what effects in-class laptop use has on students, and in what circumstances in-class laptop use is beneficial to students and in what circumstances in-class laptop use is detrimental.

Structured vs. Unstructured In-Class Laptop Use

There are essentially two types of in-class laptop use: structured and unstructured (Kay & Lauricella, 2011). Unstructured in-class laptop use refers to classes in which laptops are allowed in class but are not required for any specific activities. For example, students might use laptops to follow along in lecture, despite their laptops not being required to do so. This is in contrast to structured laptop use, in which class activities are built around the use of students' laptops. Essentially, structured laptop classrooms require laptops be integrated into classroom activities. Examples are: data collection and simulations (Weaver & Nilson, 2005), using specific discipline-related software (Kolar, Sabatini, & Fink, 2004; Siegle & Foster, 2001), and exercises involving class concepts (Barak, Lipson, & Lerman, 2006).

Effects of Unstructured In-Class Laptop Use on Academic Performance

In general, research has shown a negative association between unstructured in-class laptop use and academic performance. For example, Fried (2008) found that students who used their laptops in class had a lower course grade than students who did not, even after controlling for high school class rank, ACT score, and attendance. The students in this study were not asked about what activities they were doing on their laptops, so these results could be due to a number of reasons.

One reason for this general association between unstructured in-class laptop use and low course grades is that laptop users have the potential to be distracted by their own laptops. In general, many students find their laptops to be a source of distraction (Wurst, Smarkola, & Gaffney, 2008), and this distraction has been found to have a more severe impact on course grades than that caused by other electronic media, such as MP3 players, phones, portable games, and CD players (Zhang, 2015). In general, using laptops for nonacademic activities during class is associated with low grade point averages (GPAs), likely because these nonacademic activities are distracting students (Gaudreau, Miranda, & Gareau, 2014; Kraushaar & Novak, 2010). However, the main distractor seems to be the temptation to browse the internet (Wurst, Smarkola, & Gaffney, 2008). Unfortunately for students, the distractions posed by the internet are detrimental to learning. As Grace-Martin and Gay (2001) found, browsing the internet in class is negatively associated with course grade. This association holds even after controlling for intellectual ability as measured by ACT scores (Ravizza, Hambrick, & Fenn, 2014).

However, laptops do more than distract their users—they also distract users' peers as well. Fried (2008) found that students rated others' laptop use in class as a distraction significantly more often than other potential sources of distraction, such as other students talking and noise from the hallway. Also, Sana, Weston, and Cepeda (2013) found that students who were in view of another student's laptop screen during a lecture scored significantly lower on a comprehension exam than students who were not in view of another student's laptop screen. It is important to note that students who were using a laptop were instructed to switch between browsing the internet and taking notes, providing evidence that even just some off-task behavior can be distracting to other students.

Advantages of Structured In-Class Laptop Use

There are many advantages to a structured approach to in-class laptop use. For example, Trimmel and Bachmann (2004) found that in "pure" laptop classrooms (analogous to structured laptop classrooms), students had higher levels of interest and class participation when compared to students in non-laptop classrooms. Also, Kay and Lauricella (2011) found that students spent significantly less time using their laptops for off-task activities in structured laptop classrooms compared to unstructured laptop classrooms, and spent significantly more time using their laptops for on-task activities in structured laptop classrooms than in unstructured laptop classrooms. Skolnik and Puzo (2008) also found that students were more likely to be conducting on-task behaviors during integrated laptop activities than they were during unstructured lectures. Additionally, Kolar, Sabatini, and Fink (2002) found that students in structured laptop classrooms had higher class participation scores than students in classrooms without laptops. Also, Zhu, Kaplan, Dershimer, and Bergom (2012) found that students in structured laptop classrooms were more engaged and attentive during lecture than students in unstructured laptop classrooms.

Furthermore, there is evidence that structured in-class laptop use is beneficial for students' academic performance. For example, Kolar et al. (2002) found that students in a structured laptop class had higher course grades than students in a class with no laptops. Though this difference was not statistically significant, the students in the structured laptop class had a lower GPA at the start of the class than the students that were in the no-laptop class, indicating the possible existence of a positive association between structured laptop classes and course grades. In support of this possible trend, Siegle and Foster (2001) found that using laptops equipped with software relevant to classroom activities was associated with higher course grades than using traditional paper-based materials. Similarly, Gulek and Demirtas (2005) also found that students in structured laptop classes generally have higher grades than those in classes that do not allow laptops. Even on measures of perceived academic performance, students in structured laptop classes benefit more than students in unstructured laptop classes. For example, Zhu et al. (2012) found that students in structured laptop classes scored higher on a measure of perceived learning than students in unstructured laptop classes.

Need for a Measure to Determine Structure of Laptop Use

Given the vast differences in student outcomes between structured and unstructured laptop use in classrooms, it is important to be able to assess a class's degree of structured in-class laptop use. Some measures exist that can be used to measure this construct (see Kay & Lauricella, 2011; and Zhu et al., 2012), but these measures were not created for the purpose of assessing a laptop classroom's degree of structure. The measures used in these studies exist to judge differences between structured and unstructured laptop classrooms in terms of on-task and off-task behavior (Kay & Lauricella, 2011) and in terms of engagement during lecture, student attentiveness during class, and students' perceived learning (Zhu et al., 2012). Thus, these measures are not deemed appropriate for determining a laptop classroom's degree of structure, so a new measure was constructed and validated for this purpose.

Creation of the Structured In-Class Laptop Use Measure

A review of the literature found that there are seven constructs that are important in determining the structure of a classroom's in-class laptop use. These are: on-task use of the laptops, off-task use of the laptops, instructor regulation, student participation, distraction, instructor preparation, and instructor beliefs.

On-task use of laptops. The first construct identified as being important for this measure is the on-task use of laptops in class. Lauricella and Kay (2009) define on-task use of the laptop in their Laptop Effectiveness Scale as using the laptop for activities that are related to the class, such as following along with the lecture and doing in-class assignments or activities. When validating this measure in 2010, Kay and Lauricella found that using the laptop to take notes was highly correlated with this construct. So, for the purposes of this measure, taking notes, doing in-class assignments and activities, and following along with lecture have been included as academic uses of the laptop.

Determining how much the students' laptops are used for academic activities is important in determining how structured a classroom is around the use of laptops. As Kay and Lauricella (2011) found, laptops are used for on-task purposes more often in structured laptop classes than in unstructured laptop classes. So, three questions were developed for this construct (see Table 1). The first three on-task items are taken and modified from Kay and Lauricella (2010). The fourth on-task item is included as some authors (e.g., Efaw, Hampton, Martinez, & Smith, 2004) have noted that students can use their laptop to look up answers during class discussions. The fifth and sixth items were developed for the purposes of this study. Each question uses a seven-point Likert scale (1 = Strongly Disagree, 7 = Strongly Agree).

Table 1

On-Task Behaviors Items

On-Task Behaviors Item Number	On-Task Behaviors Items
1	I used my laptop in class to take notes during lecture.
2	I used my laptop in class to follow along during lecture.
3	I used my laptop to complete in-class assignments or activities.
4	I used my laptop in class to find answers to questions posed by the instructor.
5	I used my laptop in class to keep up with the instructor's notes.
6	I used my laptop in class to better understand course concepts.

Lack of off-task use of laptops. Similarly to how structured laptop classrooms are more closely associated with on-task laptop use than unstructured laptop classrooms, unstructured laptop classrooms are more closely associated with off-task use of laptops than structured laptop classrooms (Kay & Lauricella, 2011). While this construct would seems to be closely (and negatively) associated with on-task use of laptops, Kay and Lauricella (2011) found that it was its own separate construct. Furthermore, Tallvid, Lundin, Svensson, and Lindström (2015) found that academic and nonacademic use of laptops are not necessarily negatively correlated.

However, both sets of authors define nonacademic use differently; Kay and Lauricella (2011, using the measure developed in Lauricella & Kay, 2009) define nonacademic use as email, instant messaging, playing games, and watching movies not related to class, while Tallvid, et al. (2015) define nonacademic use as playing games, chatting, off-task web browsing, and downloads not related to class. For the purposes of this measure, Kay and Lauricella's 2009 survey was used as the basis, given that these authors validated their measure in 2010; emails and instant messages not related to class, watching movies, and playing games have been retained for this measure. However, Tallvid et al.'s off-task web browsing was used to capture all other off-task online behavior. Finally, Zhu et al. (2012) recommend asking students how often they used their laptop to do homework for other classes, so that item was included as well. The six items developed for this construct can be seen in Table 2. All questions are on a seven-point Likert scale (1 = Strongly Disagree, 7 = Strongly Agree). Note that all of these items were reverse-scored so that a higher score indicates a lower amount of off-task behavior.

Table 2

Lack of Off-Task Behaviors Items

Lack of Off-Task Behaviors Item Number	Lack of Off-Task Behaviors Items
1	I used my laptop in class to send emails for purposes not related to [name of class].
2	I used my laptop in class to send instant messages (msn, facebook chat, etc) for purposes not related to [name of class].
3	I used my laptop in class to browse the internet for purposes not related to [name of class].
4	I used my laptop in class to watch movies or videos.
5	I used my laptop in class to play games.
6	I used my laptop in class to do homework for other classes.

Note. The text string *[name of class]* refers to the class title, which is previously entered in the survey.

Instructor regulation. The third construct identified as being important for this measure is the behavior of the instructor in regards to regulating students' laptop use. Many authors have identified that the instructor's regulatory behavior is an important aspect of a structured approach to using laptops in the classroom. For example, Zhu, Kaplan, Dershimer, and Bergom (2011) and Wurst, Smarkola, and Gaffney (2008) recommend that instructors set a clear policy regarding the use of laptops in class. Jackson (2012) also found that students believed that policies should not only be stated, but enforced. Furthermore, Efaw et al. (2004) noted the effectiveness of monitoring laptop behavior to keep students on task in structured laptop classrooms.

Based on these guidelines, six items regarding instructor behavior were developed, and can be seen in Table 3. Again, these are all 7-point Likert scale items (1 = Strongly Disagree, 7 = Strongly Agree). Note that the third, fourth, and fifth Instructor Regulation items were reverse-scored so that a higher score indicates a higher degree of instructor regulatory behavior.

Table 3

Instructor Regulation Items

Instructor Regulation Item Number	Instructor Regulation Items
1	My instructor clearly discussed his/her policy regarding laptop use.
2	My instructor reminded students about his/her policy regarding in-class laptop use.
3	My instructor ignored students' in-class laptop use.
4	My instructor allowed students to do what they wanted on their laptops in class.
5	My instructor allowed students to use laptops for purposes unrelated to class.
6	If students were not using their laptops for activities related to class, my instructor would ask them to stop.

Lack of distraction from other students. The fourth hypothesized construct is lack of distraction from other students. This refers to whether or not students are distracted by their classmates' off-task laptop use. For example, Jackson (2012) and Kay and Lauricella (2014) found qualitative evidence that students are distracted by others' in-class laptop use. Quantitatively, Fried (2008) found that students identified that their classmates' most distracting behavior was laptop use. Furthermore, as previously mentioned, Sana et al. (2013) found that students who were in view of another student's off-task laptop activities during a lecture received lower scores on a comprehensive exam than those who were not. In addition to this, Zhu et al. (2012) and Samson (2010) found that students in structured classrooms are more attentive than those that are in unstructured classrooms, indicating that structured laptop classrooms cause less distraction than unstructured laptop classrooms.

Unfortunately, no measures could be found that directly measured distraction (other than Zhu et al.'s 2012 measure). However, based on the current research, seven distraction items were developed. The fourth item is based on Zhu et al.'s (2012) measure, while the rest are based on evidence that students are distracted by classmates' off-task behavior (see Table 4). All items are on a seven-point Likert scale (1 = Strongly Disagree, 7 = Strongly Agree). Note that, for this construct to be in the same direction as all other constructs (i.e. that a higher score correlates with a higher degree of structured laptop use), the first two and last three items were reverse-scored so that a higher score on these items will indicate less distraction from other students.

Table 4

Lack of Distraction from Other Students Items

Lack of Distraction from Other Students Item Number	Lack of Distraction from Other Students Items
1	I was often distracted by my classmates' laptop activities.
2	I frequently noticed that other students were using their laptops for activities not related to [name of class].
3	I was able to concentrate in class.
4	I was attentive during class.
5	My classmates were easily distracted by others' laptop activities.
6	I had difficulty staying engaged in class.
7	My classmates seemed to have difficulty staying engaged in class.

