Investigating the Impact of Guided Inquiry Tutorials on Student Engagement

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Thank you to those students who agreed to participate in our education project during the 2023-2024 edition of SK-BANV13. Your insights have been invaluable in helping us better understand factors affecting tutorial attendance and engagement. The summary below provides an overview of what we learned and what steps we plan to take next.

Purpose of the Study

Inorganic and Solid-State Chemistry (SK-BANV13) is a second-year course designed for the chemistry bachelor's program. The course's tutorials previously consisted of students working on short problem sets and asking for help from teaching assistants if needed. The problem sets focused on testing student knowledge of lecture topics, and students had the option to work with others or individually. Over the last few years, there has been a noticeable decline in tutorial attendance as well as retention of key course concepts. Our goal was to incorporate new problem sets that were based on guided inquiry principles, and to have students work in small groups to construct knowledge through these scaffolded worksheets. We chose this style of tutorial since it has been linked to increased student interaction, improved academic performance, and the development of transferable skills such as critical thinking and teamwork.[1–3]

Method Overview

The six inorganic tutorials were divided into three new-style and three traditional-style tutorials. The new-style tutorials took place during Weeks 1, 3, and 6, while the traditional-style tutorials took place during Weeks 2, 4, and 5. Tutorial attendance was made mandatory to ensure a more representative dataset. Students had to attend at least five of the six inorganic tutorials to qualify to sit for the exams. Classroom engagement was measured using the Activity Engagement Survey, a 19-item survey designed to investigate behavioral, cognitive, emotional, and social engagement.[4] This survey was selected due to its prior use in chemistry courses.[5] At the end of the course, students were invited to participate in a 20-minute interview that focused on student attitudes towards the two tutorial styles, specifically what aspects students considered beneficial and challenging. Students were also asked about the specific aspects of tutorials that motivated them to participate, as well as for recommendations on future tutorial implementations.

Key Findings & Implications

The following key findings were a result of our investigation with help from your participation:

- *Students indicated liking the new style of worksheet but found it less desirable to work in randomly assigned groups*. When asked which tutorial style was preferred on the final survey, a majority of students selected the new style, but not by a large margin (see Figure 1). This preference seemed to be primarily based on the new style of activities. Students mentioned appreciating the inclusion of background material, how seemingly approachable the questions were, and the direct connection between lecture and tutorial content, although one of the drawbacks of the new activities were their length. The preference for traditional-style tutorials seemed to be mostly driven by the fact that students were given the choice to work with friends or alone. This idea was reinforced when disaggregating tutorial preference by room assignment, where it becomes clear that the traditional-style tutorials were preferred by students in Room B (see Figure 1). These same students also reported lower social engagement in new-style tutorials compared to students in Room A, indicating a more negative experience when made to work in random group assignments.
- *Working in self-selected groups can benefit social engagement, although sometimes at the cost of behavioral and cognitive engagement.* While the engagement survey did not indicate any strong relationship between tutorial style and student engagement, student interviews suggested that the type of group work may impact which form of engagement is activated. Working with friends in a self-selected group may feel more comfortable socially, but oftentimes this can lead to students

being easily distracted. Conversely, if students are put into random groups, then the social pressure of being with those who are less familiar can result in an increase in focus. The downside is that sometimes the social pressure is so great that it can lead to feelings of judgment and embarrassment, causing students to socially withdraw. Selected quotes to illustrate these ideas are shown in Table 1. Each group formation strategy has its own benefits and challenges, and the goal of group work should be carefully considered when deciding how to best form student groups.

- *While the mandatory attendance policy was disliked, academic performance benefited from tutorial attendance.* We set a mandatory attendance policy to ensure the validity of our study as the typical low attendance at tutorial would prevent us from having a representative student sample. Some students felt the conditions of the attendance policy were too severe, yet despite the negative reception of the policy, attending the inorganic tutorials did seem to benefit student exam performance (see Figure 2). Midterm scores for this year's cohort were skewed towards higher grades compared to last year's cohort, and while the average midterm score was similar, the midterm passing rate was slightly higher for this year's cohort (73% versus 68%). This is in contrast with midterm scores for the solid-state portion of the course (for which no attendance policy was in place), where this year's cohort performed worse than last year's cohort (passing rate of 80% versus 88%). When asked in the last survey whether students would have regularly attended tutorial if it was not mandatory, 42% of students stated they would have, 45% stated they would not have, and 13% stated being unsure. This is compared to roughly 84% of students who attended when a mandatory attendance policy was in place.

