Creating an Instrument to Measure Student Response to Instructional Practices

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Accepted on October 16, 2016 for publication in

Journal of Engineering Education Vol. 106 (No. 2) (April, 2017)

DeMonbrun, R. M., Finelli, C. J., Shekhar, P., Prince, M., Borrego, M., Shekhar, P., . . . Waters, C. (in press, 2017). Creating an instrument to measure student response to instructional practices. *Journal of Engineering Education, 106*(2).

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Abstract

Background Research has provided evidence on the benefits of active learning on student learning and success in the engineering classroom. Yet the adoption of such types of instruction has been slow. Prior research has suggested that students' responses may have a significant effect on instructors' willingness to adopt different types of instruction.

Purpose We describe our method for creating an instrument to measure the effects of several variables on student response to instructional practices. We discuss the step-by-step process for creating this instrument from the initial development process through multiple stages of validity and reliability testing.

Design/Method The process for instrument development consisted of six steps: item generation and construct development, validity testing, implementation, exploratory factor analysis, confirmatory factor analysis, and instrument modification and replication. We discuss the pilot testing of the initial instrument (n=362) as well as construct development and validation using exploratory and confirmatory factor analyses.

Results This process resulted in the creation of 49 items measuring three parts of our framework. Types of instruction separated into four factors (interactive, constructive, active, and passive); strategies for using in-class activities into two factors (explanation and facilitation); and student responses to instruction into five factors (value, positivity, participation, distraction, and evaluation).

Conclusions This study describes the design process and final results for an instrument to measure Student Response to Instructional Practices, a useful tool for understanding the relationship between the type of instruction used and students' response.

Keywords active learning; instructional methods; factor analysis; student resistance;

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Introduction

There have been repeated calls to increase the number and diversity of students receiving STEM degrees (science, technology, engineering, and mathematics) (AAAS, 2010; NAS, NAE, & IOM, 2007). Promoting more widespread use of research-based types of instruction has been recommended to help achieve this goal (Jamieson & Lohmann, 2012; Kuh, 2008; Seymour & Hewitt, 1997). Many of these types of instruction fall under the broad definition of active learning, or requiring students to participate in class activities beyond watching an instructor lecture (Felder & Brent, 2009). The educational benefits of active learning are well established. For example, a meta-analysis of 225 studies found that "active learning leads to increases in examination performance that would raise average grades by a half a letter, and that failure rates under traditional lecturing increase by 55% over the rates observed under active learning" in undergraduate STEM courses (Freeman, et al., p. 8410). Other studies show that active learning can be especially effective for educating a diverse student body (Prince, 2004; Seymour & Hewitt, 1997) and for increasing the retention rate of students in STEM programs (Angelo & Cross, 1993; Prince & Felder, 2006).

Despite this literature base, translation of research about active learning to instructional practice has been slow (Friedrich, Sellers, & Burstyn, 2007; Handelsman et al., 2004; Hora, Ferrare, & Oleson, 2012; PCAST, 2012; Singer, Nielsen, & Schweingruber, 2012). Several researchers have identified a number of instructor-reported barriers that help to explain these slow adoption rates. Among the least researched but most often mentioned barriers is the concern that students will "resist," or respond in negative ways (Borrego, Froyd, & Hall, 2010; Dancy & Henderson, 2012; Finelli, Daly, & Richardson, 2014; Froyd, Borrego, Cutler, Prince, & Henderson, 2013; Henderson & Dancy, 2007; Seidel & Tanner, 2013). In actuality, student response to new and different types of instruction can be positive if students are engaged in these activities, view them in a positive light, and see the value in their use (Gauci, Dantas, Williams, & Kemm, 2009; Livingstone & Lynch, 2000). However, worries about such negative responses can discourage instructors from adopting new and different types of instruction.

To address concerns about student response, research that characterizes the types of student response (both positive and negative) to various types of instruction and identifies strategies for introducing these types of instruction could help eliminate a key barrier to faculty adoption of active learning. And though literature offers a variety of tips for instructors wishing to promote positive response and minimize negative reactions to different types of instruction (e.g. Armstrong, 1998; Arum & Roksa, 2011; Felder, 2011; Johnson, Johnson, & Smith, 1991; Lake, 2001; Michael, 2007; Moffett & Hill, 1997; Prince, Borrego, Henderson, Cutler, & Froyd, 2013), these suggestions tend to be drawn from personal experience and have yet to be empirically tested. These limitations show the need for additional research in this area. Such research requires an instrument to assess and measure students' responses to different types of instruction and the strategies used (or not used) with each instructional type. Here, we report on development of the Student Response to Instructional Practices (StRIP) instrument to achieve this goal.

Rather than focusing on the effects of instructional types, this article describes the development process of the StRIP instrument, following accepted approaches for instrument development (e.g., Carberry, Lee, & Ohland, 2010; Li, McCoach, Swaminathan, & Tang, 2008; Ro, Merson, Lattuca, & Terenzini, 2015). The resulting StRIP instrument can be used by researchers and practitioners seeking a tool to study student response to types of instruction in the classroom, and the framework we have developed attempts to explain the relationship between types of instruction, strategies for using these types of instruction during class, and how students respond.

Instrument Development Methods

In this section, we discuss the many steps we took in developing, administering, and refining the instrument to measure student response to types of instruction. We adapted the instrument development process from Hinkin (1998), as illustrated in Figure 1, and we applied this process to the development of the StRIP instrument. Note that the process is an iterative one (as depicted by curved arrows), which involves a six-step approach:

1. Generating items and developing constructs for the instrument, which borrows from prior literature on instructional types, student response, and strategies for using in-class activities,
2. Testing for validity by observing the engineering classroom, as well as by subjecting the instrument to expert review and cognitive interviewing,
3. Implementing the instrument,
4. Conducting an exploratory factor analysis, an important step since there was not a previously instrument on student response to instructional practices,
5. Conducting a confirmatory factor analysis to verify the constructs established in the exploratory factor analysis, and
6. Modifying the instrument and replicating findings through full instrument administration.

[Figure 1 here]

Step 1: Item Generation and Construct Development

In creating a new instrument, researchers must first generate the items needed to measure the desired construct(s), a process that can be accomplished through deductive and/or inductive

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scale development. Given the limited amount of empirical research and absence of a developed framework on students' responses to types of instruction, we chose an inductive approach to item generation (Ironson, Smith, Brannick, Gibson, & Paul, 1989). Figure 2 illustrates the framework we developed in order to better understand students' responses to types of instruction, which comprises several groups of variables that potentially contribute to student response. Instructors likely influence student response by their choice of instructional strategy (e.g. lecturing, active learning, etc.) and how they introduce and manage that strategy in the classroom. In addition, response is hypothesized to depend in part on student characteristics, preferences, expectations, and prior experiences. Finally, the framework highlights characteristics of the course itself and clarifies that a student's reason for taking the course potentially influences his/her response to types of instruction.

The instrument has three sections, which correspond to the three parts of our framework:

- Types of Instruction (e.g., lecturing or active learning), which measures the types of instruction used and students' preferred types of instruction,
- Strategies for Using In-Class Activities, and
- Student Responses to Instruction (e.g., seeing the activity in a positive light, fully participating in the activity, placing value on the activity, or evaluating the course highly based on the use of certain activities).