Note. The text string *[name of class]* refers to the class title, which is previously entered in the survey.

Instructor preparation. The sixth hypothesized construct is instructor preparation. This construct represents how prepared students feel their professors are to use laptops in the classroom. As Silvin-Kachala and Bialo (2000; as cited in Inan & Lowther, 2010) found by examining over 300 studies, training instructors to use computers is the most significant factor influencing the use of computers in the classroom. Similarly, in a review of thirty studies, Penuel (2006) found that formal training in skills related to technology is important for the successful integration of laptops into classrooms.

Kanaya, Light, and Culp (2005) found that prior experience with technology and intensity of technology training both were significant factors in predicting whether or not teachers would integrate new software in their teaching activities, showing that familiarity with technology can influence pedagogical practices. Additionally, Wozney, Venkatesh, and Abrami (2006) found a strong positive correlation between instructors' self-reported computer proficiency and frequency of computer integration into instruction. Furthermore, Inan and lowther (2010) found a strong association between how ready teachers feel to use computers in the classroom and actual laptop integration into the classroom (both measured by the Freedom to Learn-Teacher Technology Questionnaire, or FTL-TTQ). Collectively, this research indicates that instructor preparation to use technology is a strong predictor of actual technology use in the classroom.

Following these findings from the literature, seven Instructor Preparation items were created (see Table 5). The first four items are modified from the Teacher Readiness to Integrate Technology of the FTL-TTQ (as it appears in Lowther, Inan, Ross, & Strahl, 2012) so that they are from the perspective of the student, not the instructor. The final two items are created using the Technology Implementation Questionnaire's measure of computer proficiency (item 43) as the basis (Wozney et al., 2006). Each item is on a seven-point Likert scale (1 = Strongly Disagree, 7 = Strongly Agree), with higher scores on each item indicating a higher degree of instructor preparation. The last two items were reverse-scored to indicate a higher degree of instructor preparation.

Table 5

Instructor Preparation Items

Instructor Preparation Item Number	Instructor Preparation Items
1	My instructor knows how to meaningfully integrate laptops into lessons.
2	My instructor seems to have adequate computer skills to conduct classes that have students using their laptops.
3	My instructor seems to have received adequate training to incorporate laptops into [name of class].
4	My instructor is able to align the use of the laptop with the curriculum of [name of class].
5	My instructor seems to have little experience using laptops.
6	My instructor has trouble performing basic laptop functions.

Note. The text string *[name of class]* refers to the class title, which is previously entered in the survey by the participant.

Instructor beliefs. The seventh hypothesized construct relates to the beliefs of the instructor in terms of technology use in the classroom. More specifically, these beliefs refer to instructors' perceptions of the impact of laptop use on student achievement and classroom activities (Inan & Lowther, 2010). There is evidence in the literature that these perceptions are strong predictors of laptop integration into the classroom. For example, Van Braak, Tondeur, and Valcke (2004) found that instructors with positive attitudes towards using computers in education were more likely to integrate computers into classroom instruction. Wozney et al.

(2006) also found that instructors with positive perceptions of the effectiveness and value of in-class computer use were more likely to integrate computers into classroom instruction than those with negative perceptions of the effectiveness and value of in-class computer use. Similarly, Inan and Lowther (2010) found that instructors with positive perceptions of how laptop use impacted students and classroom instruction were more likely to integrate laptops into the classroom.

In their study, Inan and Lowther (2010) used the Freedom to Learn-Teacher Technology Questionnaire, or FTL-TTQ. Based on this measure (as it appears in Lowther et al., 2012), six items were created. The first five items are based on the Teacher Beliefs construct (which includes the Impact on Classroom Instruction and Impact on Students items), but are modified so that they are from the perspective of the student, not the instructor. The sixth item was developed for the purpose of this study. These six items are shown in Table 6. All are on a seven-point Likert scale (1 = Strongly Disagree, 7 = Strongly Agree), with a higher score indicating more positive instructor beliefs about laptop use. The sixth item was reverse scored so that a higher score indicates more positive instructor beliefs regarding the use of laptops in the classroom.

Table 6

Instructor Belief Items

Instructor Belief Item Number	Instructor Belief Items
1	My instructor believes that the use of laptops in the classroom increases the level of student interaction and/or collaboration.
2	My instructor believes that the use of laptops in the classroom positively impacts student learning and achievement.
3	My instructor believes that the use of laptops in the classroom improves the quality of student work.
4	My instructor believes that using laptops in the classroom has a positive impact on classroom learning.
5	My instructor believes that using laptops in the classroom makes lessons more interactive.
6	My instructor believes that using laptops in the classroom makes it difficult for students to learn.

Chapter II: Methodology

The methodology for this study is designed to develop and validate the In-Class Structured Laptop Use Measure (also known as the ICSLUM). The following sections discuss the methodology used to do so, and include a discussion of survey distribution, an overview of psychometric concepts, instruments used, and analyses conducted.

Survey Distribution

After approval from the University of Wisconsin—Stout's Institutional Review Board was received, the survey (see Appendices A, B, C, and D) link was sent to a random sample of University of Wisconsin—Stout students. Students were not eligible if they had only taken online courses during the spring 2016 semester. Students who completed the survey were entered into a drawing to receive one of two iTunes gift cards. Furthermore, students received an email reminding them to take the survey one week after they were initially invited. The survey was hosted by Qualtrics, an online survey tool. As the survey was electronic, students were able to take it wherever they had an internet connection. Note that, due to low response rates, two samples were invited: one sample was invited during the spring 2016 semester, while the other sample was invited during the summer semester.

Students who took the survey were be exposed to six different measures: the ICSLUM (the measure developed in this study); the Modified Laptop Effectiveness Scale (Kay & Lauricella, 2011); Zhu et al.'s (2012) measures of course engagement, student attentiveness, and perceived learning; and demographic items. It was expected that all of these measures could be completed in within fifteen minutes.

Psychometrics

In measurement construction, it is important to assess the validity and reliability of a measure. These concepts are briefly reviewed for the benefit of the reader.

Validity. The validity of a measure refers to how accurate that measure is, and can be measured in terms of content validity, criterion validity, and construct validity. The first method of validity, content validity (Murphy & Davidshofer, 2005, pp. 156-161), refers to how well the test represents each of the domains it is supposed to measure, and is often assessed by subject matter experts. Another method, construct validity, refers to how well a specific construct is measured (Murphy & Davidshofer, pp. 162-173). Often, a measure is correlated against other measures that measure the same construct to assess how closely related it is to that construct. The third method, criterion-related validity, refers to comparing a measure's test scores against that of some other variable with which the measured construct is theorized to correlate (Murphy & Davidshofer, 2005, pp. 181-188).

Reliability. Reliability refers to how consistent a measure is. There are multiple methods of measuring reliability. One method is test-retest reliability (where a test is given to respondents at two different times to assess if respondents answer similarly at each time point). Another method is alternate forms reliability, which is similar to the test-retest method except that the second test is an alternate form of the test given at the first time point. Tests can also be administered once, with the items randomly split in half to assess how closely scores on one half are associated with the other. However, the most common method of measuring reliability is the internal consistency method. This involves computing correlation between each item on a test and calculating an average. This results in a measure known as Cronbach's alpha (Murphy & Davidshofer, 2005).

Instrumentation

The measurements that participants were exposed to are discussed. Each is described in terms of its purpose, its validity, and its reliability.

In-class structured laptop measure. This is the measure currently being constructed (see Appendix A). It consists of thirty-seven items, and can be completed in under fifteen minutes. There are six hypothesized factors in this measure: on-task behavior, off-task behavior, instructor regulation, distraction, instructor readiness, and instructor beliefs.

Validity. No validity data is available for this measure.

Reliability. No reliability data is available for this measure.

Modified laptop effectiveness scale. This measure was developed by Kay and Lauricella (2011). It is based on a measure created by Kay and Lauricella (2010) that was designed to assess the degree to which students use their laptops for on-task and off-task behaviors. In 2011, the authors modified the survey to assess if there is a difference between students in structured laptop classrooms and students in structured laptop classrooms in terms of using laptops for on-task and off-task behaviors. As Kay and Lauricella (2011) found that students in structured laptop classes score higher than students in unstructured laptop classes on measures of on-task behavior and lower than students in unstructured classes on measures of off-task behavior, this is an important instrument to use for validation.

It can be completed within five minutes, and consists of four factors: academic use, non-academic use (communication), non-academic use (watching movies), and non-academic use (playing games). The academic use factor refers to using the laptop for on-task purposes, such as taking notes or following along in lecture, while the non-academic use factors refer to using the laptop for off-task purposes, such as sending emails and instant messages for purposes not related to class, watching movies not related to class, and playing games not related to class. All items are on 5-point scales (1 = 0% of the Time, 5 = 76-100% of the Time). For both the academic use and non-academic use factors, a higher score indicates a higher frequency of that type of behavior (e.g., a higher score on the academic use factor indicates a higher frequency of academic use of laptops; a higher score on the non-academic use factor indicates a higher frequency of non-academic use of laptops). For this study, the items making up the non-academic use factors were reverse-scored so that a higher score indicated fewer off-task behaviors. This was done so that these items would be in the same direction as the items making up the hypothesized Lack of Off-Task Behaviors component. See Appendix B.

Construct validity. Kay and Lauricella (2011) found that students in structured laptop classes more frequently participated in on-task (academic) activities than did students in unstructured laptop classes. This is true for both the combined on-task score and the individual questions that make up the combined on-task score. These on-task activities include taking notes, following along in lecture, doing in-class assignments and activities, and viewing the course outline.

Similarly, students in unstructured laptop classes more frequently participated in off-task (non-academic) activities than did students in structured laptop classes. These off-task activities include using the laptop to play games and send emails and messages not related to class. There was not a difference between students in structured and unstructured classes in terms of the frequency with which they used their laptops to watch movies, but this was a behavior that rarely occurred for either group of students. Still, students in unstructured laptop classes were found to more frequently participate in off-task activities more often than students in structured laptop classes.

Reliability. No reliability data exists for the modified measure, though the measure it is based on has acceptable reliability, with Cronbach's alpha coefficients ranging from 0.75 to 0.87 for each construct (Kay & Lauricella, 2010).

Zhu et al.'s (2012) Attentiveness Measure. Zhu et al.'s (2012) Attentiveness Measure is included as students in structured laptop classes were shown to score higher on this measure than students in unstructured laptop classes. This measure consists of one item: "My attentiveness has increased due to laptop use", which is on a five-point Likert scale (1 = Strongly Disagree, 5 = Strongly Agree). This measure appears in Appendix C.

Construct validity. Students that were in structured laptop classes scored higher on the Attentiveness Measure than did students that were in unstructured laptop classes.

Reliability. There is no reliability data for this measure.

Zhu et al.'s (2012) Engagement Measure. Zhu et al.'s (2012) Engagement Measure is included as students in structured laptop classes were shown to score higher on this measure than students in unstructured laptop classes. This measure consists of one item: "My laptop helped me to be more engaged during lecture", which is on a five-point Likert scale (1 = Strongly Disagree, 5 = Strongly Agree). This measure appears in Appendix C.

Construct validity. Students that were in structured laptop classes scored higher on the Engagement Measure than did students that were in unstructured laptop classes.

Reliability. There is no reliability data for this measure.

Zhu et al.'s (2012) Perceived Learning Measure. Zhu et al.'s (2012) Perceived Learning Measure is included as students in structured laptop classes were shown to score higher on this measure than students in unstructured laptop classes. This measure consists of one item:

"I learned more due to the use of a laptop than I would have without it", which is on a five-point Likert scale (1 = Strongly Disagree, 5 = Strongly Agree). This measure appears in Appendix C.

Construct validity. Students that were in structured laptop classes scored higher on the Perceived Learning Measure than did students that were in unstructured laptop classes.

Reliability. There is no reliability data for this measure.

Descriptive variables. Respondents' age, academic standing, and gender were collected. See Appendix D for these measures. Participant's letter grades in their chosen class were measured on a five-point scale such that a higher score indicated a higher grade (0 = F, 1 = D, 2 = C, 3 = B, 4 = A). Participants' grade point averages (GPAs) were measured in the form of a sliding scale that ranged from 0 to 4, with higher scores indicating a higher grade point average. Furthermore, participants' class attendance was measured using a non-validated five-point Likert scale (1 = Never attended, 5 = Always attended). See Appendix D for these measures.

Analyses

An outline of the analyses conducted in this study follow for the benefit of the reader.

Validity. The validity of the ICSLUM was assessed with the following analyses.

Content validity. The content validity of the ICSLUM was not assessed as doing so is outside the scope of this study.

Construct validity. The construct validity of the ICSLUM was assessed with the following analyses.

Principal component analysis. A principal component analysis was used to assess if the hypothesized constructs form seven components/factors. A principal component analysis was used as no scales measuring the structure of in-class laptop use were found (this is the same approach and justification used in Kay & Lauricella, 2010). All items retained during the principal component analysis were then used to create an In-Class Structured Laptop Use

Measure (ICSLUM) score, with a higher number indicating a higher degree of structured in-class laptop use. There were also a set of components created by the principal component analysis. Each component was an average score of all items that loaded onto that component.

Regression 1: ICSLUM score, Total On-Task Behaviors score and Total Lack of Off-Task Behaviors score. A regression was conducted to assess the relationship between the ICSLUM score and students' on-task and off-task behaviors. The Total On-Task Behaviors score and Total Lack of Off-Task Behaviors score were entered into the regression as predictors, while the ICSLUM score was used as the outcome variable.

Criterion validity. The criterion validity of the ICSLUM was assessed with the following analyses.

Regression 2: ICSLUM score and Engagement Measure score, Attentiveness Measure score, and Perceived Learning Measure score. A regression was conducted to assess the relationship between the ICSLUM score and engagement, attentiveness, and perceived learning as measured by Zhu et al. (2012). The Engagement Measure score, Attentiveness Measure score, and Perceived Learning Measure score were entered into the regression as predictors, while the ICSLUM score was used as the outcome variable.

Regression 3: ICSLUM score on Perceived Learning Measure score. To further investigate the relationship between the ICSLUM and the Perceived Learning Measure score, a second regression was conducted with the Perceived Learning Measure score as the outcome variable and the ICLSLUM score as a predictor. Participants' GPAs, attendance, and level of course engagement were controlled for based on findings that these three variables are related to students' course grades. Class attendance was included as a covariate as it was found to be a significant predictor of course grade (Fried, 2008). GPA was also included as a covariate as

Fried (2008) and Ravizza et al. (2014) found that prior academic performance predicts course grade as well. However, Fried (2008) and Ravizza et al. (2014) both used students' ACT scores as a measure of prior academic performance. This measure was not available for this study, so GPAs were used as GPAs and ACT scores were found to be positively correlated (Marsh, Vandehey, & Diekhoff, 2008). Furthermore, students' level of course engagement was controlled for as this has been found to be a significant predictor of course grades (Handelsman, Briggs, Sullivan, & Towler, 2010).

A further exploratory analysis was conducted to assess if the level of student engagement in a course moderated the relationship between the ICSLUM and perceived learning. As there is a relationship between engagement and course grade (Handelsman et al., 2010), it is possible that there will only be a positive relationship between the ICSLUM and perceived learning if student engagement is high. Thus, a moderation analysis was conducted to test this hypothesis.

Regression 4: ICSLUM score on students' letter grade. An ordinary least squares regression was used to judge the predictive validity of the ICSLUM score on the letter grade (*A*, *B*, *C*, *D*, or *F*) students indicated they had received or would receive in their class of choice. While this analysis is similar to that of Regression 4, letter grade was treated as an interval variable. This was done to more precisely assess the relationship between the ICSLUM score and letter grade than could be done with an ordinal logistic regression. As in Regression 4, students' current GPA, class attendance, and level of course engagement were controlled for, as each of these variables has been found to predict course grade (Fried, 2008; Handelsman et al., 2010; Marsh et al., 2008; Ravizza et al., 2014; see section discussing Regression 3). Sample time was also included as a covariate for the same reason it was included as a covariate in Regression 4.

A further exploratory analysis was conducted to assess if the level of student engagement in a course moderated the relationship between the ICSLUM and letter grade. As there is a relationship between engagement and course grade (Handelsman et al., 2010), it is possible that there will only be a positive relationship between the ICSLUM and letter grade if student engagement is high. Thus, a moderation analysis was conducted to test this hypothesis.

Reliability. Cronbach's alpha was used to assess the internal consistency of each of the identified constructs from the principal component analysis. The reliability of each component was also analyzed after removing each item. Additionally, Cronbach's alpha was used to assess the internal consistency of the entire measure. The reliability of the ICSLUM was also analyzed after removing each item.

Chapter III: Results

The results of the study are described in the following sections. These sections describe the participants demographically and offer descriptive statistics for participants' scores on each measure. Correlations between measures are also provided. Results also cover the construct and criterion validity of the ICSLUM. Finally, reliability estimates for each of the components of the ICSLUM are calculated along with an overall reliability estimate for the ICSLUM as a whole.

Participants

Initially, 1389 invitations were sent out to students at the University of Wisconsin - Stout. Every student at the university had an equal chance of being included in the sample. However, only 72 students initially completed the survey. To increase the number of respondents, a second sample was sent to a different sample of 1196 students. Again, every student at the university had an equal chance of being included in the sample, though this sample was corrected so that students who only took online classes during the spring 2016 semester were excluded. Sixty-one students completed the survey during this second sampling process. In total, 2585 invitations were sent to students to participate in the study. One hundred and thirty-three students completed the survey, resulting in a response rate of 5.15%. Seventy-nine of the respondents were female, 48 were male, and six preferred not to disclose their gender. The average age of participants was 21.85 years old. Fifteen participants were freshmen, 24 were sophomores, 33 were juniors, 52 were seniors, eight were graduate students, and one preferred not to disclose their academic standing. When asked to identify their race, 113 participants chose White, one chose African American or Black, one chose Cambodian, six chose Hmong, four chose Other Asian, and eight preferred not to disclose their racial information. In regards to ethnicity, one participant identified as Cuban, three students identified as Other Hispanic, and five preferred not to disclose their ethnic information. The remaining 124 students identified as non-Hispanic.

Descriptive Statistics and Correlations of Measures Used

Means and standard deviations of participants' Engagement Measure score, Attentiveness Measure score, Perceived Learning Measure score, Total On-Task Behaviors score, Total Off-Task Behaviors score, GPAs, and attendance are shown in Table 7, as well as the number of participants that provided information for each measure. The correlations between these variables is shown in Table 8.

Table 7

Means and SDs of the Continuous Measures used for Validation

Variable	Mean (*SD*)	Range of Scores	N
Engagement Measure	3.57 (*1.07*)	1-5	129
Attentiveness Measure	3.20 (*1.09)*	1-5	129
Perceived Learning Measure	3.82 (*1.03*)	1-5	129
Total On-Task Behaviors	3.36 (*1.29*)	1-5	129
Total Lack of Off-Task Behaviors	4.58 (0.*50*)	1-5	129
GPA	3.40 (0.*47*)	0-4	121
Attendance	4.80 (0.*39*)	1-5	129

Table 8

Pearson Product-Moment Correlations Between the Continuous Measures used for Validation

Variable	1.	2.	3.	4.	5.	6.	7.
1. Engagement Measure	--	.76***	.66***	.57**	-.03	-.13	.17
2. Attentiveness Measure		--	.59***	.44***	.01	-.14	.12
3. Perceived Learning Measure			--	.39***	-.04	-.00	.18
4. Total On-Task Behaviors				--	-.21*	-.01	.06
5. Total Lack of Off-Task Behaviors					--	.19*	.14
6. GPA						--	.20*
7. Attendance							--

*$p < .05$. **$p < .01$. ***$p < .001$

The final measure used for validation purposes was participants' letter grade in their chosen class. The distribution of letter grades is shown in Table 9, while the correlations between each of the continuous variables and letter grade is shown in Table 10. Note that Spearman's rank-order correlation coefficients are displayed in Table 10.

Table 9

Distribution of Participants' Letter Grades

Letter Grade	Frequency (Percent)
A	72 (59.50%)
B	37 (30.58%)
C	10 (8.26%)
D	2 (1.65%)
F	0 (0%)

Note. No student received a letter grade of *F*. 121 participants provided their letter grade.

Table 10

Spearman's Rank-Order Correlation Coefficients Between Letter Grade and Each Continuous Variable

Variable	1.
1. Letter Grade	--
2. Engagement Measure	-.06
3. Attentiveness Measure	-.09
4. Perceived Learning Measure	.12
5. Total On-Task Behaviors	.11
6. Total Lack of Off-Task Behaviors	-.05
7. GPA	.51***
9. Attendance	.15

***p < .001

Construct Validity

The assessment of the construct validity of the ICSLUM is described in the following sections.

Principal component analysis. Data was analyzed using SPSS version 23. A principal component analysis was conducted on the 37 items of the Structured Laptop Measure to assess if they formed the seven hypothesized factors. A direct oblimin rotation was utilized on the components as recommended by Costello and Osborne (2005). Direct oblimin rotations are an oblique rotation, which means that they allow components to correlate. Orthogonal rotations (such as varimax and quartimax) do not allow components to correlate. However, if the components are uncorrelated, then orthogonal and oblique rotations should yield the same results (Costello & Osborne, 2005). Thus, it was decided that a direct oblimin rotation would be used.

Before conducting the principal component analysis, the factorability of the 37 items created for the ICSLUM was assessed. Thirty-four of the 37 items correlated at least .3 with at least one other item, which suggests reasonable factorability. Furthermore, the Kaiser-Meyer-Olkin measure of sampling adequacy was 0.85, and Bartlett's test of sphericity indicated that there was a sufficient amount of correlation among the items to conduct a principal component analysis, $\chi^2(666) = 3251.62$, $p < .001$. Also, all of the diagonals of the anti-image correlation matrix were above 0.5, indicating that each item should be included in the principal component analysis. Additionally, the communality of each item was above 0.3, indicating that each item's variance can be adequately accounted for by the extracted components. Thus, a principal component analysis was conducted on all 37 items.

Table 11 shows the component loadings obtained by the principal component analysis with direct oblimin rotation. Only the components with an eigenvalue of one or greater are shown in Table 11. Table 12 shows the items grouped by component loading.

Table 11

Direct Oblimin Rotated Component Loadings of the ICSLUM

Item	C 1	C 2	C 3	C 4	C 5	C 6	C 7	C 8	C 9
On-Task 1	-.08	.04	.03	-.13	**.84**	-.01	.01	.10	.06
On-Task 2	.26	-.13	.07	.07	**.76**	.09	.01	.01	-.05
On-Task 3	.14	-.11	-.07	.13	.13	**.64**	.19	.02	-.03
On-Task 4	-.21	-.16	-.13	-.06	.28	-.12	.12	.14	**.60**
On-Task 5	.11	.08	-.00	.09	**.86**	.02	.04	-.02	.07
On-Task 6	.37	-.05	-.02	.05	**.56**	.14	-.07	-.07	.15
Lack Off-Task Behaviors 1	.04	**-.93**	.03	.02	.00	-.09	-.02	.11	-.07
Lack Off-Task Behaviors 2	.04	**-.71**	-.23	.03	-.08	.06	.11	.07	.23
Lack Off-Task Behaviors 3	-.03	**-.71**	-.15	.06	-.03	-.22	.15	.22	.09
Lack Off-Task Behaviors 4	.20	-.26	.15	.16	-.03	.02	-.19	**.61**	.08
Lack Off-Task Behaviors 5	.05	.10	-.03	.02	.11	-.17	.00	**.84**	.01
Lack Off-Task Behaviors 6	.01	**-.71**	.11	.05	.09	.08	-.11	.11	-.07
Instructor Regulation 1	.33	.17	**.43**	.21	-.09	-.21	-.11	-.38	.41
Instructor Regulation 2	.05	.09	**.76**	.13	.02	-.07	.09	.10	.01
Instructor Regulation 3	-.074	.05	**.67**	-.17	-.16	.23	.03	.33	-.06
Instructor Regulation 4	-.08	-.03	**.80**	-.15	.06	-.15	.08	-.08	-.09
Instructor Regulation 5	-.11	.12	**.67**	-.16	.11	-.05	.07	-.20	.03
Instructor Regulation 6	-.04	-.12	**.72**	-.12	-.06	.32	-.01	-.01	.07
Lack of Distraction 1	.05	-.06	.05	**-.78**	.13	-.14	.00	-.01	-.02
Lack of Distraction 2	-.01	.20	.05	**-.83**	-.03	.08	-.04	.07	.11
Lack of Distraction 3	.09	.05	.04	-.13	.08	.41	-.01	-.05	**.60**
Lack of Distraction 4	-.07	.31	.03	.11	.14	**.67**	.08	-.23	-.10
Lack of Distraction 5	.15	.01	.09	**-.80**	-.07	-.13	.06	-.13	-.02
Lack of Distraction 6	.20	.22	.12	-.09	-.00	**.51**	.02	-.14	.30
Lack of Distraction 7	.18	.05	.11	**-.52**	-.24	.44	-.07	-.01	.12
Instructor Preparation 1	**.67**	.17	.03	-.02	.02	.10	.21	.20	.10
Instructor Preparation 2	.44	.10	-.04	.02	-.05	.01	**.62**	.04	-.04
Instructor Preparation 3	**.54**	.04	-.03	.09	.03	.02	.42	.11	.16
Instructor Preparation 4	**.64**	-.02	.11	.02	-.02	.05	.27	-.03	.19
Instructor Preparation 5	.08	.01	.09	-.05	.08	-.01	**.82**	-.05	-.04
Instructor Preparation 6	-.08	-.06	.13	.01	-.04	.08	**.87**	-.07	.05
Instructor Beliefs 1	**.84**	-.01	.01	-.05	.18	.02	-.04	.08	-.08
Instructor Beliefs 2	**.86**	-.05	-.04	-.10	.10	.02	-.03	-.02	.01
Instructor Beliefs 3	**.72**	-.17	-.06	-.21	.10	.15	.03	.02	-.05
Instructor Beliefs 4	**.85**	.00	-.16	-.07	.02	-.03	.02	.01	.11
Instructor Beliefs 5	**.78**	-.08	.06	.02	.13	.01	.12	-.01	-.14
Instructor Beliefs 6	**.52**	-.03	-.14	-.30	.22	.06	.10	-.09	-.17