Next Steps

We plan to use these findings to inform the redesign of the six inorganic tutorials for the 2024-2025 edition of SK-BANV13. More specifically, we will not have a mandatory attendance requirement, but we will instead encourage attendance through other means. This includes only using activities that are inquiry based, although we will ensure these activities are of a more appropriate length. We will also work with teaching assistants in group facilitation strategies so that group work can be more productive. Additionally, we would like to more closely investigate the relationship between engagement and how groups are formed. While fostering social engagement is important, it is also critical that students develop the necessary skills to work productively with people who are less familiar. We plan to design a more systematic study of the effect of self-selected and random group assignments on engagement as well as exam performance.

Contact Information

If you have any questions or comments about this research or would like more information, please contact Jennifer Casey at j.r.casey@uu.nl.

References

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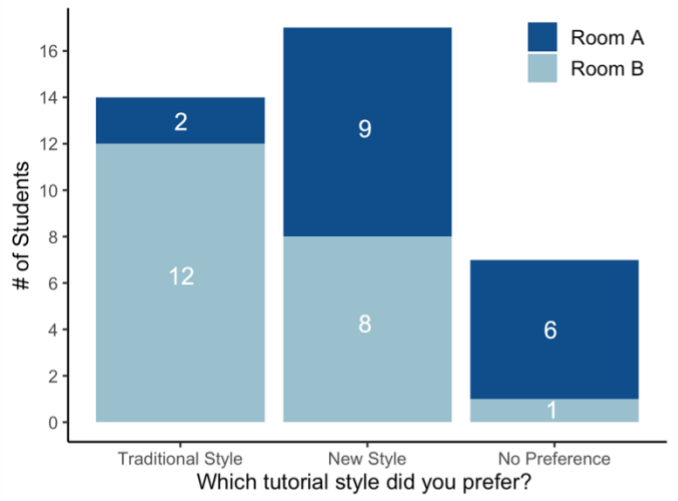

Figure 1: Student responses to the question "Which tutorial style did you prefer?". The data was disaggregated by room (A, dark blue and B, light blue), and the numbers inside each bar indicate the number of students who chose that response.

"… of course you are soon with your own group of friends and that is a lot of fun, but sometimes also distracting because if one person doesn't feel like it, sometimes it goes fine and sometimes you are more easily distracted by that, so that you are also pulled along again."
"There was a much higher level of engagement [with the new method] and also a lot more of what I notice from our group, from my group and also from other groups I think we asked a lot more questions, also to the TA."
"There was a difference between them. For example, I was doing well in tutorial 1 [new style], in terms of motivation. What I didn't like was that I found this tutorial a difficult subject. My group mates went through it quickly, but this was difficult for me. This was because I was a little embarrassed to ask how they answered certain questions."

Table 1: Three quotes from student interviews, translated from Dutch to English.

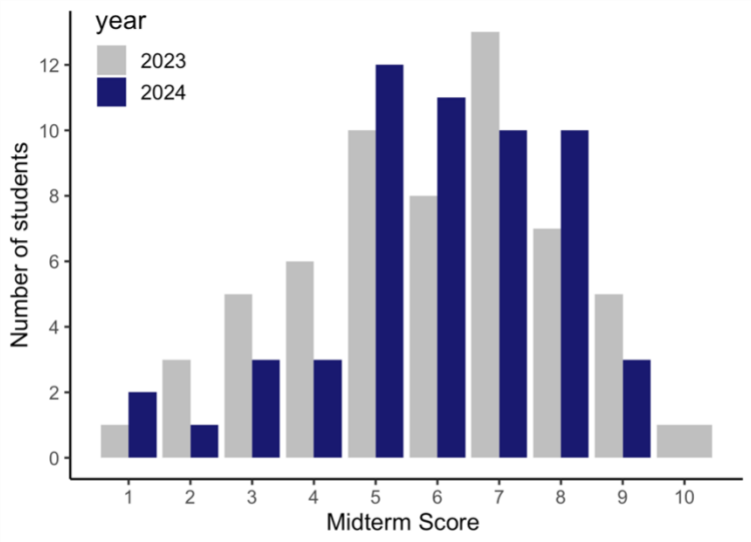

Figure 2: Distribution of student midterm scores on the inorganic portion of the exam (2023 class, light gray and 2024 class, dark blue). The exams were comparable in level of difficulty.