These sections are discussed at length later. The other items in our framework are measured using different instruments not discussed here (see Shekhar, Borrego, et al., 2015 for additional information on our other approaches).

Types of Instruction. Because students' responses vary based on the types of instruction experienced by the student, we developed items to capture these instructional types, ranging from traditional lecture to simple and more complex forms of active learning. While trying to characterize these types of instruction by the nature of what occurs during the instruction (e.g., individual work, group work, pair and share), we also wanted to frame them around the types of cognitive processes elicited from students during the activities to understand whether or not certain types of instruction impact students' responses.

[Figure 2 here]

To accomplish this task, we modified Chi and Wylie's (2014) Interactive-Constructive-Active-Passive (ICAP) model, which classifies instructional activities as interactive, constructive, active, or passive learning processes. Although our modified version uses the same format as the original ICAP, we redefined some of the original terminology to be more consistent with other research on active learning (Felder & Brent, 2009; Prince, 2004). The modifications to these classifications are discussed next.

First, we sought to differentiate between active and passive types of instruction, which Chi (2009) suggests are converse to one another. Both definitions, however, involve the individual students' actions (or lack thereof) during the instructional practice. We defined *passive instruction* as occurring when students are expected to passively receive information from the instructor. Examples include listening to lectures or watching the instructor solve problems on the board. Since our focus for passive instruction is on information received directly from the instructor, we did not include textbooks and other resources when asking students about information sources. We defined *active instruction* as occurring when students are engaged with the course content in any individual activity. Examples include asking the instructor questions or answering questions posed by the instructor during class.

Next, because there is clear evidence that team and group activities can generate high levels of negative student response (Bacon, Stewart, & Silver, 1999; Donohue & Richards, 2009; Lake, 2001; Oakley, Hanna, Kuzmyn, & Felder, 2007; Powell & Kalina, 2009), we made a distinction between individual activities and those with two or more students. We characterized the latter as *interactive instruction*, which is similar to Chi and Wylie's (2014) use of the term. Our conceptualization differs, however, in that we included any interaction students might have with their peers during the semester (including studying or completing homework in groups), while Chi and Wylie (2014) stipulate that the activity must involve students creating knowledge together (e.g., students must have a dialogue with other students). Examples of interactive types of instruction include doing hands-on group activities during class and being graded based on the performance of a group.

Finally, some complex types of active learning include elements like self-directed learning and ill-structured problems that have been hypothesized to generate significant student resistance (Hung, Bailey, & Jonassen, 2003; Van Barneveld & Strobel, 2011; Yadav, Subedi, Lunderberg, & Bunting, 2011). These types of activities are defined by learning on one's own (i.e., self-discovery), rather than learning from being told what to do (i.e., direct instruction) (Chi, 2009). Thus, we retained Chi and Wylie's (2014) definition for *constructive instruction* for these instructional types since they place high expectations on students and represent significant departures from many traditional classes.

Altogether, we created 21 items for students to report the frequency of these types of instruction (Table 1). We also asked students whether they wanted more or fewer of these activities in their "ideal course" to gauge their desired frequency. We expected students' responses to a particular type of instructional practice to be based not only on the actual level of use, but also on the difference between the actual and desired levels of use.

Strategies for Using In-Class Activities. While little empirical research has investigated the effectiveness of strategies for using in-class activities, several authors give advice about how to introduce different types of instruction and minimize negative reactions (Armstrong, 1998; Bentley, Kennedy, & Semsar, 2011; Moffett & Hill, 1997; Van Barneveld & Strobel, 2011). We included these strategies in the StRIP instrument to allow more thoughtful analysis of their relative effectiveness.

[Table 1 here]

The literature on reducing student resistance can be grouped into several themes. First, beginning the course activity with an explanation of its purpose and process and an acknowledgment of its challenges can better prepare students for what is expected of them and why the activity is important (Bacon et al., 1999; Yadav et al., 2011), particularly if their participation might affect their grade (Donohue & Richards, 2009). Indeed, Gaffney, Gaffney, and Beichner's (2010) Pedagogical Expectancy Violation Assessment (PEVA) acknowledges that students' expectations of active learning can fluctuate throughout the semester, and that this fluctuation can affect students' responses to the activities. Second, soliciting student feedback and providing the support needed to successfully complete the activity assists students in achieving their goals (Bentley et al., 2011; Yadav et al., 2011). Finally, designing appropriately challenging activities ensures that all students can successfully attempt and complete the activity (Donohue & Richards, 2009; Van Barneveld & Strobel, 2011).

We used both the published strategies suggested for using in-class activities and strategies we observed in our prior research (Shekhar, DeMonbrun, et al., 2015) as we developed the Strategies for Using In-Class Activities items on the StRIP instrument. Altogether, we created eight items for students to report how frequently the instructor engaged in the recommended strategies (Table 2).

[Table 2 here]

Student Responses to Instruction. To characterize students' responses to types of instruction, we drew upon published literature, including the school classroom engagement concept of Fredricks, Blumenfeld, and Paris (2004), Chasteen's (2014) construct of productive engagement, and Weimer's (2002) framework on student resistance. The idea of engagement is often characterized as the responses students have to their experiences at specific moments in time (Lawson & Lawson, 2013). Such responses can range from moments of total engagement or "flow" to more passive moments of boredom or lack of interest (Pekrun & Linnebrink-Garcia, 2012). Our instrument is similarly aligned in that we wished to examine how types of instruction facilitate students' engagement in the classroom, but we also wished to address faculty concerns regarding student resistance to these types of instruction (rather than simply measuring lack of engagement or boredom).

Previous research has found that classroom engagement is typically conceptualized as having three forms: cognitive engagement (psychological investment in classroom activities), affective-emotional engagement (social and emotional connections to the classroom), and behavioral engagement (students' behavior in the classroom) (Appleton, Christenson, & Furlong, 2008; Fredericks et al., 2004; Furlong & Christenson, 2008; Skinner & Pitzer, 2012). Following this framework, we characterized students' responses using these three forms of engagement and included a fourth concept of evaluation, which we added because of the value instructors place on end-of-semester student ratings. Our four subscales include: (1) value – the degree to which students see the activity as worthwhile (cognitive); (2) positivity – how positive or negative students feel about the activity (affective-emotional); (3) participation – the extent to which students do or do not participate or demonstrate resistance (behavioral); and (4) evaluation – the way students rate the instructor or course at the end of the term.

Value. Chasteen (2014) defines value as a measure of some elements of cognitive engagement that is impacted by students' thoughts, beliefs, and expectations. In their review of school engagement, Fredricks and colleagues (2004) indicate that cognitive engagement stresses students' investment in their learning and incorporates literature on learning and instruction, self-regulation, and investment in learning. There are several conceptualizations of cognitive engagement, which include a desire to go beyond the typical requirements of a course (Connell & Wellborn, 1991; Newmann, Wehlage, & Lamborn, 1992; Wehlage, Rutter, Smith, Lesko, & Fernandez, 1989) and a self-regulated motivation to learn and do well in a course (Brophy, 1987; Pintrich & De Groot, 1990; Zimmerman, 1990). In our instrument, *value* is related to students' investment in their learning. At the high end of the value scale, students understand and accept the rationale for the activity, and they feel the time used for the activity is beneficial. At the other end of the scale, students tend to disagree with the rationale for the activity and feel that time could be better spent doing other things.

Positivity. Affective-emotional engagement references the various affective reactions to what students experience in the classroom, including anxieties, feelings of belongingness, happiness, sadness, interest, and boredom (Connell & Wellborn, 1991; Skinner & Belmont, 1993). Although a traditional scale of academic emotions (Pekrun, Goetz, Titz, & Perry, 2002) measures how students' goals impact their own emotions in the classroom setting (Lee & Smith, 1995; Pekrun, Elliot, & Maier, 2009; Stipek, 2002), the context of our StRIP instrument is different in that it measures students' reactions to the instructor and the course. Thus, we decided to label this factor as *positivity* to avoid any confusion with the academic emotions scale. At the high end of this scale, students feel positively about the task, instructor, and classroom environment. Students with low positivity respond in the opposite way.

Participation. Because the research on behavioral engagement is considerably broad (Lawson & Lawson, 2013) and often captures student behavior outside of the classroom (Finn, Folger, & Cox, 1991), we opted to constrain behaviors in our instrument to those exhibited only in the college classroom. Chasteen's (2014) work provided guidance for the positive components of behavioral engagement included in the instrument, we applied Weimer's (2002) framework on student resistance to further distinguish the negative components. Weimer (2002) identified three types of resistance or negative behavioral engagement:

- Open resistance: On some occasions, students openly object to the approach. They may demonstrate open resistance by complaining, arguing, or objecting, and they generally do so in ways that are not constructive.
- Passive, non-verbal resistance: "Overwhelming lack of enthusiasm" (Weimer, 2002, p. 154). It is often an unspoken message that students do not want to participate and can be a way for students to "… object without having to own the responsibility of doing so" (p. 154). Students may demonstrate passive, non-verbal resistance by not doing assignments but offering excuses, faking attention, or appearing to take notes while working on material from another class.
- Partial compliance: Students may demonstrate partial compliance by completing a task poorly, half-heartedly, or quickly, by putting forth minimal effort, or by being preoccupied with procedural details.

In combination, we labeled this factor *participation*. The items on our StRIP instrument in the participation subscale represent both these positive and negative components of participation.

Evaluation. Another significant element of students' responses is evaluation, or how students rate both the overall course and quality of instruction on course evaluation forms. Since student evaluations play a significant role in many instructors' reviews for retention, tenure, and promotion, low student ratings are clearly an important response that is likely to influence whether instructors adopt and continue to use various types of instruction in their classes. To capture this element of students' responses, we added items on our StRIP instrument about the quality of the course and the quality of instruction. These items were based on similar items from the IDEA (Individual Development and Educational Assessment) student survey form (Cashin, 1988, 1990).

Altogether, we created 17 items for students to report how often they responded in various ways to the types of instruction that were used in their course. These items are listed in Table 3.

[Table 3 here]

Step 2: Validity Testing

In the second step in the instrument development process, testing for validity, we wanted to ensure that the proposed uses for the instrument were appropriate given the context and purposes of our study (AERA, APA, & NCME, 2014). Specifically, we developed our StRIP instrument to measure students' responses to types of instruction encountered in the undergraduate engineering classroom. Therefore, the process of establishing evidence for the validity of our measures was achieved in a number of ways, including: using multiple, mixed-methods approaches for development and validation (Haynes, Richard, & Kubany, 1995); subjecting the instrument to expert review (Nunnally & Bernstein, 1994); conducting cognitive interviewing with potential respondents of the instrument (Nunnally & Bernstein, 1994); and reporting results to expert reviewers (Hinkin, 1998). Particularly, we used classroom observations, expert review, and cognitive interviewing during this validation process. These are all standard practices for establishing validity as according to the "2014 Standards for Educational and Psychological Measurement" (AERA et al., 2014). As illustrated by the recursive nature of steps 1 and 2 in Figure 1, this process often led to generating new items and revising factors based on feedback from these various sources.

Classroom observations. In addition to our extensive literature review, item generation, and construct development process, we recognized the need to collect more concrete data about students' responses to types of instruction. We conducted classroom observations to inform the instrument development process. During our survey development process, we conducted observations in four large introductory engineering courses (ranging in size from 70-150 students) at two large public research universities (Shekhar, DeMonbrun, et al., 2015).

These observations served three purposes. First, by collecting first-hand observations of various types of students' responses to instruction, we further confirmed our framework (Figure 1). Second, we observed strategies for using in-class activities that were not mentioned in the literature and which we subsequently added to our instrument. Specifically, items 5 and 6 from Table 2 ("used activities that were the right difficulty level (not too easy, not too difficult)" and "walked around the room to assist me or my group with the activity, if needed") were included to address strategies observed in the classroom. Finally, we piloted the StRIP instrument in some of the same classes we observed, allowing us to study the extent to which students' responses about types of instruction aligned with our independent observations. Using these observations as a form of triangulation (Greene, Caracelli, & Graham, 1989), we were able to gain confidence in the instrument's ability to measure the underlying factors in our study.

Expert review. Following our initial review of the literature, we created a preliminary draft of the StRIP instrument and invited our three member advisory board to offer their expert critique. The board included faculty who were experienced in instrument design and psychometrics, types of instruction, and students' responses to different types of instruction. Their feedback aided in refining our instrument because they reflected on timing and logistics for implementing the instrument, suggested that we find a framework for our instructional types and include items related to positivity and enjoyment, and recommended we clarify the response scale for the items by incorporating Fraser's (1998) classroom environments frequency scale rather than using a typical Likert scale response.

Cognitive interviewing. Following the approach used by Ouimet, Bunnage, Carini, Kuh, and Kennedy (2004), we conducted cognitive interviews (Willis, 2004) with undergraduate engineering students (n=12) at three institutions to confirm that the instrument was well designed for the target audience. We asked students to review each individual item; describe what they thought the item was asking, how they would respond, and how they would arrive at their response; and talk about other issues such as clarity of items and response scales and ease of completion. These cognitive interviews provided assurance that the students' interpretations of the instrument and its individual items were aligned with the intended constructs. Student feedback allowed us to better organize the instrument and reformat some question prompts. Specifically, these students suggested that we move the Student Responses to Instruction section to the front of the instrument, as it allowed them to think broadly about their experiences in class before outlining specific practices in the Types of Instruction section. Additionally, they asked us to move the prompts for the actual and ideal types of instruction next to each of these columns to avoid confusion.

Step 3: Implementation

The third step in our instrument development process was pilot testing the draft instrument. We piloted the instrument in two phases. During the first pilot phase, we studied four courses from three institutions (n=191 students), and we studied an additional four courses from three institutions (n=171) during the second phase. Across both phases, we administered the instrument to a total of 362 students in 8 courses at 4 institutions participated in the piloting process

We selected courses for our pilot testing through a mix of convenience and purposive sampling (Teddlie & Yu, 2007). A member of our research team at each of four institutions chose one or two instructors teaching gateway engineering courses based on prior knowledge of their instructional methods, including both active learning and traditional lecture formats. All students in those classes were asked to complete the StRIP instrument. Although students were offered an opportunity to opt out of taking the instrument, we are not aware of any students who did so. Therefore, no sample weights were used, as our selection was representative of each course. Only a small number of responses had missing or incomplete data on any of the items (11 total surveys). Because this number was less than 3% of the total sample and the missing data pattern appeared to be random (Rubin, 1976), these surveys were removed from the analyses. We used data from the first phase of pilot testing for an exploratory factor analysis and the second phase for confirming the factors identified in our first phase. All analyses were computed using Stata 13.1 SE software. Additional information on the courses in our sample, see Table 4.

[Table 4 here]

Step 4: Exploratory Factor Analysis

We conducted an exploratory factor analysis (EFA) on the StRIP instrument to identify emergent factors from our first phase of pilot testing and to determine items that might be particularly problematic given low or multiple factor loadings. The EFA included 191 responses to 47 items, giving us a 4:1 ratio of respondents to items, remaining above recommendations for a 3:1 participant-to-item ratio (Reise, Waller, & Comrey, 2000; Thompson, 2004).

Because we were studying three categories of variables (Types of Instruction, Strategies for Using In-Class Activities, and Student Responses to Instruction), we conducted three separate EFAs. Using a common-factors method and promax oblique rotation (recommended for inter-correlated measures by Worthington & Whittaker, 2006), we identified four factors for Types of Instruction, two factors for Strategies for Using In-Class Activities, and four factors for Student Responses to Instruction (as described subsequently, we later split this construct into five factors). The factors and their loadings are listed in Tables 5, 6, and 7. All factors had eigenvalues above 1.0 (Kaiser, 1958), and each EFA model was tested using standard tests of significance (Bartlett's test of sphericity) and sampling adequacy (Kaiser-Meyer-Olkin). All models were statistically significant ($p<0.001$), indicating that the variables were inter-correlated, and their sampling adequacies were above 0.60, required for good factor analyses (Tabachnick & Fidell, 2001). All items had a loading at or above the threshold of 0.32 (Comrey & Lee, 1992), and each construct had a construct reliability above the recommended benchmark of 0.60 (Bagozzi & Yi, 1988). For the evaluation construct, we used the Spearman-Brown coefficient to measure construct reliability, as recommended in previous research (Eisinga, Grotenhuis, & Pelzer, 2013).

Based on the response loadings in each EFA, we developed a name for each factor to assist in describing the phenomenon captured by the groupings. The items included in each of the factors are also listed in Tables 5, 6, and 7.

For Types of Instruction (Table 5), we conducted an EFA on both students' ideal types of instruction as well as what they actually experienced in the course. While the factors related to ideal instruction closely aligned to our adaptations of the ICAP framework (Chi & Wylie, 2014), those related to actual experience did not. We hypothesize this occurred because, while students tend to think about ideal types of instruction in term of the interactive, constructive, active, and passive categories, the capabilities of an instructor to balance each of these types in actual instruction might be limited. As such, we only present the analyses for the ideal types of instruction (Table 5).

For Strategies for Using In-Class Activities (Table 6), we identified factors including explanation strategies (where the instructor was the main character in the strategy and took the role of explaining the activity) and facilitation strategies (where the instructor facilitated opportunities for students to participate in the strategy). For Student Responses to Instruction (Table 7), although we initially designed the instrument with four subscales – value, participation, positivity, and evaluation – the EFA resulted in two factors that emerged from the participation factor – student distraction and student participation. Distraction features items where students distract themselves and/or peers during the learning process, whereas participation indicates the extent to which students participated in the activity. All five resulting factors and their loadings are presented in Table 7.

[Table 5 here]

[Table 6 here]

[Table 7 here]

Step 5: Confirmatory Factor Analysis

Given the success of the initial pilot testing, we used data from the second pilot phase of

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the StRIP instrument to conduct a confirmatory factor analysis (CFA) (see Tables 8, 9 and 10) to verify the reliability of the factors. The CFA included 171 responses to 47 items giving us a nearly 4:1 ratio of respondents to items, falling within recommended minimum sample size (Kline, 2005). The purpose of the CFA was to test the model identified in the EFA for structural fit to the developed constructs. Recently, researchers have turned to Structural Equation Modeling (SEM) rather than standard factor analysis techniques to conduct a CFA (Martens, 2005; Martens & Hasse, 2006). Usually, SEM consists of two steps in the model building process: testing for the factorial validity of a theoretical construct (first-order CFA model) and a path analysis to describe the relationship between theoretical constructs. Given our desire to replicate the latent factors of the instrument, as opposed to determining their relationship(s) with other factors, we chose to only conduct a first-order CFA model (Byrne, 2013).

The test statistics indicated good overall model fit. The chi-squared statistic for the model was 2.98, falling below the recommended threshold (Kline, 1998). The Root Mean Square Error of Approximation (RMSEA) was 0.06, with the lower bound of our 90% confidence interval at 0.00 and an upper bound at 0.14, suggesting a reasonable fit to the model. The Comparative Fit Index (CFI) statistic was 0.98, indicating good model fit (Hu & Bentler, 1999). Finally, the Standardized Root Mean Square Residual (SRMR) was 0.03, considered to be favorable for the model (Hu & Bentler, 1999).

In addition to the factor loadings, we also display the standard error, item reliability, average variance extracted, and construct reliability of each of the factors in Tables 8, 9, and 10. Item reliabilities ranged from 0.51 to 0.89, which exceed the acceptable value of 0.50 (Hair, Anderson, Tatham, & Black, 1992). The average variance extracted for all constructs was well above the threshold value of 0.5 (Fornell & Larker, 1981). Finally, the reliabilities for each construct were above the benchmark of 0.60 (Bagozzi & Yi, 1988). As noted in the exploratory factor analysis section, the construct reliability for our two-item evaluation construct was conducted using the Spearman-Brown statistic, as is recommended with the use of two-item scales (Eisinga et al., 2013).

[Table 8 here]

[Table 9 here]

[Table 10 here]

Step 6: Instrument Modification and Replication

After conducting the exploratory and confirmatory factor analyses, we engaged in instrument modification and replication to further strengthen the instrument. In the EFA and CFA, we found that two of the Student Responses to Instruction items loaded strongly on two different factors. These items included, "I pretended but did not actually participate," and "I rushed through the activity, giving minimal effort." We determined this instance of double-loading to be the result of items being worded as compound statements. The statements "I did not actually participate" and "I gave minimal effort" appeared to relate to the participation factor (the standardized factor loadings from our CFA were 0.71 and 0.64, respectively), while the statements "I pretended to participate" and "I rushed through the activity" appeared to relate to distraction (the standardized factor loadings from our CFA were 0.70 and 0.63, respectively). As such, we split these items to create four different items to address both of the factors:

- I did not actually participate in the activities (participation)
- I gave the activities minimal effort (participation)
- I pretended to participate in the activities (distraction)
- I rushed through the activities (distraction)

In addition to these changes, while we found that the reliability for the “evaluation” factor was strong, we chose to add a third item to strengthen the factor: “I would recommend this instructor to other students” (Cashin, 1988, 1990). As our objective to this study was to measure the effects of in-class exercises, we also modified or removed all instances of out of class learning from our instrument to represent only those types of instruction that occur during class. Following this modification process, we finalized StRIP instrument v1.0 (Appendix A). This instrument represents our team’s efforts to further investigate students’ responses to different types of instruction and is ready to be administered as part of our full-scale study.

Limitations and Future Research

A few limitations in our instrument development are worth noting, which we plan to address in our future research. First, the exploratory and confirmatory factor analyses are based on data from 8 courses at 4 different institutions. Although the four institutions represent doctoral, baccalaureate and minority-serving institutions, our findings are not necessarily generalizable. Furthermore, although our sample sizes appear to meet recommendations from the literature, they are still small and might influence our model fit. In our future research, we plan to expand our data collection methods to more settings in order to address these issues. We also plan to refine the instrument as needed based upon these expanded results.

Second, because we asked students how often they reacted in various ways to all activities as a whole, rather than specific types of activities (Table 3), it is more difficult to relate specific activities to specific student reactions. This decision was a tradeoff for brevity (i.e., students would have to respond to the 17 Student Response to Instruction items for each of the 21 different instructional types listed) that may be reconsidered as emerging results help focus future studies on particular aspects of student response to instruction.

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Third, the estimates for our “types of instruction” models are based solely on *ideal* types of instruction. As noted earlier, we believe this finding is because an instructor’s ability to actually cover each of these types of instruction throughout the semester would be difficult. However, students still perceive these types of instruction as aligned with one of these four categories: interactive, constructive, active, and passive. Consequently, much of our future research directly investigates how students feel about these types of instruction in their ideal classroom, whether or not this perception aligns with what they actually experienced in the classroom, and subsequently, how they responded to the use of these types of instruction. Furthermore, we plan to also consider the use of separate constructs for the actual and ideal types of instruction in our future research.

Finally, the instrument relies on student self-reports of instructional practices, instructor strategies, and reactions to active learning. While this limitation is less of a concern for positivity, value, and evaluation items (Table 3), student reports of their own participation (Table 3), instructor strategies (Table 2) and frequency of types of instruction (Table 1) may be different from those of other students and the instructor. We note this constraint in all our future research utilizing this instrument, yet conclude that students’ perception of the frequency of these activities is an important key to understanding how they ultimately respond to active learning. Other aspects of our ongoing work describe the preliminary results for our findings on student response to types of instruction and how we are comparing student and instructor responses and working with instructors to interpret their own data in instructional decisions.

Conclusion

In this paper we described the design process and pilot results for an instrument to measure Student Response to Instructional Practices. Since the focus of this paper was on development of the instrument, future analyses involve a broader administration and more systematic analysis of the instrument across multiple types of courses and institutions. The instrument measures three constructs related to our framework: 1) Types of Instruction, 2) Strategies for Using In-Class Activities, and 3) Student Responses to Instruction. Although the instrument was developed in the context of gateway engineering courses (i.e., core courses that most engineering majors take), we expect that it may be relevant for a wider variety of STEM contexts and encourage other researchers to examine its usefulness in other contexts.

We believe there are several practical implications for the use of this instrument in the engineering classroom. First, we described a spectrum of activities in the instrument so faculty can examine the types of instruction currently used in the engineering classroom, and how "ideal" these activities might be to their students. Second, based on our review of the literature, we compiled a list of several strategies for using in-class activities that faculty may wish to incorporate into their own courses to support student engagement. Third, we provided a list of students' responses to these types of instruction so that faculty can examine how their students respond to these activities and identify behaviors that might indicate students are disengaged during the process. Finally, our overall framework was developed with the hope that researchers and instructors, alike, can utilize this instrument to study multiple classrooms and identify relationships between types of instruction, how each type of instruction is introduced, and how students subsequently respond. For example, do students notice efforts taken by an instructor to explain the purpose of an activity? If not, maybe these efforts need to be more explicit or more frequent. Similarly, a few vocal students can sometimes give the impression that the entire class dislikes active learning. Having results from the instrument can help an instructor understand the views of all students in the class. There is much to be learned about this important area, and we encourage other instructors and researchers to use and build on this instrument in their own work.

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Appendix A: StRIP Student Instrument

StRIP Student Instrument

1. In this course, when the instructor asked you to do an in-class activity (e.g., solve problems in a group during class or discuss concepts with classmates), **how often did you react in the following ways?**	1. Almost never (< 10% of the time)	2. Seldom (~30% of the time)	3. Sometimes (~ 50 % of the time)	4. Often (~ 70 % of the time)	5. Very Often (> 90 % of the time)
a. I disliked the activity.	1	2	3	4	5
b. I did not actually participate in the activity.	1	2	3	4	5
c. I gave the activity minimal effort.	1	2	3	4	5
d. I felt positively towards the instructor.	1	2	3	4	5
e. I tried my hardest to do a good job.	1	2	3	4	5
f. I distracted my peers during the activity.	1	2	3	4	5
g. I pretended to participate in the activity.	1	2	3	4	5
h. I felt the effort it took to do the activity was worthwhile.	1	2	3	4	5
i. I participated actively (or attempted to).	1	2	3	4	5
j. I talked with classmates about other topics besides the activity.	1	2	3	4	5
k. I felt the instructor had my best interests in mind.	1	2	3	4	5
l. I saw the value in the activity.	1	2	3	4	5
m. I felt the time used for the activity was beneficial.	1	2	3	4	5
n. I enjoyed the activity.	1	2	3	4	5
o. I surfed the internet, checked social media, or did something else instead of doing the activity.	1	2	3	4	5
p. I voiced my objections so the instructor could hear.	1	2	3	4	5
q. I rushed through the activity.	1	2	3	4	5
r. I planned to give the instructor a lower course evaluation.	1	2	3	4	5
s. I complained to other students.	1	2	3	4	5

2. In this course, when the instructor asked you to do an in-class activity (e.g,. solve problems in a group during class or discuss concepts with classmates), **how often did the instructor do the following things?**	1. Almost never (< 10% of the time)	2. Seldom (~30% of the time)	3. Sometimes (~ 50 % of the time)	4. Often (~ 70 % of the time)	5. Very Often (> 90 % of the time)
a. Clearly explained what I was expected to do for the activity.	1	2	3	4	5
b. Clearly explained the purpose of the activity.	1	2	3	4	5
c. Discussed how this activity related to my learning.	1	2	3	4	5
d. Solicited my feedback or that of other students about the activity.	1	2	3	4	5
e. Used activities that were the right difficulty level (not too easy, not too difficult).	1	2	3	4	5
f. Walked around the room to assist me or my group with the activity, if needed.	1	2	3	4	5
g. Encouraged students to engage with the activity through his/her demeanor.	1	2	3	4	5
h. Gave me an appropriate amount of time to engage with the activity.	1	2	3	4	5

3. Please rate your level of agreement with the following items.	Strongly disagree	Disagree	Neutral	Agree	Strongly Agree
a. Overall, this was an excellent course.	1	2	3	4	5
b. Overall, the instructor was an excellent teacher.	1	2	3	4	5
c. I would recommend this instructor to other students.	1	2	3	4	5

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4. In how many of your college courses has the instructor asked you to do an in-class activity at least once a week?

- ☐ Every one of my college courses
- ☐ Almost all of my college courses
- ☐ About half of my college courses
- ☐ A few of my college courses
- ☐ None of my college courses

5. For each of the following things, please indicate how often you did each thing **in this course** and how often you would like to do each **in your ideal course**.

	In the actual course, how often did you ……					**In your ideal course**, how often would you like to ……				
	1. Never	2. Seldom (1-5 times/semester)	3. Sometimes (5-10 times/semester)	4. Often (once a week)	5. Very often (more than once/week)	1. Much less	2. Slightly less	3. About the same	4. Slightly more	5. Much more
a. Listen to the instructor lecture during class.	1	2	3	4	5	1	2	3	4	5
b. Brainstorm different possible solutions to a given problem	1	2	3	4	5	1	2	3	4	5
c. Find additional information not provided by the instructor to complete assignments	1	2	3	4	5	1	2	3	4	5
d. Work in assigned groups to complete homework or other projects	1	2	3	4	5	1	2	3	4	5
e. Make individual presentations to the class	1	2	3	4	5	1	2	3	4	5
f. Be graded on my class participation	1	2	3	4	5	1	2	3	4	5
g. Study course content with classmates outside of class	1	2	3	4	5	1	2	3	4	5
h. Assume responsibility for learning material on my own	1	2	3	4	5	1	2	3	4	5
i. Discuss concepts with classmates during class	1	2	3	4	5	1	2	3	4	5
j. Make and justify assumptions when not enough information is provided	1	2	3	4	5	1	2	3	4	5
k. Get most of the information needed to solve the homework directly from the instructor	1	2	3	4	5	1	2	3	4	5
l. Be graded based on the performance of my group	1	2	3	4	5	1	2	3	4	5
m. Preview concepts before class by reading, watching videos, etc.	1	2	3	4	5	1	2	3	4	5
n. Solve problems in a group during class.	1	2	3	4	5	1	2	3	4	5
o. Solve problems individually during class	1	2	3	4	5	1	2	3	4	5
p. Answer questions posed by the instructor during class	1	2	3	4	5	1	2	3	4	5
q. Ask the instructor questions during class	1	2	3	4	5	1	2	3	4	5
r. Take initiative for identifying what I need to know	1	2	3	4	5	1	2	3	4	5
s. Watch the instructor demonstrate how to solve problems	1	2	3	4	5	1	2	3	4	5
t. Solve problems that have more than one correct answer	1	2	3	4	5	1	2	3	4	5
u. Do hands-on group activities during class	1	2	3	4	5	1	2	3	4	5

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Acknowledgements

This project is funded by the U.S. National Science Foundation through grant numbers 1347417, 1347482, 1347580, 1347718, and 1500309. The opinions are those of the authors and do not necessarily represent the National Science Foundation. The authors would like to thank the instructors and students who agreed to be part of the pilot study, as well as project advisory board members.

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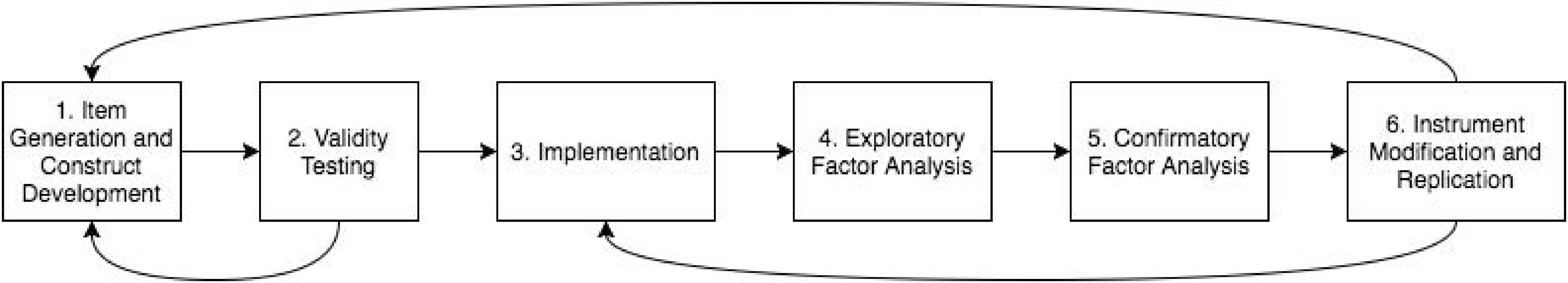
[Insert Figure 1]

Figure 1. The StRIP Instrument Development Process (adapted from Hinkin, 1998).

[Insert Figure 2]

Note: Items in bold are those measured in the StRIP instrument. Items with asterisks are measured using other instruments not discussed here.

Figure 2. A framework for explaining students' responses to types of instruction.


1. Item Generation and Construct Development
2. Validity Testing
3. Implementation
4. Exploratory Factor Analysis
5. Confirmatory Factor Analysis
6. Instrument Modification and Replication

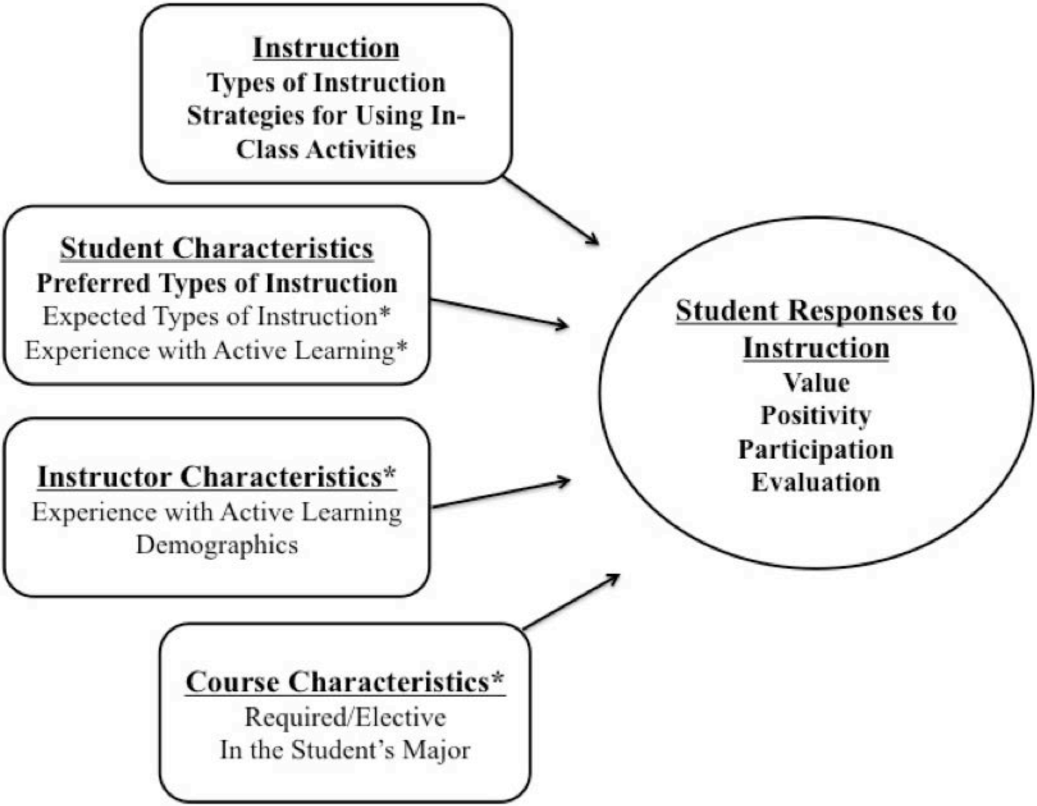

Instruction
Types of Instruction
Strategies for Using In-Class Activities
Student Characteristics
Preferred Types of Instruction
Expected Types of Instruction*
Experience with Active Learning*
Instructor Characteristics*
Experience with Active Learning
Demographics
Course Characteristics*
Required/Elective
In the Student's Major
Student Responses to Instruction
Value
Positivity
Participation
Evaluation

Table 1

"Types of Instruction" Items

For each of the following things, please indicate how often you did each thing in this course, and how often you would like to do each in your ideal course.

For how often you did each thing: *1. Never; 2. Seldom (1-5 times/semester); 3. Sometimes (5-10 times/semester); 4. Often (once a week); 5. Very often (more than once/week)*
For how often you would like to do each thing: *1. Much less; 2. Slightly less; 3. About the same; 4. Slightly more; 5. Much more*

1. Study course content with classmates outside of class.
2. Discuss concepts with classmates during class.
3. Work in assigned groups to complete homework or other projects.
4. Solve problems in a group during class.
5. Do hands-on group activities during class.
6. Be graded based on the performance of my group.
7. Brainstorm different possible solutions to a given problem.
8. Make and justify assumptions when not enough information is provided.
9. Take initiative for identifying what I need to know.
10. Find additional information not provided by the instructor to complete assignments.
11. Assume responsibility for learning material on my own.
12. Solve problems that have more than one correct answer.
13. Preview concepts before class by reading, watching videos, etc.
14. Ask the instructor questions during class.
15. Answer questions posed by the instructor during class.
16. Solve problems individually during class.
17. Make individual presentations to the class.
18. Be graded on my class participation.
19. Listen to the instructor lecture during class.
20. Watch the instructor demonstrate how to solve problems.
21. Get most of the information needed to solve the homework directly from the instructor.

Table 2

“Strategies for Using In-Class Activities” Items

When the instructor asked you to do an in-class activity (e.g,. solve problems in a group during class or discuss concepts with classmates), how often did the instructor do the following things?

1. Almost never (< 10% of the time); 2. Seldom (~30% of the time); 3. Sometimes (~ 50 % of the time); 4. Often (~ 70 % of the time); 5. Very Often (> 90 % of the time)

1. Clearly explained what I was expected to do for the activity.
2. Clearly explained the purpose of the activity.
3. Discussed how this activity related to my learning.
4. Solicited my feedback or that of other students about the activity.
5. Used activities that were the right difficulty level (not too easy, not too difficult).
6. Walked around the room to assist me or my group with the activity, if needed.
7. Encouraged students to engage with the activity through his/her demeanor.
8. Gave me an appropriate amount of time to engage with the activity.

Table 3

“Students’ Responses to Instruction” Items

In this course, when the instructor asked you to do an in-class activity (e.g., solve problems in a group during class or discuss concepts with classmates), how often did you react in the following ways?

1. Almost never (<10% of the time); 2. Seldom (~30% of the time); 3. Sometimes (~50 % of the time); 4. Often (~70 % of the time); 5. Very Often (>90 % of the time)

1. I felt the time used for the activity was beneficial
2. I saw the value in the activity
3. I felt the effort it took to do the activity was worthwhile
4. I felt positively towards the instructor/class
5. I felt the instructor had my best interests in mind
6. I enjoyed the activity
7. I participated actively (or attempted to)
8. I tried my hardest to do a good job
9. I rushed through the activity, giving minimal effort (R)
10. I focused on doing specifically what the instructor asked, rather than on mastering the concepts (R)
11. I talked with classmates about other topics besides the activity (R)
12. I surfed the internet, checked social media, or did something else instead of doing the activity (R)
13. I pretended but did not actually participate (R)
14. I distracted my peers during the activity (R)
15. I disliked the activity and voiced my objections (R)
16. Overall, this was an excellent course.*
17. Overall, the instructor was an excellent teacher.*

*The stem for these items differed from others. It was “Please rate your level of agreement with the following items. (1. Strongly disagree; 2. Disagree; 3. Neutral; 4. Agree; 5. Strongly agree)

(R) These items were reverse-coded

Table 4

Descriptive Statistics for Pilot Testing of StRIP Instrument (n=362)

First pilot phase (n=191) – Exploratory Factor Analysis			
Course #1 (n=96)	Course #2 (n=34)	Course #3 (n=34)	Course #4 (n=27)
Sophomore-level chemical engineering course	Team-taught first-year engineering course	Sophomore-level thermodynamics course	First-year chemical engineering course
Team-based work in randomized seating assignments	Traditional lecture-style and pair-and-share group work	Multiple instructional practices throughout the semester	Primarily traditional instructional strategies (comparison class)
Second pilot phase (n=171) – Confirmatory Factor Analysis			
Course #5 (n=24)	Course #6 (n=50)	Course #7 (n=24)	Course #8 (n=54)
Lower division mechanical engineering course.	Lower division electrical engineering course.	Junior-level fluid mechanics course in mechanical engineering	First-year chemical engineering course
Students worked on problems individually	Group based problem solving and discussion activities	Multiple instructional practices throughout the semester	Primarily traditional instructional strategies (comparison class)

Table 5

Factor Loadings for Promax Oblique Four-Factor Solution for the Ideal Types of Instruction Items

Instrument Item	Factor 1	2	3	4
Factor 1: Interactive (6 items)				
Solve problems in a group during class.	0.71			
Do hands-on group activities during class.	0.61			
Discuss concepts with classmates during class.	0.59			
Work in assigned groups to complete homework or other projects.	0.56			
Be graded based on the performance of my group.	0.52			
Study course content with classmates outside of class.	0.42			
Factor 2: Constructive (6 items)				
Make and justify assumptions when not enough information is provided		0.69		
Find additional information not provided by the instructor to complete assignments		0.66		
Take initiative for identifying what I need to know		0.62		
Brainstorm different possible solutions to a given problem.		0.58		
Assume responsibility for learning material on my own		0.58		
Solve problems that have more than one correct answer		0.43		
Factor 3: Active (6 items)				
Make individual presentations to the class.			0.64	
Be graded on my class participation.			0.54	
Solve problems individually during class.			0.47	
Answer questions posed by the instructor during class.			0.46	
Ask the instructor questions during class.			0.42	
Preview concepts before class by reading, watching videos, etc.			0.32	
Factor 4: Passive (3 items)				
Listen to the instructor lecture during class.				0.52
Watch the instructor demonstrate how to solve problems.				0.57
Get most of the information needed to solve the homework directly from the instructor.				0.48
Eigenvalue	2.08	2.59	1.49	1.16
% of Variance	23%	29%	17%	13%
Construct Reliability	0.73	0.77	0.63	0.59

Table 6

Factor Loadings for Promax Oblique Two-Factor Solution for the Strategies for Using In-Class Activities Items

Instrument Item	Factor 1	Factor 2
Factor 1: Explanation (4 items)		
Clearly explained the purpose of the activity.	0.66	
Discussed how this activity related to my learning.	0.60	
Clearly explained what I was expected to do for the activity.	0.42	
Used activities that were the right difficulty level.	0.38	
Factor 2: Facilitation (4 items)		
Encouraged students to engage with the activity through his/her demeanor.		0.81
Walked around the room to assist me or my group with the activity, if needed.		0.71
Gave me an appropriate amount of time to engage with the activity.		0.56
Solicited my feedback or that of other students about the activity.		0.37
Eigenvalue	1.96	1.62
% of Variance	49%	41%
Construct Reliability	0.80	0.71

Table 7

Factor Loadings for Promax Oblique Five-Factor Solution for the Strategies for the Student Responses to Instruction Items

Instrument Item	Factor 1	2	3	4	5
Factor 1: Value (3 items)					
I felt the time used for the activity was beneficial	0.89				
I saw the value in the activity	0.84				
I felt the effort it took to do the activity was worthwhile	0.71				
Factor 2: Positivity (3 items)					
I felt positively towards the instructor/class		0.73			
I felt the instructor had my best interests in mind		0.66			
I enjoyed the activity		0.57			
Factor 3: Participation (4 items)					
I participated actively (or attempted to)			0.59		
I tried my hardest to do a good job			0.48		
I pretended but did not actually participate			0.46		
I rushed through the activity, giving minimal effort			0.41		
Factor 4: Distraction (5 items)					
I distracted my peers during the activity				0.63	
I talked with classmates about other topics besides the activity				0.60	
I surfed the internet, checked social media, or did something else instead of doing the activity				0.52	
I pretended but did not actually participate				0.35	
I rushed through the activity, giving minimal effort				0.34	
Factor 5: Evaluation (2 items)					
Overall, this was an excellent course					0.82
Overall, the instructor was an excellent teacher					0.82
Eigenvalue	2.00	1.28	1.70	2.10	1.36
% of Variance	67%	43%	43%	27%	68%
Construct Reliabilty	0.87	0.72	0.77	0.69	0.73*

*Statistic calculated using the Spearman-Brown coefficient (Eisinga et al., 2013)

Table 8

Confirmatory Factor Analysis Estimates for Ideal Types of Instruction

Instrument Item	Standardized factor loadings	Standard Error	Item reliability (R^2)	Construct reliability	Average variance extracted
Factor 1: Interactive (6 items)				0.80	0.88
Solve problems in a group during class.	0.72	0.05	0.74		
Do hands-on group activities during class.	0.63	0.06	0.76		
Discuss concepts with classmates during class.	0.64	0.06	0.77		
Work in assigned groups to complete homework or other projects.	0.70	0.05	0.75		
Be graded based on the performance of my group.	0.44	0.07	0.80		
Study course content with classmates outside of class.	0.61	0.06	0.77		
Factor 2: Constructive (6 items)				0.77	0.86
Make and justify assumptions when not enough information is provided	0.51	0.07	0.76		
Find additional information not provided by the instructor to complete assignments	0.66	0.05	0.72		
Take initiative for identifying what I need to know	0.60	0.06	0.73		
Brainstorm different possible solutions to a given problem.	0.50	0.07	0.75		
Assume responsibility for learning material on my own	0.76	0.05	0.69		
Solve problems that have more than one correct answer	0.50	0.07	0.75		
Factor 3: Active (6 items)				0.73	0.85
Make individual presentations to the class.	0.43	0.08	0.72		
Be graded on my class participation.	0.42	0.08	0.73		
Solve problems individually during class.	0.55	0.06	0.71		
Answer questions posed by the instructor during class.	0.74	0.04	0.67		
Ask the instructor questions during class.	0.74	0.04	0.67		
Preview concepts before class by reading, watching videos, etc.	0.56	0.06	0.70		
Factor 4: Passive (3 items)				0.65	0.80
Listen to the instructor lecture during class.	0.62	0.09	0.51		
Watch the instructor demonstrate how to solve problems.	0.60	0.08	0.52		
Get most of the information needed to solve the homework directly from the instructor.	0.51	0.08	0.63		

Table 9

Confirmatory Factor Analysis Estimates for Strategies for Using In-Class Activities

Instrument Item	Standardized factor loadings	Standard Error	Item reliability (R^2)	Construct reliability	Average variance extracted
Factor 1: Explanation (4 items)				0.80	0.91
Clearly explained the purpose of the activity.	0.82	0.05	0.68		
Discussed how this activity related to my learning.	0.63	0.04	0.79		
Clearly explained what I was expected to do for the activity.	0.70	0.06	0.75		
Used activities that were the right difficulty level.	0.63	0.05	0.78		
Factor 2: Facilitation (4 items)				0.71	0.83
Encouraged students to engage with the activity through his/her demeanor.	0.81	0.08	0.54		
Walked around the room to assist me or my group with the activity, if needed.	0.70	0.08	0.61		
Gave me an appropriate amount of time to engage with the activity.	0.57	0.08	0.66		
Solicited my feedback or that of other students about the activity.	0.37	0.08	0.75		

Table 10

Confirmatory Factor Analysis Estimates for Student Responses to Instruction

Instrument Item	Standardized factor loadings	Standard Error	Item reliability (R^2)	Construct reliability	Average variance extracted
Factor 1: Value (3 items)				0.87	0.95
I felt the time used for the activity was beneficial	0.71	0.04	0.89		
I saw the value in the activity	0.84	0.03	0.80		
I felt the effort it took to do the activity was worthwhile	0.89	0.03	0.74		
Factor 2: Positivity (3 items)				0.72	0.86
I felt positively towards the instructor/class	0.66	0.07	0.64		
I felt the instructor had my best interests in mind	0.73	0.07	0.53		
I enjoyed the activity	0.57	0.07	0.72		
Factor 3: Participation (4 items)				0.77	0.84
I participated actively (or attempted to)	0.58	0.08	0.70		
I tried my hardest to do a good job	0.67	0.08	0.72		
I pretended but did not actually participate	0.71	0.07	0.74		
I rushed through the activity, giving minimal effort	0.64	0.09	0.68		
Factor 4: Distraction (5 items)				0.73	0.85
I distracted my peers during the activity	0.58	0.08	0.75		
I talked with classmates about other topics besides the activity	0.39	0.05	0.68		
I surfed the internet, checked social media, or did something else instead of doing the activity	0.65	0.06	0.65		
I pretended but did not actually participate	0.70	0.06	0.67		
I rushed through the activity, giving minimal effort	0.63	0.06	0.65		
Factor 5: Evaluation (2 items)				0.72*	0.93
Overall, this was an excellent course	0.82	0.05	0.60		
Overall, the instructor was an excellent teacher	0.82	0.05	0.60		

*Statistic calculated using the Spearman-Brown coefficient (Eisinga et al., 2013)