Note. *C* stands for *Component*

Table 12

Items Grouped by Component Loadings

Item	C 1	C 2	C 3	C 4	C 5	C 6	C 7	C 8	C 9
Instructor Beliefs 2	**.86**	-.05	-.04	-.10	.10	.02	-.03	-.02	.01
Instructor Beliefs 4	**.85**	.00	-.16	-.07	.02	-.03	.02	.01	.11
Instructor Beliefs 1	**.84**	-.01	.01	-.05	.18	.02	-.04	.08	-.08
Instructor Beliefs 5	**.78**	-.08	.06	.02	.13	.01	.12	-.01	-.14
Instructor Beliefs 3	**.72**	-.17	-.06	-.21	.10	.15	.03	.02	-.05
Instructor Preparation 1	**.67**	.17	.03	-.02	.02	.10	.21	.20	.10
Instructor Preparation 4	**.64**	-.02	.11	.02	-.02	.05	.27	-.03	.19
Instructor Preparation 3	**.54**	.04	-.03	.09	.03	.02	.42	.11	.16
Instructor Beliefs 6	**.52**	-.03	-.14	-.30	.22	.06	.10	-.09	-.17
Lack Off-Task Behaviors 1	.04	**.93**	.03	.02	.00	-.09	-.02	.11	-.07
Lack Off-Task Behaviors 2	.04	**.71**	-.23	.03	-.08	.06	.11	.07	.23
Lack Off-Task Behaviors 3	-.03	**.71**	-.15	.06	-.03	-.22	.15	.22	.09
Lack Off-Task Behaviors 6	.01	**.71**	.11	.05	.09	.08	-.11	.11	-.07
Instructor Regulation 4	-.08	-.03	**-.80**	-.15	.06	-.15	.08	-.08	-.09
Instructor Regulation 2	.05	.09	**-.76**	.13	.02	-.07	.09	.10	.01
Instructor Regulation 6	-.04	-.12	**-.72**	-.12	-.06	.32	-.01	-.01	.07
Instructor Regulation 3	-.07	.05	**-.67**	-.17	-.16	.23	.03	.33	-.06
Instructor Regulation 5	-.11	.12	**-.67**	-.16	.11	-.05	.07	-.20	.03
Instructor Regulation 1	.33	.17	**-.43**	.21	-.09	-.21	-.11	-.38	.41
Lack of Distraction 2	-.01	.20	.05	**-.83**	-.03	.08	-.04	.07	.11
Lack of Distraction 5	.15	.01	.09	**-.80**	-.07	-.13	.06	-.13	-.02
Lack of Distraction 1	.05	-.06	.05	**-.78**	.13	-.14	.00	-.01	-.02
Lack of Distraction 7	.18	.05	.11	**-.52**	-.24	.44	-.07	-.01	.12
On-Task 5	.11	.08	-.00	.09	**.86**	.02	.04	-.02	.07
On-Task 1	-.08	.04	.03	-.13	**.84**	-.01	.01	.10	.06
On-Task 2	.26	-.13	.07	.07	**.76**	.09	.01	.01	-.05
On-Task 6	.37	-.05	-.02	.05	**.56**	.14	-.07	-.07	.15
Lack of Distraction 4	-.07	.31	.03	.11	.14	**-.67**	.08	-.23	-.10
On-Task 3	.14	-.11	-.07	.13	.13	**-.64**	.19	.02	-.03
Lack of Distraction 6	.20	.22	.12	-.09	.00	**-.51**	.02	-.14	.30
Instructor Preparation 6	-.08	-.06	.13	.01	-.04	.08	**.87**	-.07	.05
Instructor Preparation 5	.08	.01	.09	-.05	.08	-.01	**.82**	-.05	-.04
Instructor Preparation 2	.44	.10	-.04	.02	-.05	.01	**.62**	.04	-.04
Lack Off-Task Behaviors 5	.05	.10	-.03	.02	.11	-.17	.00	**.84**	.01
Lack Off-Task Behaviors 4	.20	-.26	.15	.16	-.03	.02	-.19	**.61**	.08
On-Task 4	-.21	-.16	-.13	-.06	.28	-.12	.12	.14	**.60**
Lack of Distraction 3	.09	.05	.04	-.13	.08	.41	-.01	-.05	**.60**

Note. *C* stands for *Component*

As Tables 11 and 12 show, there are nine components. However, only two items load onto the eighth and ninth components, so it was decided that only the first seven would be kept. In total, these seven components account for 66.75% of the variance in the ICSLUM. Table 13 shows the eigenvalues of each of the first seven components as well as the total amount of variance accounted for by each.

Table 13

The Eigenvalues and Percent of Variance Accounted for of First Seven Components

Component	Eigenvalue	Percent Variance	Cumulative Percent Variance
1	9.62	26.00	26.00
2	5.91	15.98	41.98
3	2.42	6.53	48.51
4	2.09	5.65	54.16
5	1.78	4.80	58.96
6	1.52	4.10	63.06
7	1.37	3.69	66.75

Naming the components of the ICSLUM. The seven components of the ICSLUM are named as follows.

Component 1: Instructor Beliefs and Preparation. Component 1, which consisted of six Instructor Belief items and three Instructor Preparation items, is the only component (along with component 6) to contain items from two separate hypothesized constructs. To reflect that fact that this component consists of both Instructor Beliefs and Instructor Preparation items, this component was named Instructor Beliefs and Preparation. A higher score on this construct indicates that instructors believe more strongly in the benefits of laptop use in the classroom and were more prepared to use laptops in the classroom.

Component 2: Lack of Off-Task Behaviors. Four Lack of Off-Task Behaviors items loaded onto the third component and were the only items to do so. Thus, this component was named Lack of Off-Task Behaviors. As each Lack of Off-Task Behaviors item was reverse-coded, higher scores indicate lower amounts of off-task behaviors.

Component 3: Instructor Regulation. All six Instructor Regulation items loaded onto the third component. As such, this component was named Instructor Regulation, and a higher score indicates a higher amount of instructor regulation of student laptop use.

Component 4: Lack of Distraction from Other Students. Three Lack of Distraction from Other Students items (numbers 1, 2, and 5) loaded onto the fourth component. Each of these three items relates to distraction from other students; Lack of Distraction from Other Students items one and two relate to the participant being distracted directly by other students' laptop activities, while the fifth Lack of Distraction from Other Students item relates to perceived distraction of classmates by others' laptop activities. Thus, this component was named Lack of Distraction from Other Students. As items were coded such that higher scores indicate less distraction, a higher score on this component indicates less distraction from other students.

Component 5: On-Task Behaviors. Four On-Task items load onto the fifth component. These On-Task items relate to using the laptop for the following: taking notes, following along with the lecture, keeping up with the class notes, and gaining a better understanding of course concepts. Because of these loadings, this component was named On-Task Behaviors, and a higher score indicates a higher amount of on-task behaviors.

Component 6: Class Activity Engagement. Two Lack of Distraction items and one On-Task item load onto this component. The two Lack of Distraction items relate to staying attentive and engaged in class, while the On-Task item relates to using the laptop to complete in-class assignments. As these three items are related to staying engaged in class and completing in-class tasks, this component was named Class Activity Engagement, and a higher score indicates a higher level of engagement in class activities. Note that this component was not one of the hypothesized constructs.

Component 7: Instructor Technical Skills. Three Instructor Preparation items load onto this construct. These three items relate to the instructor's personal skills regarding laptop use. This is distinct from the first component (Instructor Beliefs and Preparation) as it relates more closely to the instructor's personal skill with using laptops and less to the instructor's skill with using laptops to teach a class. As these items seem to focus on the instructor's laptop skills, this component was named Instructor Technical Skills, and a higher score indicates a higher amount of instructor skill using the laptop. Note that this component was not one of the hypothesized constructs.

The correlations between each of these seven components is shown in Table 14.

Table 14

Correlations Between the First Seven Components

Variable	1.	2.	3.	4.	5.	6.	7.
1. Instructor B & P[a]	--	-.07	.05	.29**	.59***	.46***	.57***
2. Lack of Off-Task Behaviors		--	.38***	.27**	-.13	.32***	.06
3. Instructor Regulation			--	.38***	-.08	.26***	.20*
4. Lack of Distraction[b]				--	.06	.27***	.17
5. On-Task Behaviors					--	.31*	.31***
6. Class Activity Engagement						--	.40***
7. Instructor Technical Skills							--

[a]*Instructor B & P* represents the Instructor Beliefs and Preparation component

[b]*Lack of Distraction* represents the Lack of Distraction from Other Students component

*$p < .05$. **$p < .01$. ***$p < .001$

The means and standard deviations of each component are shown in Table 15. The score on each component is an average score of its items. The highest possible score on any component is 7, while the lowest possible score is 1.

Table 15

Means and SDs for Each of the Components of the ICSLUM

Component	Mean (*SD*)
Instructor Regulation and Preparation	5.08 (*1.23*)
Lack of Off-Task Behaviors	4.99 (*1.55*)
Instructor Regulation	4.92 (*1.19*)
Lack of Distraction from Other students	4.50 (*1.40*)
On-Task Behaviors	4.55 (*1.50*)
Class Activity Engagement	5.89 (*1.11*)
Instructor Technical Skills	5.64 (0.*96*)

A visual representation of which items loaded onto which components is shown in Table 16. This table shows the item number, item text, and loading for the component that it primarily loaded onto.

Table 16

Visual Representation of Each Items' Primary Component Loadings[a]

Item Number[b]	Item Text	IBP	LOTB	IR	LDFOS	OTB	CAE	ITS
IB1	My instructor believes that the use of laptops in the classroom increases the level of student interaction and/or collaboration	.84						
IB2	My instructor believes that the use of laptops in the classroom positively impacts student learning and achievement.	.86						
IB3	My instructor believes that the use of laptops in the classroom improves the quality of student work.	.72						
IB4	My instructor believes that using laptops in the classroom has a positive impact on classroom learning.	.85						

(continued)

Item Number[b]	Item Text	IBP	LOTB	IR	LDFOS	OTB	CAE	ITS
IB5	My instructor believes that using laptops in the classroom makes lessons more interactive.	.78						
IB6	My instructor believes that using laptops in the classroom makes it difficult for students to learn.	.52						
IP1	My instructor knows how to meaningfully integrate laptops into lessons.	.67						
IP3	My instructor seems to have received adequate training to incorporate laptops into [name of class].	.54						
IP4	My instructor is able to align the use of the laptop with the curriculum of [name of class].	.64						
LOTB1	I used my laptop in class to send emails for purposes not related to [name of class].		.93					

(continued)

Item Number[b]	Item Text	IBP	LOTB	IR	LDFOS	OTB	CAE	ITS
LOTB2	I used my laptop in class to send instant messages (msn, facebook chat, etc) for purposes not related to [name of class].		.71					
LOTB3	I used my laptop in class to browse the internet for purposes not related to [name of class].		.71					
LOTB6	I used my laptop in class to do homework for other classes.		.71					
IR1	My instructor clearly discussed his/her policy regarding laptop use.			.43				
IR2	My instructor reminded students about his/her policy regarding in-class laptop use.			.76				
IR3	My instructor ignored students' in-class laptop use.			.67				
IR4	My instructor allowed students to do what they wanted on their laptops in class.			.80				

(continued)

Item Number[b]	Item Text	IBP	LOTB	IR	LDFOS	OTB	CAE	ITS
IR5	My instructor allowed students to use laptops for purposes unrelated to class.			.67				
IR6	If students were not using their laptops for activities related to class, my instructor would ask them to stop.			.72				
LDFOS1	I was often distracted by my classmates' laptop activities.				.78			
LDFOS2	I frequently noticed that other students were using their laptops for activities not related to [name of class].				.83			
LDFOS5	My classmates were easily distracted by others' laptop activities.				.86			
LDFOS7	My classmates seemed to have difficulty staying engaged in class.				.52			

(continued)

Item Number[b]	Item Text	IBP	LOTB	IR	LDFOS	OTB	CAE	ITS
OTB1	I used my laptop in class to take notes during lecture.					.84		
OTB2	I used my laptop in class to follow along during lecture.					.76		
OTB5	I used my laptop in class to keep up with the instructor's notes.					.86		
OTB6	I used my laptop in class to better understand course concepts.					.56		
OTB3	I used my laptop to complete in-class assignments or activities.						.64	
LDFOS4	I was attentive during class.						.67	
LDFOS6	I had difficulty staying engaged in class.						.51	

(continued)

Item Number[b]	Item Text	IBP	LOTB	IR	LDFOS	OTB	CAE	ITS
IP2	My instructor seems to have adequate computer skills to conduct classes that have students using their laptops.							.62
IP5	My instructor seems to have little experience using laptops.							.82
IP6	My instructor has trouble performing basic laptop functions.							.87

[a]Primary component loadings are abbreviations of discovered components; IBP = Instructor Beliefs and Preparation, LOTB = Lack of Off-Task Behaviors, IR = Instructor Regulation, LDFOS = Lack of Distraction from Other Students, OTB = On-Task Behaviors, CAE = Class Activity Engagement, ITS = Instructor Technical Skills

[b]Item Number refers to the original number assigned to each item as described in the *Creation of the In-Class Structured Laptop Use Measure* section; IB = Instructor Beliefs, IP=Instructor Preparation, LOTB = Lack of Off-Task Behaviors, IR = Instructor Regulation, LDFOS = Lack of Distraction from Other Students, OTB = On-Task Behaviors

Descriptive Statistics of the ICSLUM

An average score for the ICSLUM was calculated using the mean of the 33 items that were retained by the principal component analysis. The mean and standard deviation of this ICSLUM score is shown in Table 17, with higher scores indicating a higher degree of laptop structure in the classroom. The highest score possible on the ICSLUM is 7, while the lowest possible score is 1. The correlations between the continuous variables and the ICSLUM are shown in Table 18.

Table 17

Mean and SD of the ICSLUM

Variable	Grand Mean (*SD*)	Range of Possible Scores (Lowest to Highest)	N
ICSLUM	4.78 (0.*73*)	1-7	129

Table 18

Pearson Product-Moment Correlations Between the Continuous Measures used for Validation and the ICSLUM Score

Variable	1.
1. ICSLUM	--
2. Engagement Measure	.47***
3. Attentiveness Measure	.47***
4. Perceived Learning Measure	.37***
5. Total On-Task Behaviors	.52***
6. Total Off-Task Behaviors	.28**
7. GPA	-.00
8. Attendance	.15

*$p < .05$. **$p < .01$. ***$p < .001$

The final measure used for validation purposes was participants' letter grade in their chosen class. The Spearman rank-order correlation between letter grade and the ICSLUM score is shown in Table 19.

Table 19

Spearman Rank-Order Correlation Between Letter Grade and the ICSLUM Score

Variable	1.
1. Letter Grade	--
2. ICSLUM	.11

***$p < .001$

Construct Validity

The construct validity of the ICSLUM was assessed with the following analyses.

Regression 1: Using on- and off-task behaviors to predict ICSLUM. To assess the relationship between the ICSLUM and Kay and Lauricella's (2010) measures of on-task and off-task behaviors, a regression was conducted with the ICSLUM score as an outcome variable and Kay and Lauricella's (2010) measures of on-task and off-task behaviors as predictors. The Pearson product-moment correlations between these three variables are shown in Table 8 and Table 18.

Due to the similarity between the Lack of Off-Task Behaviors and On-Task Behaviors components of the ICSLUM and Kay and Lauricella's (2010) measures of on-task and off-task behaviors, a principal component analysis was conducted to determine if these components were measuring the same construct. All items that made up the Lack of Off-Task Behaviors (Off-Task items 1, 2, 3, and 6) and On-Task Behaviors (On-Task items 1, 2, 5, and 6) were added into the principal component analysis, as did all items that made up Kay and Lauricella's measures of Total On-Task Behaviors (Total On-Task Behaviors items 1 and 2) and Total Lack of Off-Task Behaviors (Total Off-Task Behaviors items 1, 2, 3, and 4). A direct oblimin rotation was used as the rotation method as recommended by Costello and Osborne, 2005.

The Kaiser-Meyer-Olkin measure of sampling adequacy was 0.80, and Bartlett's test of sphericity indicated that there was a sufficient amount of correlation among the items to conduct a principal component analysis, $\chi^2(91) = 1103.15$, $p < .001$. The diagonals of the anti-image correlation matrix were each above 0.5, and the communality of each item was above 0.3, indicating that each item's variance can be adequately accounted for by the extracted components.

The principal component analysis indicated that the items making up On-Task Behaviors component were measuring the same construct as Kay and Lauricella's (2010) measure of Total On-Task Behaviors (see Table 20). Furthermore, the items making up the Lack of Off-Task Behaviors and Kay and Lauricellas's (2010) all loaded onto the same component with the exception of the third and fourth item of the Total Lack of Off-Task Behaviors measure (see Table 20).

Table 20

Component Loadings of ICSLUM Lack of Off-Task Behaviors Items, ICSLUM On-Task Behaviors Items, Kay & Lauricella's (2010) Total Lack of Off-Task Behaviors Items, and Kay & Lauricella's (2010) Total On-Task Behaviors Items

Variable	C1	C2	C3
On-Task 1	**.79**	-.08	.07
On-Task 2	**.88**	-.22	.01
On-Task 5	**.89**	-.05	-.06
On-Task 6	**.76**	-.14	-.05
Off-Task 1	-.06	**.86**	-.03
Off-Task 2	-.13	**.80**	-.33
Off-Task 3	-.05	**.84**	-.31
Off-Task 6	-.14	**.77**	-.09
Total On-Task 1	**.85**	.05	-.18
Total On-Task 2	**.72**	.14	-.02
Total Lack of Off-Task 1	-.19	**.69**	-.29
Total Lack of Off-Task 2	-.10	**.71**	-.60
Total Lack of Off-Task 3	-.10	.26	**-.91**
Total Lack of Off-Task 4	-.05	.24	**-.86**

Note. *C* stands for *Component*

This was determined to be sufficient evidence that the On-Task Behaviors component is measuring the same construct as Kay and Lauricella's (2010) Total On-Task Behaviors measure. Even though the third and fourth items of Kay and Lauricella's (2010) Total Off-Task Behaviors loaded onto their own component, the first two items of this measure loaded onto the same component as the Off-Task items from the ICSLUM. Thus, it was determined that the Lack of Off-Task Behaviors component is measuring the same construct as Kay and Lauricella's (2010) Total Off-Task Behaviors measure.

The ICSLUM score was re-calculated with these components removed and is referred to as the Adjusted ICSLUM score. The linear combination of Total On-Task Behaviors score and Total Off-Task Behaviors score was a significant predictor of the Adjusted ICSLUM score, $F(2,130) = 22.69$, $p < .001$, adjusted $R^2 = .25$. The Total On-Task Behaviors score was significantly positively related to the Adjusted ICSLUM score, $\beta = 0.48$, $p < .001$, while the Total Off-Task Behaviors score was significantly negatively related to the Adjusted ICSLUM score, $\beta = -0.30$, $p < .001$. The results of this regression are shown in Table 21.

Table 21

Regression on the Adjusted ICSLUM Score[a] *with Kay & Lauricella's (2010) Measures of Total On-Task and Off-Task Behaviors as the Predictors*

	b	SE	β	*t*
Constant	4.76	0.23		
Total On-Task Behaviors	0.31	0.05	0.48	6.20***
Total Off-Task Behaviors	0.49	0.13	0.30	3.87***

Note. Model $F(2,130) = 22.69$, $p < .001$, adjusted $R^2 = .25$

[a] The Adjusted ICSLUM score is calculated without the Lack of Off-Task Behaviors and On-Task Behaviors components

*** *p < .001*

Criterion Validity

The criterion validity of the ICSLUM was assessed with the following analyses.

Regression 2: Using the Engagement Measure, Attentiveness Measure, and Perceived Learning Measure scores to predict ICSLUM. To assess criterion validity, a linear regression was conducted. The ICSLUM score was used as the outcome variable, with Zhu et al.'s (2012) Engagement Measure, Attentiveness Measure, and Perceived Learning Measure scores as predictors. The Pearson product-moment correlations between Zhu et al.'s (2012) Engagement Measure, Attentiveness Measure, and Perceived Learning Measure scores is shown in Table 8, and the Pearson product moment correlations between each of these scores and the ICSLUM score is shown in Table 17.

Given the high correlations between the Engagement Measure, Attentiveness Measure, and Perceived Learning Measure scores (see Table 8), a principal component analysis was conducted to assess the extent to which these three variables measured the same construct. The Kaiser-Meyer-Olkin measure of sampling adequacy was 0.71, and Bartlett's test of sphericity indicated that there was a sufficient amount of correlation among the items to conduct a principal component analysis, $\chi^2(3) = 183.68$, $p < .001$. The diagonals of the anti-image correlation matrix were each above 0.5, and the communality of each item was above 0.3, indicating that each item's variance can be adequately accounted for by the extracted components.

The principal component analysis indicated that the Engagement Measure, Attentiveness Measure, and Perceived Learning Measure scores loaded onto one component (see Table 22). Because only one component was extracted, no rotation was used. Thus, it was determined that each of these measures are measuring similar constructs, indicating that they can be combined into one total score.

Table 22

Component Loadings of Engagement Measure, Attentiveness Measure, and Perceived Learning Measure Scores

Variable	C1
Engagement Measure	.92
Attentiveness Measure	.89
Perceived Learning Measure	.84

Note. *C* stands for *Component*

A subsequent principal component analysis was conducted to assess if Zhu et al.'s (2012) measures of engagement and attentiveness were measuring the same construct as the Class Activity Engagement component. This was decided as the items included in this component are similar to the items included in Zhu et al.'s (2012) measures of engagement and attentiveness. Furthermore, both sets of measures claim to measure similar constructs and, if this is so, then the Class Activity Engagement component should be removed from the ICSLUM score when comparing it to Zhu et al.'s (2012) measures of engagement and attentiveness.

The three items making up the Class Activity Engagement component (On-Task item 3, Distraction item 4, and Distraction item 6) and Zhu et al.'s (2012) two items measuring engagement and attentiveness (the Engagement Measure and the Attentiveness Measure) were entered into a principal component analysis with direct oblimin rotation. Note that Zhu et al.'s (2012) Perceived Learning Measure was not entered into this analysis as none of the items making up the Class Activity Engagement component were intended to measure perceived learning.

The Kaiser-Meyer-Olkin measure of sampling adequacy was 0.61, and Bartlett's test of sphericity indicated that there was a sufficient amount of correlation among the items to conduct a principal component analysis, $\chi^2(10) = 172.53$, $p < .001$. The diagonals of the anti-image correlation matrix were each above 0.5, and the communality of each item was above 0.3, indicating that each item's variance can be adequately accounted for by the extracted components. The results of this principal component analysis are shown in Table 23.

Table 23

Component Loadings of ICSLUM Class Activity Engagement and Zhu et al.'s (2012) Engagement Measure and Attentiveness Measure

Variable	C1	C2
On-Task 3	.41	**.58**
Distraction 4	.22	**.84**
Distraction 6	.12	**.85**
Engagement Measure	**.93**	.21
Attentiveness Measure	**.92**	.30

Note. *C* stands for *Component*

As Table 23 shows, the items that make up the Class Activity Engagement of the ICSLUM load onto a different component that Zhu et al.'s (2012) items that measure engagement and attentiveness. Thus, it was decided that the items making up the ICSLUM's Class Activity Engagement component should not be removed from the ICSLUM when validating it against Zhu et al.'s (2012) Engagement Measure and Attentiveness Measure.

Following the previous analysis, participants' Engagement Measure, Attentiveness Measure, and Perceived Learning Measure scores were summed together to create a single representation of these three measures. This total score was entered into the regression, with participants' ICSLUM score as the outcome. Results are shown in Table 24.

Table 24

Regression on the ICSLUM Score with the Sum of Zhu et al.'s (2012) Measures of Attentiveness and Engagement

	b	SE	β	*t*
Constant	3.58	0.23		
Engagement + Attentiveness + Perceived Learning	0.14	0.02	0.50	6.43***

Note. Model $F(1,127) = 41.40$, $p < .001$, $R^2 = .25$

*** $p < .001$

As Table 24 shows, the regression model including participants' sum of Engagement Measure, Attentiveness Measure, and Perceived Learning Measure scores significantly predicts participants' ICSLUM score, $F(3,125) = 41.40$, $p < .001$, adjusted $R^2 = .25$. Additionally, the relationship was in the direction predicted: the sum of participants' Engagement Measure, Attentiveness Measure, and Perceived Learning Measure scores were positively associated with their ICSLUM scores.

Regression 3: Using ICSLUM to predict Perceived Learning Measure scores. A regression was conducted to assess the relationship between participants' ICSLUM scores and their Perceived Learning Measure scores. Participants' GPA, attendance, engagement, and attentiveness were controlled for in this analysis, with participants' ICSLUM scores entered as a predictor and their Perceived Learning Measure scores entered as the outcome variable.

Because of the strong correlation between participants' Attentiveness Measure and Engagement Measure scores (see Table 8) and a principal component analysis indicated that these two items are measuring the same construct (see Table 23), these two scores were summed to create a single representation of these two variables. As Table 25 shows, the ICSLUM score is not predictive of participants' Perceived Learning Measure score while controlling for GPA, attendance, Engagement Measurement score, Attentiveness Measurement score, $\beta = 0.10$, $t = 1.24$, $p = .203$.

Table 25

Regression Assessing Relationship Between ICSLUM Score and Perceived Learning Measure Score While Controlling for GPA, Attendance, Engagement, and Attentiveness

	b	SE	β	*t*
Constant	0.74	1.01		
GPA	0.17	0.15	0.08	1.08
Attendance	0.01	0.18	0.00	0.04
Engagement + Attentiveness	0.30	0.04	0.60	7.05***
ICSLUM	0.10	0.10	0.08	0.93

Note. Model $F(4,114) = 14.90$, $p < .001$, adjusted $R^2 = .38$

*** *p < .001*

The degree of student engagement and attentiveness as measured by Zhu et al. (2012) was examined as a moderator of the relationship between degree of laptop structure and perceived learning. Attendance, GPA, ICSLUM score, and the combined Engagement Measure and Attentiveness Measure scores and age were entered into the first step of the regression, while the interaction between the ICSLUM score and the combined Engagement Measure and Attentiveness Measure scores was entered in the second step. In the second step, there was not a significant interaction between the ICSLUM score and the combined Engagement Measure and Attentiveness Measure scores, $\Delta F(5, 115) = 3.25$, $p = .201$, $\Delta R^2 = .03$ (see Table 26).

Table 26

Moderation Analysis Predicting Perceived Learning Measure Score with the Interaction Between ICSLUM Score and Engagmenet and Attentiveness While Controlling for GPA, Attendance, Engagement, and Attentiveness

	b	SE	β	*t*
Constant	3.31	0.92		
GPA	0.18	0.15	0.09	1.18
Attendance	-0.01	0.18	-0.00	-0.06
Engagement + Attentiveness	0.29	0.04	0.57	6.58***
ICSLUM	0.14	0.11	0.11	1.23
ICSLUM × (Engage + Attentive)	-0.04	0.04	-0.09	-1.12

Note. Model $F(5,115) = 18.15$, $p < .001$, adjusted $R^2 = .42$

*** $p < .001$

Regression 4: Using ICSLUM to predict letter grade while treating letter grade as an interval variable. To further assess the criterion validity of the Structured Laptop Measure, an ordinary least squares regression was conducted to assess if the ICSLUM was a significant predictor of students' letter grades. For this analysis, letter grade was treated as an interval variable to allow for a more direct analysis of the relationship between the ICSLUM and course grades. Letter grades were numerically coded as they would be to create a GPA (0 = F, 1 = D, 2 = C, 3 = B, 4 = A).

Furthermore, the sample that a student was included in was controlled for as well due to the fact that the item asking students about their letter grade changed. In the first sample, students were asked to predict the letter grade they would receive in their selected class. However, because the second sample was sent out after the end of the spring 2016 semester, students were asked to provide the letter grade they received in their selected class. Thus, because the wording of the item changed, it was included in the regression as a predictor. Table 27 shows the number of participants in each sample.

Table 27

Number of Students in Each Sample

Sample Time	Frequency (Percent)
First (predict letter grade in Spring 2016; Spring 2016)	73 (54.89%)
Second (disclose letter grade received in Spring 2016; Summer 2016)	60 (45.11%)

A regression was conducted to assess the relationship between a student's ICSLUM score and letter grade while controlling for GPA, attendance, and sample. Additionally, participants' Engagement Measure score and participants' Attentiveness Measure score were included as covariates. The correlations between each of these variables is shown in Table 8, Table 18 and Table 19.

Due to the strong correlation between participants' Engagement Measure and Attentiveness Measure scores and because a principal component analysis indicated that these two scores are measuring the same construct (see Table 23), these two scores were summed to create a single representation of these two measures. Results indicate that the ICSLUM score is not a significant predictor of letter grade while controlling for GPA, attendance, sample, engagement, and attentiveness, $\beta = 0.17$, $p = .063$. However, the overall model is a significant predictor of participants' letter grades, $F(5, 114) = 10.22$, $p < .001$, adjusted $R^2 = .28$. The results can be seen in Table 28.

Table 28

Regression Predicting Letter Grade with ICSLUM Score While Controlling for Sample Time, Attendance, GPA, Engagement, and Attentiveness

	b	SE	β	*t*
Constant	-0.45	0.82		
Sample (First)	-0.26	0.11	-0.18	-2.26*
Sample (Second)	--	--	--	--
GPA	0.65	0.12	0.43	5.27***
Attendance	0.20	0.15	0.11	1.40
Engagement + Attentiveness	-0.06	0.03	-0.17	-1.83
ICSLUM	0.16	0.08	0.17	1.88

Note. Model $F(5, 114) = 10.22$, $p < .001$, adjusted $R^2 = .28$

$^{*}p < .05$, $^{***}p < .001$

The degree of student engagement and attentiveness as measured by Zhu et al. (2012) was examined as a moderator of the relationship between degree of laptop structure and letter grade. The sample, attendance, GPA, ICSLUM score, and the combined Engagement and Attentiveness scores and age were entered into the first step of the regression, while the interaction between the ICSLUM score and the combined Engagement and Attentiveness scores was entered in the second step. In the second step, there was a significant interaction between the ICSLUM score and the combined Engagement Measure and Attentiveness Measure scores, $\Delta F(1, 113) = 4.22$, $p = 0.042$, $\Delta R^2 = .02$ (see Table 29). At low levels of engagement and attentiveness, degree of in-class laptop structure was not associated with letter grade, $\beta = -0.02$, $p = 0.857$. At high levels of engagement and attentiveness, degree of in-class laptop structure was positively associated with letter grade, $\beta = 0.24$, $p = 0.013$. Every one-unit increase in a student's

ICSLUM score was associated with a 0.22-unit increase in letter grade. In other words, a one-unit increase in a student's ICSLUM score is associated with almost a quarter increase (2.2 percentage points) in a student's course grade.

Table 29

Regression Predicting Letter Grade with the Interaction Between ICSLUM Score and Engagement Measure and Attentiveness Measure Scores While Controlling for Sample Time, Attendance, and GPA

	b	SE	β	*t*
Constant	0.08	0.73		
Sample (First)	-0.26	0.11	-0.18	-2.34*
Sample (Second)	--	--	--	--
GPA	0.63	0.12	0.41	5.12***
Attendance	0.23	0.15	0.13	1.59
Engagement + Attentiveness	-0.05	0.03	-0.12	-1.30
ICSLUM	0.10	0.09	0.11	1.17
ICSLUM × (Engage + Attentive)	0.06	0.03	0.17	2.05*

Note. Model $F(6, 113) = 9.46$, $p < .001$, adjusted $R^2 = .30$

*$p < .05$, ***$p < .001$

Reliability

Cronbach's alpha was calculated for each of the seven components. Reliability was high for most of the components, though this was not the case with the Class Activity Engagement component. Reliability estimates ranged from .64 to .94; these values are shown in Table 30.

Table 30

Reliability Estimates for Each of the Components of the ICSLUM

Component	Cronbach's Alpha
Instructor Regulation and Preparation	.94
Lack of Off-Task Behaviors	.86
Instructor Regulation	.82
Lack of Distraction from Other students	.83
On-Task Behaviors	.87
Class Activity Engagement	.64
Instructor Technical Skills	.82

An additional reliability analysis was run on each of the components regarding whether or not the reliability of a component would increase if any of the items making it up were removed. It was found that the reliability of one of the components would benefit from removing an item. The reliability of the instructor regulation component would increase from .82 to .83 if the first instructor regulation item ("My instructor clearly discussed his/her policy regarding laptop use") were removed. However, this increase is small, so this item was not removed.

Finally, Cronbach's alpha was calculated for the entire ICSLUM. This reliability estimate was equal to .90, indicating high reliability for the entire measure. Furthermore, the Cronbach's alpha was evaluated with the removal of each item from the ICSLUM. No item could be removed to increase the ICSLUM's total reliability above .90, indicating that the ICSLUM is a reliable measure.

Chapter IV: Discussion

A summary of the findings is presented an expanded upon in the following sections. In addition to summarizing the findings, the following sections discuss future uses of the ICSLUM, both as a research tool and as an educational assessment tool. Limitations and implications of the current study are explored. Finally, possibilities for future research are discussed.

Summary of Findings

The following sections summarize the findings of the study. The components, validity, and reliability of the ICSLUM are reviewed. Additionally, findings are compared with the original hypotheses.

Summary of the principal components analysis. The ICSLUM is an instrument that is intended to measure the degree of structure of laptop use in the classroom. A principal component analysis revealed seven different constructs: Instructor Beliefs and Preparation, Lack of Off-Task behaviors, Instructor Regulation, Lack of Distraction from Other Students, On-Task Behaviors, Class Activity Engagement, and Instructor Technical Skills. While these components are similar to those hypothesized, there are differences between the hypothesized and discovered constructs. More specifically, the Instructor Beliefs and Instructor Preparation constructs loaded onto one component instead of two, and two new components, Class Activity Engagement and Instructor Technical Skills, emerged. While not hypothesized, these two new components are not surprising. As Zhu et al. (2012) found that students in structured laptop classrooms are more engaged in class than students in unstructured laptop classrooms, it makes sense that items relating to engagement in classroom activities would load onto their own component. It is also not surprising that a component relating to instructors' technical skills emerged, as instructors who are familiar with laptops might be more able to lead a structured laptop classroom than instructors who are unfamiliar with laptops.

The reliability of the ICSLUM. While the items did not load onto the components exactly as hypothesized, reliability of each component was still high. With the exception of the Class Activity Engagement component, each component had a Cronbach's alpha of .82 or higher, with the instructor beliefs and preparation component having a Cronbach's alpha of .95. Overall, the ICSLUM has a Cronbach's alpha of .90, and is deemed to be a reliable measure.

The validity of the ICSLUM. The measure is also deemed to be moderately valid. While the ICSLUM is not significantly associated with students' letter grades by itself, it is positively related to students' course grades if students are engaged and attentive in class. This suggests that no degree of laptop structure will benefit the grades of students who are not engaged and not attentive in class, though students who are not engaged in class might not experience much benefit from any class activities in general. Thus, it might be that students must first be engaged in class before they are able to receive benefits from that class. Notably, the ICSLUM is only weakly associated with students' letter grades, accounting for two percent of the variance in students' letter grades when interacting with students' engagement and attentiveness. While the relationship between the ICSLUM and students' letter grades was in the predicted direction, there are many other variables that influence students' grades in addition to, and greater than, the ICSLUM. Thus, it is important for instructors to keep students engaged with course material, as structured in-class laptop use is not enough by itself to benefit student grades.

Additionally, the ICSLUM is significantly positively associated with Kay and Lauricella's (2010) measure of On-Task Behaviors and Off-Task Behaviors, as predicted, showing that higher scores on the ICSLUM are associated with more frequent on-task behaviors and less frequent off-task behaviors than lower scores. Furthermore, the ICSLUM is positively associated with Zhu et al.'s (2012) measures of perceived learning, attentiveness, and engagement, also as hypothesized. However, the relationship between the participants' ICSLUM scores and participants' Perceived Learning scores becomes statistically insignificant when controlling for GPA, attendance, participants' Engagement Measure score, and participants' Attentiveness Measure score. This is true regardless of students' levels of engagement and attentiveness. As such, the ICSLUM cannot be said to uniquely predict students' perceived learning, despite being hypothesized to do so.

Comparison between hypothesized constructs and discovered constructs. This study indicates that there are seven constructs to in-class structured laptop use. As discussed, these constructs are: Instructor Beliefs and Preparation, Lack of Off-Task Behaviors, Instructor Regulation, Lack of Distraction from Other Students, On-Task Behaviors, Class Activity Engagement, and Instructor Technical Skills. This indicates that structured in-class laptop use encompasses a wide range of variables, including the instructor's behavior, what types of activities are included in classroom instruction, and students' behaviors.

While it was hypothesized that structured laptop use would include classroom activities, instructors' behaviors, and students' behaviors variables, there were some differences between the hypothesized components and the discovered components. In general, the discovered components were similar to the hypothesized components. For example, the On-Task Behaviors, Lack of Off-Task Behaviors, Instructor Regulation, Lack of Distraction from Other Students, and Instructor Preparation components were all supported by the principal component analysis. However, not all items loaded onto components as expected, and the Instructor Beliefs and Instructor Preparation components were shown to be one component. As previously mentioned, two components that were not hypothesized were discovered: Class Activity Engagement and Instructor Technical Skills. These two components refer to students' engagement with classroom activities and instructors' personal skills with using laptops, respectively. While not hypothesized, these two components are significantly correlated with many of the other components in the ICSLUM (see Table 14) and are thus deemed to be valid components of structured laptop use.

Comparison between hypotheses and findings. A summary of all hypotheses can be found in Table 31. This table shows the hypotheses, whether or not they were supported, and additional details regarding the hypotheses.

Table 31

Summary of Hypotheses and Findings

Hypothesis	Supported?	Details
1. There will be six components relating to in-class structured laptop use: On-Task Behaviors, Lack of Off-Task Behaviors, Instructor Regulation, Lack of Distraction from Other Students, Instructor Preparation, and Instructor Beliefs	1. Partially	1. Seven components were found: Instructor Beliefs and Preparation, Lack of Off-Task Behaviors, Instructor Regulation, Lack of Distraction from Other Students, On-Task Behaviors, Class Activity Engagement, and Instructor Technical Skills
2. On-task behaviors and off-task behaviors as measured by Kay & Lauricella (2010) will be able to predict the ICSLUM score	2. Supported	2. The ICSLUM was found to be positively related to Kay & Lauricella's (2010) measure of on-task behaviors and off-task behaviors

3. Engagement, attentiveness, and perceived learning (as measured by Zhu et al., 2012) will be able to predict the ICSLUM score	3. Supported	3. The ICLSUM was found to be positively related to Zhu et al.'s (2012) measures of engagement, attentiveness, and perceived learning
4. The ICSLUM will be able to predict perceived learning	4. Not supported	4. The ICSLUM was not able to predict perceived learning while controlling for engagement, attentiveness, and GPA

5. There will be an interaction between engagement + attentiveness (as measured by Zhu et al., 2012) and the ICSLUM such that the ICSLUM will be positively related to perceived learning (as measured by Zhu et al., 2012) at high levels of engagement + attentiveness	5. Not supported	5. The ICLSUM was not able to predict perceived learning (as measured by Zhu et al., 2012) while interacting with engagement + attentiveness (as measured by Zhu et al., 2012) and controlling for GPA and attendance
6. The ICSLUM will be able to predict letter grade	6. Not supported	6. The ICSLUM was not able to predict letter grade while controlling for sample, GPA, attendance, and engagement + attentiveness (as measured by Zhu et al., 2012)

7. There will be an interaction between engagement + attentiveness (as measured by Zhu et al., 2012) and the ICSLUM such that the ICSLUM will be positively related to letter grade at high levels of engagement + attentiveness	7. Supported	7. There was an interaction between engagement + attentiveness (as measured by Zhu et al., 2012) such that the ICLSUM was positively related to letter grade at high levels of engagement + attentiveness while controlling for sample, GPA, and attendance; there was no relationship between ICSLUM and letter grade at low levels of engagement + attentiveness
8. The components of the ICSLUM will be highly reliable	8. Partially supported	8. Six of the seven components of the ICSLUM had reliability estimates higher than .80; the class activity engagement component had a relatively low reliability (.64)

Using the ICSLUM in Research

As a result of this study, it is now possible for a numerical score to be assigned to academic courses to describe the degree of structured laptop use within that course. To date, researchers have only determined structured laptop classes categorically (e.g., Kay & Lauricella, 2011; Kolar et al, 2002; Trimmel & Bachmann, 2004; Zhu et al., 2012), and these determinations have been made based on the researcher's knowledge of the class, not on a standardized measure. This lack of a standardized measure creates difficulty in comparing results across studies, as different authors use different definitions of structured laptop use. Not only will the ICSLUM allow for more standard determinations of students' perceptions of a classroom's laptop structure than was previously allowed, it will also improve research on this topic as it will allow researchers to examine the relationship between varying degrees of structure and any outcome variables of interest. For example, it will now be easier to examine the covariation between degree of structured laptop use and course grade.

Using the ICSLUM as an Educational Assessment Tool

Furthermore, the ICSLUM can be used as an assessment of educators' classrooms. Given the literature supporting the importance of structured laptop activities, educators' will want to ensure that their classrooms have a high degree of structure. These educators will be able to use this measure to assess the degree of laptop structure within their own classrooms, as a higher average score on the ICSLUM indicates a higher degree of laptop structure. Furthermore, the ICSLUM can be used to assess instructor and student behavior in the classroom. As four of the components relate to student behavior and activities (the On-Task Behaviors, Lack of Off-Task Behaviors, Lack of Distraction from Other Students, and Class Activity Engagement components), student activities in the classroom can be assessed using this measure. Additionally, three of the components (the Instructor Beliefs and Preparation, Instructor Regulation, and Instructor Technical Skills components) assess the instructor's behavior and activities. Thus, educators can use the ICSLUM as a type of instructor assessment to identify how they could increase the level of structure in their laptop classrooms.

Finally, the ICSLUM can be used in addition to student evaluations of teaching to assess instructor performance. As already mentioned, three of the components of the ICSLUM (Instructor Beliefs and Preparation, Instructor Regulation, and Instructor Technical Skills) directly assess instructors, and the overall score of the ICSLUM assesses the degree to which instructors lead structured laptop classrooms. Research on student evaluations of teaching shows that student evaluations can be subject to gender bias (MacNell, Driscoll, & Hunt, 2014). Furthermore, student evaluations of instructors are influenced by how attractive students believe the instructor is, the instructor's age, the length of the class, and the grades received by students (Mason & Johnson, 2013). As such, it is problematic for school administrators to use these student evaluations to assess instructor quality. However, as the ICSLUM is an assessment of the classroom and not the instructor, it is possible that it can be used as an assessment of instructor quality without being affected by students' biases against the instructor. Research will need to be conducted to verify this, however.

Limitations

Many of the limitations of this study relate to its sample. The first of these limitations is that the sample size was small at only 133 participants. For the principal component analysis, at least 370 participants were needed to have at least ten participants per item. However, there was an adequate sample size to have at least ten participants per predictor in the regression analyses. A further limitation relating to the sample is that it was taken entirely from the student population at the University of Wisconsin—Stout (students were not eligible if all of their classes in the spring 2016 semester were online). This is a university in the Midwest, so it is unknown if these results would generalize to other universities across the country. Additionally, undergraduate students at the University of Wisconsin—Stout are required to rent a laptop. However, this is not a requirement at every university, and it is unknown how the results of this study would change if it were conducted at a university where students did not have the same level of access to laptops in the classroom.

Another limitation is that all items in this study were self-reported. Thus, it is unknown how honest participants were about personal laptop use in the classroom, levels of engagement, and course grade. While more objective measures (such as academic records) exist, they were not available for this study. Thus, validating the ICSLUM against objective measures is an important area for future research.

A further limitation of this study is the distribution of letter grades reported by the participants, as the distribution of letter grades did not cover the entire range of possible values. Most of the participants indicated that they had received or would receive a letter grade of *A* in their chosen class, with only three participants indicating that this grade was or would be a *D*. No students indicated that they would receive or had received a letter grade of *F*. In the future researchers should obtain participants with a larger range of letter grades to fully understand the relationship between ICSLUM scores and student grades.

Another similar limitation is that students only were asked to provide the letter grade they received or thought they would receive instead of providing the specific percentage of points earned in the course. Because of this, some of the variance in students' grades is lost, making it more difficult to identify a relationship between the ICSLUM and students' grades than if students' had provided a percentage of points earned in the course.

Finally, some of the measures used for validation purposes were not thoroughly validated themselves. In particular, Zhu et al.'s (2012) measures of engagement, attentiveness, and perceived learning were not validated against other measures of engagement, attentiveness, or perceived learning and might not be valid measurements. This is further evidenced by the fact that a principal component analysis indicated that these three measures were measuring the same construct (see Table 22).

Implications

An implication of this study is that the degree of structure in a laptop classroom may be beneficial for students' grades, but only if students are engaged and attentive in the classroom. There is preliminary evidence that it is not enough for instructors to include structured laptop activities in their teaching; instructors must ensure that students are engaged and attentive in class for laptop activities to have any benefit on student learning. Thus, instructors must be able to not only incorporate structured laptop activities into their classrooms but also determine how to best engage students with classroom material.

Another implication of this study is that the degree of structure in a laptop class is determined by several components, as already mentioned. This indicates that educators should address each of these components in their teaching, and adjust their teaching strategies to do so. For example, educators should ensure that they are familiar enough with using laptops in the classroom to confidently include them in their lectures. Additionally, educators should make a conscious effort to regulate their students' laptop use by setting policies regarding laptop use and enforcing them. Educators should also include laptop activities that require active participation from students (such as using course-specific software) rather than relying solely on PowerPoint presentations. Finally, educators should look at what their students are doing in class in terms of on-task behaviors, off-task behaviors, distractions from other students, and engagement in class activities. By doing this, instructors will be able to increase the level of structure in their laptop classrooms.

Future Research

In addition to addressing the aforementioned limitations, future research should further develop the ICSLUM. While the ICSLUM has strong evidence for its reliability and moderate evidence for its validity, both could be improved. For example, the reliability of the sixth component (class activity engagement) is low, indicating that items relating to this component should be refined. Furthermore, objective measures of learning, instructor behavior, and student behavior should be used. For example, the ICSLUM should be validated against actual course grades (as opposed to self-reported course grades) and against objective measures of student and instructor behavior (e.g., classroom observation). Also, the ICSLUM is not a predictor of perceived learning and only a weak predictor of self-reported course grade. To improve the validity of this measure, the ICSLUM should be modified to better predict these outcomes. Future research should also focus on developing items that relate to the components of Class Activity Engagement and Instructor Technical Skills, as these two components emerged from the principal component analysis despite not being hypothesized. As they were not hypothesized components, it is possible that more items will need to be developed to accurately measure these constructs.

Future research should also further investigate the relationships between the ICSLUM and student outcomes. While the ICSLUM was not found to be predictive of perceived learning, it was found to be associated with course engagement, student attentiveness, and course grade (provided that students were engaged and attentive in class). These relationships should be further explored with more comprehensive measures of course engagement, attentiveness, and course grade than those presented in this study. Other student outcomes, such as class participation and skill development, should be explored in terms of their relationship to the ICSLUM.

Research should also be conducted in order to assess what classroom factors are positively related with each of the components of the ICSLUM. As previous research has shown the benefits of structured laptop classrooms, it is important to understand what factors, if any, lead to an increase in the degree of laptop structure. For example, future studies could examine if courses from different subject areas generally have different degrees of laptop structure. Future studies could also look at the types of laptop activities students engage in (e.g., reading online articles, analyzing data) to assess if certain activities are associated with a higher degree of laptop structure than others. Comparing different classrooms with the ICSLUM could lead to discoveries regarding what variables are most associated with certain components.

Future research on the ICSLUM should investigate students' biases of instructors. Many student evaluations of teaching have been shown to include several biases (MacNell et al., 2014; Mason & Johnson, 2013). As the ICSLUM assesses the course and not the instructor, it could be an alternative form of instructor assessment. However, before using the ICSLUM to assess instructor quality, studies will need to be conducted to show that it is not susceptible to the biases that other student evaluations of teaching are.

A final area of future research is related to student engagement and attentiveness in the classroom. While higher levels of structure in laptop classrooms were found to be positively related to students' grades, this was only true for students who were engaged and attentive in class. Thus, future research should investigate what kinds of structured laptop activities are best for increasing students' levels of engagement and attentiveness in the classroom.

Conclusion

The In-Class Structured Laptop Use Measure is a measure designed to assess the degree of structured laptop use in any given classroom. It was found that six of its seven constructs are highly reliable, and there is moderate evidence for the validity of this measure. While the ICSLUM was shown to be related to other student outcomes, including engagement, attentiveness, and course grade, it cannot be used to predict students' perceived learning while controlling for engagement and attentiveness. Thus, the ICSLUM is a reliable and moderately valid measure, indicating that it is ready for use.

Furthermore, this study indicates that structured laptop use consists of several components, including classroom activity, instructor behavior, and student behavior. Thus, educators will want to ensure that their instructional methods adequately address these aspects of structured laptop classrooms. Additionally, future researchers should incorporate these components into their studies on structured laptop classrooms. However, validating the ICSLUM's measures that relate to classroom activity, instructor behavior, and student behavior against objective measures (e.g., classroom observation) will be important for future research as well.

In summary, the ICSLUM can be used as a measure of a laptop classroom's overall degree of structure, and is the first known measure to do so. Measurement of the degree of structured laptop use in classrooms could be beneficial for a wide variety of educationally related purposes. Furthermore, a standardized measure of structured laptop use provides further opportunities for research in this area.

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Appendix A: Structured Laptop Use Survey

Laptop Structure Survey

Thank you for taking time to participate in this survey.

This survey is intended to assess the integration of laptops in a class of your choice. Please answer all questions to the best of your ability, and keep in mind that no question is intended to reflect upon your abilities as a student.

Your responses to this survey will remain anonymous, and no personally identifiable information will be collected. There will be no way to connect you to your responses to this survey. There is minimal risk associated with taking this survey, and it will not be greater than that experienced in daily life. You are free to withdraw from the survey for any reason at any time with no penalty. This study has been approved by the Institutional Review Board (IRB) of the University of Wisconsin--Stout. The IRB has determined that this study meets all ethical obligations required by federal law and University policies.

Any inquiries regarding this survey should be directed to:

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Dr. Kristina Gorbatenko-Roth (Research Advisor)
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If you have any questions, concerns, or reports regarding your rights as a research subject, please contact the IRB administrator:
Elizabeth Buchanan
buchanane@uwstout.edu
(715) 232-5184

By taking this survey, you are agreeing to participate.

This survey will ask questions about one of the classes that you are currently taking this semester (Spring 2016). Please choose a class that you are currently enrolled in and name it in the blank space below. It does not matter which class you choose, but please choose a class that meets in person.

____

Who teaches [name of class]? Note that this information will only be used to redistribute this survey to your instructor; it will not be used to connect you with your answers, and your instructor will not see your responses.

____

Which of the following best describes the laptop policy in [name of class]?

- ❍ Laptops were technically banned for every class, but students still used their laptops in class
- ❍ Laptops were only allowed to be used during certain times (such as for certain in-class activities)
- ❍ Laptops were allowed to be used almost every day
- ❍ Laptops were only used during tests
- ❍ Laptops were never used during class

If Laptops were never used during class... Is Selected, Then Skip To End of Survey
If Laptops were only used during tests… Is Selected, Then Skip To End of Survey

Please indicate your agreement with the following statements in regards to your instructor for [name of class]:

	Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree
I used my laptop in class to take notes during lecture.	❍	❍	❍	❍	❍	❍	❍
I used my laptop in class to follow along during lecture.	❍	❍	❍	❍	❍	❍	❍
I used my laptop in class to complete in-class assignments or activities.	❍	❍	❍	❍	❍	❍	❍
I used my laptop in class to find answers to questions posed by the instructor.	❍	❍	❍	❍	❍	❍	❍
I used my laptop in class to send emails for purposes not related to [name of class].	❍	❍	❍	❍	❍	❍	❍

	Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree
I used my laptop in class to send instant messages (msn, facebook chat, etc) for purposes not related to [name of class].	❍	❍	❍	❍	❍	❍	❍
I used my laptop in class to browse the internet for purposes not related to [name of class].	❍	❍	❍	❍	❍	❍	❍
I used my laptop in class to watch movies or videos.	❍	❍	❍	❍	❍	❍	❍
I used my laptop in class to play games.	❍	❍	❍	❍	❍	❍	❍
I used my laptop in class to do homework for other classes.	❍	❍	❍	❍	❍	❍	❍

Please indicate your agreement with the following statements in regards to your instructor for [name of class]:

	Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree
The instructor clearly discussed his/her policy regarding in-class laptop use.	❍	❍	❍	❍	❍	❍	❍
The instructor reminded students about his/her policy regarding in-class laptop use when necessary.	❍	❍	❍	❍	❍	❍	❍
The instructor ignored students' in-class laptop use.	❍	❍	❍	❍	❍	❍	❍
The instructor allowed students to do what they wanted on their laptops in class.	❍	❍	❍	❍	❍	❍	❍

Please indicate your agreement with the following statements in regards to your instructor for [name of class]:

	Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree
My instructor knows how to meaningfully integrate laptops into lessons.	❍	❍	❍	❍	❍	❍	❍
My instructor seems to have adequate computer skills to conduct classes that have students using their laptops.	❍	❍	❍	❍	❍	❍	❍
My instructor seems to have received adequate training to incorporate laptops into [name of class].	❍	❍	❍	❍	❍	❍	❍
My instructor is able to align the use of the laptop with the curriculum of [name of class].	❍	❍	❍	❍	❍	❍	❍

Please indicate your agreement with the following statements in regards to your instructor for [name of class]:

	Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree
My instructor believes that the use of laptops in the classroom increases the level of student interaction and/or collaboration.	❍	❍	❍	❍	❍	❍	❍
My instructor believes that the use of laptops in the classroom positively impacts student learning and achievement.	❍	❍	❍	❍	❍	❍	❍
My instructor believes that the use of laptops in the classroom improves the quality of student work.	❍	❍	❍	❍	❍	❍	❍
My instructor believes that using laptops in the classroom has a positive impact on classroom learning.	❍	❍	❍	❍	❍	❍	❍

My instructor believes that using laptops in the classroom makes lessons more interactive.	❍	❍	❍	❍	❍	❍	❍

Please indicate your agreement with the following statements in regards to [name of class]:

	Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree
I participated in class discussions.	❍	❍	❍	❍	❍	❍	❍
I asked questions when I did not understand the instructor.	❍	❍	❍	❍	❍	❍	❍
I paid a lot of attention to class discussion and activities.	❍	❍	❍	❍	❍	❍	❍
I was engaged in class discussion and activities.	❍	❍	❍	❍	❍	❍	❍
I was often distracted by my classmates' laptop activities.	❍	❍	❍	❍	❍	❍	❍
I frequently noticed that other students were using their laptops for activities not related to [name of class].	❍	❍	❍	❍	❍	❍	❍
I was able to concentrate during class.	❍	❍	❍	❍	❍	❍	❍
I was attentive during class.	❍	❍	❍	❍	❍	❍	❍

Appendix B: Modified Laptop Effectiveness Scale (Kay & Lauricella, 2010)

How much of the time in this course did you use the laptop to take notes or follow the lecture?

- ❍ 76-100% of the time
- ❍ 51-75% of the time
- ❍ 36-50% of the time
- ❍ 1-25% of the time
- ❍ 0% of the time

How much of the lecture time in this course did you use the laptop for academic purposes relating to this class (i.e. following lecture, doing in-class assignments or activities, viewing course outline, etc.)?

- ❍ 76-100% of the time
- ❍ 51-75% of the time
- ❍ 36-50% of the time
- ❍ 1-25% of the time
- ❍ 0% of the time

How much of the lecture time in this course did you use the laptop for email of any kind (Hotmail, Yahoo, gmail, etc.) for purposes other than this course?

- ❍ 76-100% of the time
- ❍ 51-75% of the time
- ❍ 36-50% of the time
- ❍ 1-25% of the time
- ❍ 0% of the time

How much of the lecture time in this course did you use the laptop for instant messaging (msn, etc.) for purposes other than this course?

- ❍ 76-100% of the time
- ❍ 51-75% of the time
- ❍ 36-50% of the time
- ❍ 1-25% of the time
- ❍ 0% of the time

How much of the lecture time in this course did you use the laptop to play games?
- ❍ 76-100% of the time
- ❍ 51-75% of the time
- ❍ 36-50% of the time
- ❍ 1-25% of the time
- ❍ 0% of the time

How much of the lecture time in this course did you use the laptop to watch movies?
- ❍ 76-100% of the time
- ❍ 51-75% of the time
- ❍ 36-50% of the time
- ❍ 1-25% of the time
- ❍ 0% of the time

Appendix C: Zhu et al.'s (2012) Measures of Engagement, Attentiveness, and Perceived Learning

The following questions ask about using a laptop in THIS course.

My attentiveness has increased due to laptop use.

- Strongly Agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

My laptop helped me to be engaged during lecture

- Strongly Agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

I learned more due to the use of a laptop than I would have without it.

- Strongly Agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

Appendix D: Demographic Items

What is your academic standing?

- ❍ Freshman (0-30 credits)
- ❍ Sophomore (31-60 credits)
- ❍ Junior (61-90 credits)
- ❍ Senior (90+ credits)
- ❍ Graduate student

What is your age in years (enter as a number)? ____________________________

Note. This question is coded in Qualtrics such that respondents must enter a number between 16 and 100.

Please identify your sex/gender:

- ❍ Female
- ❍ Male
- ❍ Intersex
- ❍ Transgender
- ❍ Alternative identity (please specify)_____________________
- ❍ Prefer not to answer

Please identify your race (choose one or more):

- ❍ African American or Black
- ❍ American Indian or Alaska Native (specify tribal affiliation)
- ❍ Native Hawaiian/Pacific Islander
- ❍ Cambodian
- ❍ Hmong
- ❍ Laotian
- ❍ Vietnamese
- ❍ Other Asian (please specify)________________
- ❍ White
- ❍ Prefer not to answer

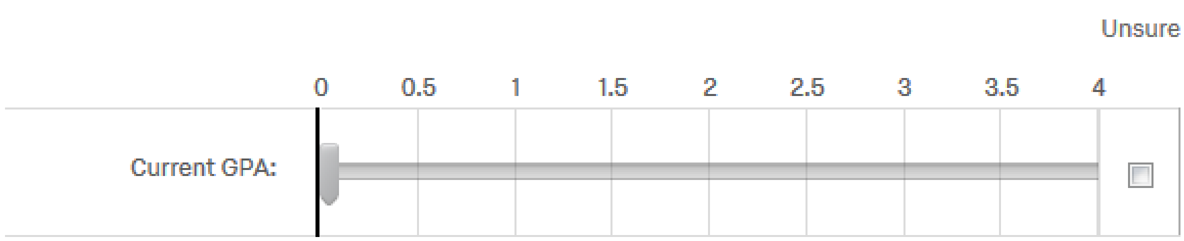
Are you of Hispanic or Latino/a origin?

- ❍ No
- ❍ Yes, Cuban
- ❍ Yes, Puerto Rican
- ❍ Yes, Mexican American or Chicano/a
- ❍ Yes, other Hispanic or Latino/a___________________
- ❍ Prefer not to answer

How frequently did you attend [name of class]?

- ❍ Never
- ❍ Rarely
- ❍ Sometimes
- ❍ Frequently
- ❍ Always

What is your current GPA? Please select "Unsure" if you are not sure.



What grade do you think you will receive in [name of class]?

- A (90-100%)
- B (80-89%)
- C (70-79%)
- D (60-69%)
- F (0-59%)

Note: The second invitation to the survey, which was sent out after the spring 2016 semester had ended, modified the above item to:

What grade did you receive in [name of class]?

- A (90-100%)
- B (80-89%)
- C (70-79%)
- D (60-69%)
- F (0-59%)