



Conversational and Comprehensive Approach to Gather Feedback In Mathematical Science

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Abstract

. Survey in classroom allows teachers to quickly ask a question and instantly receive feedback from students. This is a very efficient strategy to engage students in an online lecture, but it can be used in a face-to-face classroom as well, especially in large cohorts. This research reports the experiences of using polls in two different groups, university students within a few courses in the field of computer science and mathematics. In mathematics, education polling helps students to grasp mathematical concepts. By sharing and comparing their responses, students can evaluate different approaches, debate strategies, and collectively analyze solutions. This teaching method is applicable in all subjects, but it is also time consuming. So, it is essential to manage time effectively to ensure that it does not disrupt the flow of the lesson or compromise the coverage of important content. By planning strategically and utilizing time-saving techniques, it is possible to integrate polling effectively within the constraints of limited classroom time. The professor must strike a balance between the benefits of polling and the need to cover the necessary content and learning objectives.

Keywords: Anonymous, Confusion, Interaction, Feedback etc.

1 Introduction

Polling in the classroom refers to a teaching method of gathering feedback or opinions from students through the use of questions or prompts. The teacher poses a question or some other tasks to the students and they respond individually by selecting their answer or indicating their opinion. This strategy provides real-time feedback during the lectures, so the teacher can use them to gauge student understanding, gather insights, or guide further discussion. Polls can be anonymous or not. To vote non-anonymously students can simply vote by raising their hand. Anonymous polling can also be achieved by the use of some technological devices. Mazur was the first to introduce a learning methodology that uses devices, known as Peer Instruction methodology, where he uses clickers, handheld electronic devices, to collect and record students' responses and transmit them wirelessly to a receiver. The main idea behind this methodology was to initiate peer discussion, since he believed that often peers can be better at explaining concepts to each other than experts. Over time, as technology advanced, more sophisticated polling methods were introduced. There are many dedicated software or web-based tools to create polls or quizzes.

Also, almost all web conferencing and video communication platforms offer either built-in polling feature or third-party extensions to conduct polls. Unlike non-anonymous polling, where participants might be hesitant to express unpopular opinions or concerns due to the lack of anonymity, anonymous polling allows students feel more comfortable and lead to more candid and diverse responses and active participation from all students. This type of assessments provides a quick and efficient way for teachers to assess student comprehension and identify areas of confusion or misconceptions. By collecting anonymous responses, teachers can get a more accurate representation of the overall understanding of the class, helping them tailor their instruction and address specific needs.

Previous research finds that the field of online polling needs to be seen as a modern teaching tool that now uses students' personal technology for easier use by students and teachers. The focus is most on how such polls can be successfully deployed, describing different ways to use specific poll applications to create interesting quizzes and polls. They found that students' reaction to this teaching technique is generally quite positive. Students enjoy playing an active role in the classroom, have fun clicking in with their votes, and often attendance improves.

This research aims to see the benefits of online surveys during classes, what their advantages and disadvantages are and how we can extract meaningful information from them. In addition, we could also analyze and compare the results obtained from the surveys with the overall results achieved by the students within the courses. The initial assumption is that online surveys during class can provide the necessary information for the teacher about how much and how well the students are mastering the concepts, which would allow in real time to pay more attention to the parts of the material that are not understood properly. In addition, the assumption is that the analysis of these data can contribute to the improvement of the courses in relation to the way it was conceived.

Survey in Mathematics -

Teachers have a daily struggle to encourage active participation and discussion in their class. This is especially expressed in mathematics subjects, which are generally more difficult for students, because the concepts that are elaborated are related with some previous concepts. At our faculty, the problem is greater primarily because large amount of material must be covered within three consecutive classes, and usually it is assumed that the students are familiar with the material which is taught in the third class from the first class in that block. It is even more difficult to detect what they haven't quite understood. So, it is a big challenge for the professor to keep everyone on task and engaged in learning and to give each student the individual attention they need [9]. The development of information technologies greatly improves the situation by allowing on-line tests that automatically check the answers of students [10]. By using such tests, the professor can collect important information about the progress of the class, but the feedback is only after the lecture is over, so there is usually no time to go back to the material next week.

It is easy to tell if students are engaged when face-to-face in small groups. But in large classes, more active students often dominate, so the professor can generalize the of some small active group of students and it is almost impossible to know the opinion of each individual student. The situation in online teaching is even worse. Many of them who would comment on a question face-to-face in a classroom, during an online class do not react at all. Moreover, in online teaching, you simply cannot ask a question to the whole group. Even if students start responding, either by microphone or chat, it will create a chaotic situation. Therefore, during the pandemic when all tuitions were online, each professor, to help students be involved during class, had to look for alternatives to engage them [10]. Due to the lack of classrooms, even after the pandemic, part of the lectures is online. In many situations, like additional classes or some other situations, online classes are found as the best option.

In both cases, large classes and online teaching, polls are found to be a very good option to increase the interaction in the math class. There are various online tools that can be effective for polling in a mathematics classroom. Some popular online voting systems are Mentimeter, Poll Everywhere, Socrative, Kahoot and others. These tools often offer features like multiple-choice questions, open-ended responses, and data visualization. All of them allow you to ask questions of your learners, collect their responses by inviting them to respond through a website or phone text link. You can share collective responses in a variety of formats in real-time during the lecture. But during the on-line classes we were using the polling feature incorporated in the virtual classroom platform. We used Big Blue Button and Zoom.

The polling feature on both platforms allows you to create single-choice or multiple-choice polling questions for your meetings. BBB also has a “user response” option which is in fact an open-ended question. Both have pop-up polling windows that appear within the meeting for students to vote. Anonymous results can be shared with the participants after it is closed, but the presenter knows the individual responses.

We used polls in few university courses: Discrete structures 2, Probability and statistics, Formal languages and automata, Design of algorithms and Linear algebra This method was also used at a math camp for mathematically talented primary school students for the course “Percentages and proportions” for sixth graders. Not all math topics are suitable for asking survey questions and sometimes polling takes more time than the professor can afford to spend. Below we present our experience on different topics.

3.Scenarios' settings

This course covers relations, graphs, combinatorics and selected topics in algorithm analysis. The polling methodology is most suitable for this course, as there are many short-answer tasks, and moreover, students do not need a lot of time to answer them. There are also many problems that can be adopted as yes/no questions. At some lessons we were able to place more than 20 questions within 3 lecture hours. Here are some examples:

Yes/no questions: Is this relation transitive? Is the composition of two symmetric relations always a symmetric relation? Is this graph a planar? Is this proposition a loop invariant for a given loop?

Multi choice questions: How many children does the vertex a have? How many subsets of $A = \{1, 2, 3, 4, 5, 6\}$ are there of cardinality 4? What is the chromatics number of this graph?

User response: How many solutions in $\mathbb{N}_0$ the equation $a + b + c = 0$ have? Determine the preorder of this tree! Give a proposition which is loop invariant for a given loop!

All questions can be asked as a user response questions, but multi choice and yes/no questions are easier to analyze since they give the percent of correct answers immediately. They give the percentage of all choices, so the teacher can focus on identifying the reasons why some incorrect choice is made so frequently. On the other side, the teacher We used polls in few university courses: Discrete structures 2, Probability and statistics, Formal languages and automata, Design of algorithms and Linear algebra This method was also used at a math camp for mathematically talented primary school students for the course “Percentages and proportions” for sixth graders. Not all math topics are suitable for asking survey questions and sometimes polling takes more time than the professor can afford to spend. Below we present our experience on different topics.

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All questions can be asked as a user response questions, but multi choice and yes/no questions are easier to analyze since they give the percent of correct answers immediately. They give the percentage of all choices, so the teacher can focus on identifying the reasons why some incorrect choice is made so frequently. On the other side, the teacher needs to carefully select the options they give as alternative choices, especially in combinatorics. We try to select options that make sense to be correct answers, in order to be able to initiate a discussion about why that particular choice is not the right one. Moreover, we tried to make every question we asked to support learning, not just to activate students. Open-ended questions are not perfect for analysis, but they give the best description of the students' way of thinking. For such questions we tried to discuss all given answers, so this often takes a lot of time that could perhaps be used better. That's why we used them less often in this course and only for more complicated problems, when the professor expects a wide range of answers. Yes/no questions are the easiest to send and the feedback is the fastest. The discussion after takes less time than the discussion after answering other types of questions, so we used them whenever it was possible.

Probability and statistics

Polling methodology is suitable for this course in many ways, but the amount of material covered by this course does not allow us to use it very often. Some examples of questions:

Yes/no questions: Are there disjoint events that are also independent events? The professor can give a description of two random variables associated with an experiment and ask students whether they are independent or not. The professor can give the value of some test statistics and ask whether this value rejects the null hypothesis.

Multi choice questions: A professor might describe an experiment involving a random variable and ask students to guess the distribution of that variable. The professor can set a problem for which the students will determine what statistical test they will need to use.

User response: In all situations as in combinatorics, instead of number of ways in which an event can happen, the students have to determine the probability of that event. Due to the lack of writing formulas, this module is not very useful.

In this course, we recommend polling for a better understanding of discrete probability and probability distributions concepts. Our experience shows that after a number of similar questions, especially in the case of recognizing probability distributions, there is a significant improvement in the number of correct answers. Students very often see the statistics as recipes, without understanding the real meaning. Polling questions can be adapted to help in this direction.

Formal languages and automata

Most of the topics in this course include theoretical proofs and long procedures for designing automata, where polling is not suitable. But regular expressions as well as some simple grammars can be written in a short message, so we were using user response question for this purpose. Although the teacher must leave enough time for students to think and entire procedure for discussion takes longer than in other courses, it is of great benefit for students. Not all students will answer such question, since it is not an easy task, but around 25% of them will always give an answer in order to check if their reason is good or not. As we can see on Fig 1, usually all answers are different..

Conclusion

Polling encourages active participation, stimulates critical thinking, and helps teachers make informed instructional decisions. This is not a pedagogical revolution, but rather it creates a safe environment where students could respond without pressure. By analyzing individual responses, teachers can identify patterns, misconceptions, or knowledge gaps specific to certain students. This information allows them to tailor their instructions and provide differentiated learning experiences to meet the needs of each student. In our experience, polling is well-accepted by students. It provides students with instant feedback on their understanding of a topic. Seeing the results or comparing their responses to those of their peers allows students to gauge their comprehension and identify areas where they may need further clarification or study. Immediate feedback helps students monitor their progress and adjust their learning strategies.

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