JOURNAL OF BALTIC SCIENCE EDUCATION

ISSN 1648-3898 /Print/
ISSN 2538-7138 /Online/

PREDICTING SITUATIONAL INTEREST BY INDIVIDUAL INTEREST AND INSTRUCTIONAL ACTIVITIES IN PHYSICS LESSONS: AN EXPERIENCE SAMPLING APPROACH

Rauno Neito,
Elisa Vilhunen,
Jari Lavonen,
Kaido Reivelt

Abstract. *Enhancing interest in physics learning has been an important component of education policy and policy implementation for decades. However, in many countries, student interest in physics has not increased. The aim of this study was to predict situational interest using individual interest and the instructional activities students engaged in. Also, the suitability of the data collection approach to measure situational interest was assessed. A teaching module about real-world oscillations was implemented to 179 Estonian lower secondary school students. Data about situational interest were collected using the experience sampling method (ESM), which was measured three times during the module. The results indicated that gender, grade, and instructional activities did not predict situational interest. Individual interest was a significant predictor and correlation with situational interest increased with time, contrary to previous findings. The ESM approach used in this study was considered to be effective in disturbing students' study flow minimally but may have affected the amount of missing data. This study contributes to the research done on student interest in a classroom setting by indicating a more complex relationship between situational and individual interest than previously suggested.*

Keywords: *situational interest, instructional activities, lower secondary school physics, physics education, experience sampling method*

Rauno Neito
University of Tartu, Estonia
Elisa Vilhunen, Jari Lavonen
University of Helsinki, Finland
Kaido Reivelt
University of Tartu, Estonia

Introduction

The question "How to make science more interesting and engaging to students?" has challenged both teachers and policymakers for over a hundred years. According to Roberts and Bybee (2014), science education aims to equip students with the knowledge, skills, and attitudes necessary to understand the world around us, to ask relevant questions and to find answers through demonstrations, planned investigations, or through the search of information. Achieving this aim can be supported by having students engage in scientific practices. Scientific practices are similar to expert performance in the discipline. They involve asking questions, planning and carrying out investigations, analysing and interpreting data, developing explanations and building models based on the data. Scientific practices are not the same as inquiry, nor do they replace inquiry. Rather, they consist of a combination of activities in teaching and learning situations (Krajick & Merritt, 2012).

Students experience school science subjects, especially physics, as a complex and tedious subject (Blajvaz et al., 2022; Fidan & Tuncel, 2021). How students perceive the subject influences their motivation to study it, which in turn affects the effort the students are willing to make for that subject (Debacker & Nelson, 2000). Thus, it is no surprise that a poor experience in physics as a subject leads to lower-than-expected academic achievement (Barmby & Defty, 2006). To overcome this issue, researchers and teachers have been looking for new ways of teaching physics to make learning of physics interesting to students. Rotgans and Schmidt (2011) found in their study that situational interest predicts the active engagement of students, which in turn predicts academic achievement. This implies that interest is a crucial aspect to focus on when making efforts to improve the quality of science education and increasing scientific literacy (Lamanauskas, 2022).

https://doi.org/10.33225/jbse/23.22.1063

ISSN 1648–3898 /Print/
ISSN 2538–7138 /Online/

Interest is a multi-faceted concept described by Hidi and Renninger (2006) as a "psychological state of engaging or the predisposition to re-engage with particular classes of objects, events, or ideas over time" (p. 112) Interest is divided into situational and individual interest (Krapp et al., 1992) and according to the four-phase model of interest development by Hidi and Renninger (2006), situational interest is composed of triggered and maintained interest phases; individual interest is composed of emerging and well-developed interest phases. Triggered situational interest can be initiated for example by information that is surprising or personally relevant and it is usually supported by an external factor. Maintained situational interest is similar in the way that it is externally supported, but the maintaining is achieved through personal involvement in the act that triggered the interest. This phase can lead to the development of individual interest, but it is not always so. The next phase, emerging individual interest, is typically self-generated and doesn't need external support to exist, but it does help in moving to the final stage of well-developed individual interest. This final phase is characterised by perseverance in tasks even in the face of frustration and requires the least amount of external support. It is possible to move backward, i.e., maintain interest in something for a time but then lose interest (Hidi & Baird, 1988; Hoffmann, 2002; Krapp & Prenzel, 2011; Renninger et al., 2019).

In the context of science education, the measures of situational interest are more valuable than individual interest because situational interest is more dynamic and susceptible to external factors. Bahtaji (2023) has found that interest developed during a lesson has a stronger impact on understanding science concepts than the interest developed prior to the lesson. This is also supported by Rotgans and Schmidt (2018), who found that a lack of individual interest can be compensated by a well-presented problem and that only situational interest predicted task performance, not prior individual interest. This provides opportunities to gauge how different teaching approaches (environment, methods, teachers) affect students' interest, and thus indirectly their academic achievement. Based on such data, necessary curricula or teacher training changes can be developed to improve student learning.

Although the four-phase model of interest explains well how interest develops, it does not encompass all aspects. Based on his well-known studies on situational interest Häussler (1987) has identified three dimensions present in the construct: interest in a particular topic, interest in the context and interest in the activity engaged in in tandem with the topic and context. For example, some students may find a lesson about hydrodynamics fascinating because it is crucial to the way houses are supplied with water (interest in the context), but care little about the theoretical foundations or the calculations accompanying it (interest in the topic). Interest in the instructional activity engaged in is the focus of this study – how instructional activities associated with scientific practices influence students' situational interest. Instructional activities are activities by which students obtain new knowledge or reinforce already obtained knowledge in lessons; examples include listening, experimenting, and completing worksheets. The term "instructional" does not refer to a teacher-centred approach, it emphasises that teachers plan and manage the activities students engage in. The role of teachers in instructional activities is to guide students to make sense of the phenomena. Scientific practices are essentially the activities that scientists engage in during their everyday work. Such activities include, for example, planning and carrying out investigations, analysing data, interpreting, and asking questions.

Measuring Situational Interest

Measuring interest is a difficult task as there are many aspects to consider when designing such measurement: the data collection method in general; the scale and frequency of measurements; the number of items in a questionnaire and the factors influencing interest. The experience sampling method has gained popularity in measuring situational interest because it is very flexible, enabling the collection of data very close to learning situations (Zirkel et al., 2015). The experience sampling method or ESM is a data collection method in which the study participants provide real-time self-reports about their experiences in a situation. These experiences include reports about experienced activities, thoughts and feelings. ESM typically uses short questionnaires, which are presented to the participants at random or semi-random times during the study (Hektner et al., 2007). When measuring situational interest or similar constructs, a four or 5-point Likert scale is typically used, and the number scale has sometimes been replaced with faces (Tapola et al., 2013). However, there is no clear consensus on the proper way to conduct an ESM study (Dejonckheere & Erbaş, 2021), which is why, more research is required around its different aspects.

It is known that the frequency of asking questions from the study participants and the number of items used in every questionnaire also play a vital role. Eisele et al. (2020) have studied both effects and have found that an increase in item count has a negative effect on response rate and data quality, in addition to increasing

https://doi.org/10.33225/jbse/23.22.1063

the burden on students. Surprisingly, the frequency of questions didn't have such negative effects. Lavonen et al. (2021) used ESM to ask students about situational interest three times during a 90-minute lesson and reported high response rates (over 80%). A suitable frequency depends on the construct of the study and how fast it can change. Studies about the evolution of situational interest are rare (Rotgans & Schmidt, 2011) and it is unknown what is the optimal frequency of measuring situational interest. The factors influencing situational interest are possibly the most significant issue to tackle, as there are far too many of them to account for in any study. Some of them, such as the topic, context and the type of activity can be asked in the ESM questionnaire. Some of the factors, such as gender, previous individual interest or knowledge, can be studied using background questionnaires. However, several factors, such as the influence of peers or even how well a participant slept, could be challenging to account for. This is why much care must be taken to limit the variety of potentially influential factors and narrow the study's focus if any reliable conclusions are to be made (Eisele et al., 2020).

This study was conducted in Estonia, where teachers are expected to achieve the learning outcomes detailed in the national curriculum, but the way these are achieved is up to them. However, there are admission tests and exams at the end of lower secondary school, which are highly focused on factual knowledge and textbook-style problems. This means that making sense of phenomena is of low priority to the teachers because it is rarely required in the tests. Many physics teachers in Estonia make a clear distinction between theoretical and practical lessons. In theoretical lessons, the teacher focuses on explaining phenomena or simply gives ready answers and shows how various physics models are used for making predictions. Afterwards, the students are guided in solving textbook problems. Despite the teachers often presenting demonstrations during the lessons, they do not guide their students to inquiry activities. In practical lessons, the focus is on producing a phenomenon, but discussing the phenomenon's link to what was learned in theoretical lessons is lacking.

Research Questions

Experimenting in a physics classroom has previously been criticised as being ineffective in its current form of teaching (Abrahams & Millar, 2008; Abrahams & Reiss, 2012). This criticism is mainly due to an unsuitable approach by the teachers, who often focus on replicating a research design according to a manual instead of guiding the students to make sense of a scientific phenomenon through engagement in scientific practices. The aim of this research was to predict situational interest in a physics teaching module with a heavy emphasis on experiments. Furthermore, a goal was to assess the suitability of the chosen data collection approach. The research questions used in this study were the following:

1. Do instructional activities, individual interest, gender, and grade predict situational interest?
2. Which attributes of the instrument and its implementation but also the characteristics of the participants and their environment influenced the response rate of situational interest questions?

Research Methodology

General Background

This study used the experience sampling method to measure the situational interest of lower secondary students in a physics teaching module. Measures of situational interest were evaluated in terms of gender, grade, group size and the instructional activities students engaged in during the module. Furthermore, correlations between individual and situational interest and between each measure of situational interest were analysed. Based on the findings, linear regression models were fitted to predict student situational interest. Issues regarding the measurement of situational interest using the chosen design are discussed. This quantitative study was conducted in Estonia in the spring of 2022. Participants included ten student groups from seven different schools all over the country.

Design

A teaching module about oscillations was designed specifically for this study. This module focused heavily on planning and conducting experiments to make sense of oscillations. Tasks in the module included measurements,

https://doi.org/10.33225/jbse/23.22.1063

ISSN 1648–3898 /Print/
ISSN 2538–7138 /Online/

calculations, and interpretation of the collected data by answering multiple-choice questions. This module was taught in the form of a workshop, which consisted of two to three 45-minute lessons with breaks in between. The reasons behind choosing a workshop over a regular lesson were: a) this allowed to take measurements over a longer period of time, thus giving valuable data on the evolution of situational interest; b) experiments together with a theoretical introduction and the following discussion, the importance of which was emphasised by Abrahams and Millar (2008), take more time than a regular 45-minute lesson. As the aim of this module was to provide an in-depth understanding of oscillations and their importance in everyday life, as well as allow time for discussion, it was deemed the best course of action.

The structure of the module was in the format of blended learning (Hockly, 2018), i.e., the learning materials, as well as the study questionnaires, were in the form of online worksheets, but students conducted experiments using physical objects. Digital materials, such as videos, instructions, and explanations of concepts, were grouped in an online learning environment. The environment could be accessed via a computer or a hand-held device, and participants had to enter a unique code to see the lesson materials.

Participants

The sample of this study was composed of students who participated in a physics workshop programme run by the University of Tartu. Each year approximately 7-10 (depending on the number of applying schools) lower secondary schools are accepted for the programme and from each school approximately 15-30 (depending on the number of students interested in participating) students take part in the workshops. A total of 179 students, of which 48% were boys and 52% were girls, participated in the study. The students were from different schools located in different parts of the country and formed ten groups. For each group, the module was taught by the first author of this article to keep the teaching as uniform as possible. However, the groups were very different in terms of interest, previous experiences with physics and overall academic achievement. One of the groups included students for whom Estonian was not their mother tongue. As this study utilised a physics workshop programme run by the University of Tartu, some constraints were imposed. The groups were a mix of 8th and 9th-grade students because the programme was aimed at all lower secondary school students who learn physics. This provided an opportunity to evaluate whether there was a difference in situational interest between the grades. The programme was intended as an extra-curricular activity and was thus voluntary. Some schools, however, made it mandatory for all students to participate and most of the workshops took place during school hours. It was decided by these schools that the workshops should substitute regular physics lessons. Thus, students with both very high and low interest participated in the study. Considering the above, the sample was representative of the student population of the country. The students were asked for consent at the beginning of the module and every student had the opportunity to stop participating at any moment. The collected data cannot be linked to the participants.

Instruments

Two instruments were used in this study: a background questionnaire and a short (taking less than a minute to complete) questionnaire that was administered using the experience sampling method. The background questionnaire used in the study had questions about gender, grade, and statements about individual interest. The statements for measuring individual interest were selected from the "Students' View of Science" category of the 2015 PISA study (OECD, 2017). In the PISA study, statements about both the value and enjoyment dimensions of individual interest were present, but in this study, five statements of the enjoyment dimension were chosen. The statements used were: "Usually I am having fun learning about physics topics.", "I like reading about physics.", "I am happy when I'm dealing with physics.", "I enjoy obtaining new knowledge in physics." and "I am interested in learning about physics". All of the statements were on a 5-point Likert scale ranging from "strongly disagree" to "strongly agree". The statements were translated into Estonian and modified so that the emphasis was on physics instead of science. The questionnaire was administered to the students at the beginning of the module and included information about the study.

The second instrument of the study was the ESM questionnaire, composed of three questions: "How interesting was the activity at hand?", "What was the activity?" and "With whom were you doing the activity?" It is common to have only a few questions or items in this type of experience sampling method questionnaire (Eisele et al., 2021). An ESM questionnaire is used in real classroom situations, and a small number of questions do not influence students'

https://doi.org/10.33225/jbse/23.22.1063

learning. The first question was on a 5-point Likert scale ranging from "no interest" to "very high interest." The other two questions were multiple-choice. For instructional activities, the choices were: answering worksheet questions, listening, watching a video, experimenting, and not engaging in instructional activities. The group question had the following options: alone, in a pair, or in a group of at least three people.

Currently, there is no consensus on how to determine the reliability of single-item measurements (Eisele et al., 2021). However, the validity of such items can be assessed by studying the relationship to other related variables. In this study, individual interest, which was measured using a tested multi-item questionnaire, was related to situational interest. Correlation analysis between the two constructs confirmed a positive and predictable correlation, which is in line with other theories about interest (Hidi & Renninger, 2006). Several other studies have also used single items to measure interest and similar concepts in the context of ESM (Beymer et al., 2020; Lavonen et al., 2021; Pekrun et al., 2017; Vilhunen et al., 2022, 2021).

Research Procedure

Each module lasted for two or three 45-minute sessions, depending on the school. A general picture of the instructional activities engaged in the module can be seen in Table 1. Students were asked to fill in the background questionnaire and afterwards pay attention to their tablets for when the ESM questionnaires would appear. Next, the workshop continued in pairs, or in rare cases, alone or in a group of three, depending on the number of students. The three ESM questionnaires were separated by roughly equal amounts of time, but each student was given questions at a slightly different time. This allowed the researchers to collect data about a wide range of activities and had minimal negative effect on the classroom workflow, the importance of which is emphasised by Sinatra et al. (2015). As the study was voluntary, however, the students had the opportunity to skip the questionnaire if they did not wish to participate. It was not possible to reopen the questionnaire after it was closed on purpose or by accident.

Table 1
General Picture of the Module

Activity	Time
Introduction of the study and answering the background questionnaire	10 min
Short lecture on oscillations and calculations about oscillations	10-15 min
The first experiment (building a pendulum) and the first ESM questionnaire	20-25 min
Break	10-30 min
The second experiment (measuring using sensors) and the second ESM questionnaire	20-25 min
Third experiment (achieving resonance with the pendulum)	20-25 min
Break	10-30 min
Fourth experiment (building a model skyscraper) and third ESM questionnaire*	30 min
Discussion about experiments and resonance in everyday life, conclusion	15 min

Note. For schools which had only two lessons, the third ESM questionnaire (noted by the asterisk) appeared at the end of the second lesson.

Data Analysis

The RStudio environment (R Core Team, 2022) was used to analyse the data. For individual interest a mean value was calculated based on the five questions; the internal consistency between the five questions was high (α= .876). Mann-Whitney *U*-tests were used to compare genders and grades. A one-way ANOVA and a post-hoc test were used to compare the instructional activities based on situational interest. Kendall Tau correlation analysis was used for determining the correlations between individual and situational interest, between group size and situational interest and between each measure of situational interest. Finally, based on the analyses, linear regression models were used to predict situational interest with the relevant variables. The same analysis methods were also used to explain the response rates of the ESM questionnaires.

https://doi.org/10.33225/jbse/23.22.1063

ISSN 1648–3898 /Print/
ISSN 2538–7138 /Online/

Notes Taken During the Data Collection

Taking field notes during data collection can supplement the data with contextual information as well as help explain issues that are not visible from the collected data (Nespor, 2006; Phillippi & Lauderdale, 2018). During the teaching, the first author took short notes on the groups that he taught. General information about the school was written down for every group, but other notes were taken only when something unexpected took place. The notes were in free form, written on the computer after the teaching and most of these included only a few sentences. The notes were important in explaining why some students had not answered all of the questions. Below are a few examples of the notes taken:

1. *"Group 1 - the first attempt with the instrument worked as intended: there was time for three 45-minute lessons, but the students were visibly tired, which is why I decided to end the module 15 minutes earlier. The students were moderately compliant with the instructions, but less so when they had to build the pendulums. For some students the internet browser closed unexpectedly, disrupting the data collection. The second ESM questionnaire appeared during the break, which lessened the number of useful answers obtained from the students".*
1. Collective notes about the workshops*: "One big issue was the timing of the questionnaires. Since every school had breaks and lessons of different lengths and I learned this as after arriving at the school, there was nothing I could do to remedy the issue that at least one questionnaire appeared during a break. Another annoyance were students who downloaded games on the tablets and largely ignored me for the remainder of the module. Even if I got some of them to answer the questions on the worksheets there was a small chance that they answered the ESM questionnaires as they were easy to dismiss."*

Research Results

There were no significant gender or grade differences in situational interest or individual interest, but there was a significant difference in the two individual interest questions. The questions were "*I am happy when I am dealing with physics*" ($p < .001$) and "*Usually I am having fun when learning about physics topics*" ($p < .05$). For these questions, boys reported a higher level of interest than girls. Furthermore, levels of situational interest were higher than individual interest, and significant differences ($p < .01$) between individual interest and the second and third measures of situational interest were measured.

Table 2
Kendall Tau Correlation Coefficients between Different Measures of Interest

	Situational interest 1	Situational interest 2	Situational interest 3
Individual interest	0.29	0.35	0.41
Situational interest 1	-	0.57	0.29
Situational interest 2	-	-	0.46

Note. The numbers behind situational interest indicate each separate measure and its order. The dependent variables are displayed horizontally and the predicting variables vertically.

There were significant ($p < .001$) correlations between individual interest and all measures of situational interest; correlations were also significant ($p < .001$) between the individual measures of situational interest (see Table 2). The correlation between individual and situational interest increased as the module progressed. The strongest correlations were between the closest measures of situational interest. There was no significant correlation between group size and situational interest. One-way ANOVA analysis followed by a post-hoc test revealed that the only significant difference in situational interest was between the "experimenting" and "not engaged in instructional activities" options, with experimenting being considered more interesting. 95% confidence intervals overlapped for all other instructional activities (see Table 3).

https://doi.org/10.33225/jbse/23.22.1063

Table 3
Activities by Numbers, Their Corresponding Mean Situational Interest Levels and 95% Confidence Intervals

Instructional activities	*n*	Mean situational interest	95% CI
Experimenting	139	3.73	3.56 – 3.91
Listening	92	3.51	3.28 – 3.74
Not engaged in instructional activities	15	2.6	1.88 – 3.32
Watching a video	47	3.51	3.21 – 3.82
Worksheet questions	31	3.45	2.99 – 3.91

Based on these results, linear regression models were fitted to predict each measure of situational interest. Mixed-effect models were not used as intraclass correlations were negligible. Independent variables included individual interest and situational interest, where applicable; other variables were discarded. To determine the best fits, possible models were compared using the Akaike Information Criterion, (Table 4).

Table 4
Estimates for Predictors of Each Situational Interest Measure

Predictors	Situational int. 1	95% CI	Situational int. 2	95% CI	Situational int. 3	95% CI
(Intercept)	1.84***	1.07 – 2.61	0.79*	0.08 – 1.50	0.57	-0.26 – 1.40
Individual int.	0.46***	0.24 – 0.69	0.27*	0.06 – 0.49	0.60***	0.34 – 0.86
Situational int. 1	-	-	0.55***	0.39 – 0.71	-	-
Situational int. 2	-	-	-	-	0.31**	0.11 – 0.51
Observations	124		110		103	
Marginal R2/	0.122/		0.434/		0.369/	
Conditional R2	0.114		0.424		0.356	

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

The main issue encountered in this study was connected to the response rate. Before data analysis 17 students out of the initial 179 were excluded due to them not answering any or only one of the questions in the ESM questionnaires. 11 other students were excluded due to inconsistent and/or missing answers. Nevertheless, a drop in response rates was clear when comparing the three ESM questionnaires. Compared to the first measure, response rates dropped by an average of 6% for the second and 14% for the third measure. Situational interest questions were answered the most, followed by the activity questions and then the group questions. Response rates for these were 90%, 84% and 77% for the first measure and 77%, 70% and 63% for the last measure, respectively. No significant differences in gender or grade were found for the response rates, neither was there any correlation with either individual or situational interest. There were some differences in groups: the non-native Estonian group had a significantly lower mean response rate compared to six other groups; the difference with the remaining three groups was not statistically significant. The average response rate for the background questions was 99%.

https://doi.org/10.33225/jbse/23.22.1063

ISSN 1648–3898 /Print/
ISSN 2538–7138 /Online/

Discussion

The results involving gender, grade and mean interest levels were encouraging. Although it has been previously suggested that girls have lower interest in physics than boys (Häussler et al., 1998), it was not noted in this study apart from the two individual interest questions. It would also have made sense that 9th graders would have lower interest than 8th graders due to having already learned the topics covered in the teaching module (Palmer, 2004), but it is possible that the high novelty of the experiments compensated for the low novelty of knowledge. The fact that instructional activities did not predict situational interest was surprising. Experimenting is usually considered as an interesting activity (Abrahams & Millar, 2008), but in this study, it could not be distinguished from other activities, such as listening and answering the worksheet questions, which are arguably less interesting than experimenting. It is possible that instructional activities could be distinguished by using a larger sample but judging from the findings of Lavonen et al. (2021) and Vilhunen et al. (2021), it depends more on the context and topic than sample size (Häussler, 1987). If a ranking of instructional activities based on interest is the desired outcome, asking students to explicitly rank them instead of comparing the interest levels is likely a better approach. Similarly, to the findings of Nguyen et al. (2018), student interaction with their peers alone and not with the teacher was not a significant predictor of situational interest.

Results about the relation between individual and situational interest are partially in line with previous studies on situational interest. Post-problem situational interest levels (measures 2 and 3) were significantly higher than individual interest levels (Rotgans & Schmidt, 2017). Similarly to the findings of Rotgans and Schmidt (2018), there were positive correlations between subsequent situational interest measures, with measures more separated in time having a lower correlation. However, whereas in their study the role of individual interest decreased with time, an opposite trend was noted in this study. The correlation between individual and situational interest was low at the beginning of the module and increased with time. The fitted linear regression models confirmed the complexity of the relation – the first measure of situational interest was a stronger predictor of the second measure of situational interest than individual interest, but the latter was again a stronger predictor of the third measure of situational interest. Rotgans and Schmidt suggested that "individual interest only determines situational interest in the absence of a situationally arousing event" (p. 535). It is hard to believe this explains the noted trend, as the experiments the students conducted were certainly novel to them, considering that the topic of oscillations is often overlooked by Estonian teachers and in the best cases simple experiments involving pendulums are used. As such, the noted trend requires further investigation.

As the response rate was not significantly correlated with other measures apart from the group, other explanations are required. It is likely that the students who were excluded from the analysis were not interested in the topic of the module or participating in the study. For the included students, the drop in response rates could be explained by fatigue and the available option to skip answering. Another possibility is that these students were more engaged with experimenting and considered answering not a priority. The non-native group, which had the highest share of excluded students and the lowest response rates, could have had language issues. In Estonia, these students receive lessons both in Estonian and their mother tongue, but as some concepts in physics are difficult to understand even for native speakers, this difficulty was likely amplified. