Students' Perception of Teaching Practice in an Active Learning Environment

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Abstract

Physics Education Research has been very active since the late 70’s trying to reduce the gap between what the instructor teaches and what the students learn. One of the most important results of that research is the design of educational strategies and materials that help instructors with their teaching. It has been proved that using research-based instructional strategies in which students participate in an active way; students learn better than that of those taught in a traditional setting. Based on the Teaching Practices Inventory, we designed a survey for physics engineering students in an active learning environment to gauge what, in their perspective, is important for their comprehension. The results indicate that what instructors know is essential for students’ learning is not always the same as what students believe is important for their learning.

Keywords: Educational Innovation, Teaching Practices Survey, Physics Education Research, Active Learning.

Introduction

In the last century, significant changes in teaching and learning have transformed the foundation of education. Over time, the role of the teacher has evolved, from the transmitter of knowledge (traditional education) to facilitator [1]–[3]. Dewey [4] argued that people learn by doing, students should be exposed to experiential activities that promote reflection. Students are now placed in the center playing the main role as they are the ones who actively construct their own knowledge through the tools that the teacher provides and social interactions [5].

Active learning has been defined in different ways, Bonwell & Eison [6] provided a practical definition as "any activity that involves students doing things and thinking about what they are doing." It has been documented that active learning produces better results than traditional teaching [7]–[9] and these results are consistent for different STEM areas [10]–[14] and a variety of learning strategies [15], [16].

Given the increasing number of teachers and professors, from different content areas, moving towards active learning methodologies is relevant to evaluate the teaching practices. To that end, there have been several efforts to identify the elements and dimensions that could characterize student-centered methods from the teaching as well as from the learning perspective [17]–[19]. To this end, Wieman & Gilbert [20] developed an instrument to evaluate instructors practices for each course taught. It is understood that not all teaching practices may be applied to all courses even by the same instructor. Moreover, one instructor may decide to implement a different variety of active-learning technique for different sections of the same course depending on the students (or class) needs. The Teaching Practices Inventory [20] consists of 72-items divided into eight categories: course information, supporting materials, in-class features and activities, assignments, feedback and testing, assessing learning instruments, training of the teaching assistant, and teaching collaboration.

For the Teaching Practices Inventory [20] had been reported several implementations [21]–[23] that shows the usefulness of such an inventory. However, the perspective of the instructor is not probably the same as the perspective of the student. The purpose of this contribution is to try to understand the perception of the student in an active learning environment is. The question is that to what extent the students' perception of the importance of active learning activities or procedures compare to what the literature indicates is active learning. The question is that to what extent students give active learning activities or procedures importance and compare to what the literature indicates is active learning.

Context

This study was conducted at a large private university. All the participants took a physics engineering major calculus-based electricity and magnetism (E&M) course during their fourth semesters, i.e., different cohorts. The textbook used in all semesters was University Physics by Young and Freedman [24]. Students of the course also attended weekly laboratory sessions in which McDermott & Shaffer Tutorials in Introductory Physics [25] was used. All instruction, activities, tests, etc. were conducted in Spanish.

The instructor of the course used active learning for instruction [26]. There were activities using the Tutorials in Introductory Physics [25], but also, Peer instruction [15], collaborative-learning problem-solving activities, conceptual building activities such as TIPERs [27], cognitive scaffolding activities [28] and educational technologies such as the interactive simulations of PhETs [29]. The instruction for this course is in a SCALE-UP type of classroom [30] in which a collaborative and interactive environment promotes discussion and cooperative work among students.

Methodology

The sample is composed of E&M students from different disciplinary cohorts. We surveyed 157 students by sending an email to their university account inviting them to complete the survey, 47 of them replied. For all the different cohorts, the same instruction was implemented, and since in this contribution we will focus on general results, we are not going to present results comparing cohorts.

The instrument was an adapted survey by Wieman and Gilbert [20]. The original survey is intended to assess the level of active learning in an instructor's course asking items in which the instructor fill the different items answering whether he(she) implemented some activities/strategies and sometimes in what degree. All of the activities/strategies the survey asks are those in which the literature has (mostly) agreed that are considered active learning activities.

We adapted the survey to be implemented with students. Some questions were not included in the students' survey since they were not items in which they knew the answer. The items that were not added were in section III, part B of Wieman and Gilbert survey [20] in which the instructor is asked for the kind of teaching method he(she) used. In section V, part C, the only question that we added was the approximate fraction of exam mark from questions that required students to explain their reasoning. The other questions in which the original survey asks for the number of midterm exams and the breakdown, of course, were not added since that was information we already had. In section VI, these two items: “The use of a consistent measure of learning that is repeated in multiple offerings of the course to compare learning” and “New teaching methods or materials were tried along with measurements to determine their impact on student learning” were not included since those are not items which students know the answer. In section VII, those questions in which the survey asks to indicate whether the teaching assistants had some specific time training before going to class were not added to this survey. The only two items in this section were to ask whether there were teaching assistants and whether they were undergraduate or graduate students. Lastly, sections VIII and IX were not included since the first requests for collaboration of the instructor with colleagues and the second are open-ended questions that we decided not to include since the survey was already long for students to answer.

In addition to the items, we added, for each item when this was possible, a question whether the activity mentioned was important or not on a Likert scale of five degrees. For instance, items like: “Students read/view material on upcoming class session and complete assignments or quizzes on it shortly before class or at the beginning of class” in which instructors are asked to say whether that occurred or not. For students, we asked the same thing, whether that happened or not, but also, we asked in students’ opinion, whether that was important or not.

We analyzed the students’ responses to the survey in two ways. In items in which students were asked whether that activity occurred or not, for the instructor survey Wieman and Gilbert [20] gave a score from 0 to 2. The original survey is for an individual instructor and for a specific course. In our case, the survey was for a group of students for a specific course. We then decided to weight the average students’ responses. That is, we multiplied the score by the percentage of students replying that the item or activity indeed occurred.

In the case of the students’ opinion regarding the importance of the activity, we grouped the levels “very important” and “somewhat important” as *important* and the levels “little important” and “no important” as *not important*. The neutral level was discarded such that the sum of the percentages of students saying *important* and *not important* does not add to 100%.

Results

We divided the results into two sections: (1) the results of the percentage of students agreeing that the activity occurred and the score in the survey and (2) the results of the students’ opinion of the importance of the activity.

Survey results

Table I presents the results only for section I of the survey, “Course information provided to students.”

TABLE I
RESULTS FROM SECTION I OF TEACHING PRACTICE INVENTORY, STUDENTS' VERSION, STUDENTS' EVALUATION.

Section I: Course information provided to students	**Yes**	**Wieman & Gilbert score**	**Students' evaluation**
List of topics covered	96%	1	0.96
List of topic-specific competencies (skills, expertise…) that students should achieve (what students should be able to achieve)	87%	3	2.62
List of competencies that are not topic related (critical thinking, problem solving, …)	64%	1	0.64
Affective goals - changing students' attitudes and beliefs (interest, motivation, relevance, beliefs about their competencies, how to master the material)	70%	1	0.7

There are four items in section I, the original version has five sections; in this students' version of the inventory we decided not to add the items *others* in consideration of the length of the survey. In table I, the first column is the item description. The second column is the percentage of students who answered that this activity did occur. The third column is the score that [20] gives to the item. The last column is the students' evaluation, that is, the multiplication of the second column by the score (third column). This procedure was done for all items in the students' version of the survey. We include only this section since we want to focus on the general results, not the specifics.

Adding all items in the students' version, the students' score adds to 38.19 out of 50 possible points. This is 76% of all points possible with the items on the survey. Comparing this percentage to the score Wieman & Gilbert [20] reported, students perception of active learning activities is high. They report different scores for different instructors/courses. The highest score is about 50 out of 67 points, which is about the same as this course.

In addition, adding the score of the items which were not included on the students' version (see the methodology section), there are 17 points available. According to the instructor of the course, from the 17 points not included in the survey, the course complies with 12. That is, if those items would have been included, the total score would be 50.19 compared to about 50 of the highest score reported.

There are differences of score according to the students and according to the instructor of the course. For instance, 83% of the students agreed with the item "Students read/view material on the upcoming class session and complete assignments or quizzes on it shortly before class or at the beginning of class", so the score for this item was 1.66. However, according to the instructor, indeed that occurred, so the instructor' score is 2 having a 0.34 difference.

On the other hand, differences occurred in the other direction. One of the items asked students whether they were provided solutions for exams used on other previous years. 13% of students agreed with that item giving the students' score 0.13 points. However, according to the instructor, he never provided such solutions. In this case, there is a difference of 0.13 overestimating the students' score.

According to the instructor, considering the items on the students' version of the survey, a score of 36 points were obtained. Taking the whole Teaching Practice Inventory, the score is 48 points. This score is higher than any of the scores provided in the original report.

Perception of the importance of items

Table II presents the results for only section I of the survey: Course information provided to students. The section is the same as the one shown in the previous part; however, in this case, the students' perception of importance is presented.

TABLE II
RESULTS FROM SECTION I OF TEACHING PRACTICE INVENTORY, STUDENTS' VERSION,
STUDENTS' PERCEPTION OF THE IMPORTANCE OF THE ACTIVITIES.

Section I: Course information provided to students	**Wieman & Gilbert score**	**Important (I)**	**Not important (NI)**	**D**	**Not scored**	**Scored items score =1**	**High score items score >1**
List of topics covered	1	87%	0%	87%		Consistent	
List of topic-specific competencies (skills, expertise …) students should achieve (what students should be able to achieve)	3	64%	11%	53%			Consistent
List of competencies that are not topic related (critical thinking, problem solving, …)	1	47%	23%	23%		Not consistent	
Affective goals - changing students' attitudes and beliefs (interest, motivation, relevance, beliefs about their competencies, how to master the material)	1	68%	15%	53%		Consistent	

In the table, the first column is the item description. The second column is the score Wieman and Gilbert [20] gives to the item. The third and the fourth column are the perceptions of the importance of each of the activities scored as mentioned in the methodology section. The fifth column is the subtraction of the third column (important) minus the fourth column (not important); that is, we name this difference D as the percentage of students who said the activity was important minus the percentage of students who reported the activity was not important.

The three last columns depend on the Wieman & Gilbert score. The sixth column corresponds only to items that were not scored. In this section of the survey, there are no items with this characteristic. The seventh column corresponds to items which were scored with one point, and the last column corresponds to items which were scored with two or more points. These three columns give a measure of the importance of the items (the activities in the course) regarding active learning.

For each column, depending on the item, we defined that the item was consistent with the survey's intention whether the difference D was higher or not than 50%. In the case of the *Not scored* items, the students' perception is **not consistent** if the percentage is higher than 50%. On the other hand, in the case of the other two columns (scored and high scored items), the students' perception is **consistent** if the percentage is higher than 50%.

For the items that are not scored, there were two items that students' perceptions were consistent and three that were not consistent with the intention of the survey. One of the items that were not consistent was in section II, supporting materials. One of the items asks students whether or not the instructor provided other selected notes or supporting materials, pencasts, etc. This item is not scored, and 74% of students agreed that this was important and only 4% said that this was not important (difference D is 70%). On the other hand, an example of an item that was consistent to the survey was in the same section II, asking whether instructor provided students' wikis or discussion boards with little discussion or no contribution from the instructor. Only 34% of students believe that this is important and 55% of students think this is not important (difference D of negative 21%).

In the case of the scored items (score equal to one), there were 15 that are consistent with the survey and 14 that are not consistent with the survey. One of the highest difference D of the items was one that asks students whether the instructor showed graded the midterm exams. 94% of students agreed that this is important, and no student said that was not important (difference D of 94%). On the other hand, from the not consistent items, one of the smallest difference D was the item in which students present orally or by posters. 28% of students said this was important and 47% of students reported that this is not important (difference D of negative 19%).

In the case of the high score items (a score greater than one), there was seven items in which students' perceptions agreed with the survey intention and two that are not consistent. One of the highest differences D was an item in which the students are asked for the average number of times per class in which they have small group discussions or problem-solving. 85% of students marked that this is important and only 4% of them marked it as not important (difference D equal to 81%). On the other hand, one of the items in which students' perception is not consistent with the survey intention was in the feedback to the students section. The students were asked whether or not the instructor provided with assignments with feedback before grading or with the opportunity to redo work to improve the grade. 64% of students said this is important, but 19% of them said that this is not important making the difference D as 45%. That is, although more students think this is important, there are a significant number of students who disagree. The other item which was not consistent was on whether or not the instructor used a pre-post test (concept inventory) to measure learning. Only 53% of students said this was important and 13% of them said that this was not important (difference D equal to 40%).

Discussion and concluding remarks

According to the Teaching Practice Inventory [20], the course in which this contribution is based is an active learning class. The total score when the survey was filled by the instructor was 48 points, about the same as the highest provided by the original article [20]. In the case of the students' version of the inventory, the score was 38.19 out of 50 (76%) of the possible points compared to about the same for the highest score in the original report. Another comparison is the one reported by Drinkwater, Matthews and Seiler [22] which presented results in which the highest scores are courses with 50 points. Moreover, learning gain for this course for the different cohorts are around 0.55. It is interesting that, even though there are differences in students' perceptions in some items compared to the instructor's responses, in the end, the total score is similar. This result makes us think that the procedure we used to score the results is valid.

The main objective of this work is to provide a study that shows the perspective of students regarding active learning. In that respect, we asked students for the importance of the activities mentioned in the survey. According to the results, there are consistencies between what an instructor (or the research literature) says what activities/procedures are important to have in a course and what students perceive regarding those activities/procedures. We obtained that there are more consistencies than inconsistencies. The consistencies are important, but, in our opinion, the inconsistencies are more important. We as instructors act to have students' learning as high as possible. We know, according to the literature what to do. However, if students do not perceive that the activities or procedures we do are to benefit the teaching and learning, then probably our efforts will not be as effective as we want. That the students perceive to have pre and post-test in the course is not that important, may affect the students' performance on those diagnostics. That the students perceive that the oral presentations or the poster presentations are not as important, then the time and effort they give to those activities will not be useful for their learning.

There are some limitations to this study. The decisions we made on scoring an item as consistent or not consistent could be one of them. However, the percentage we use and the results we presented were the extremes to minimize the effect of that decision. We believe that this contribution is an important light on what students perceive regarding active learning activities and procedures the literature agrees is essential.

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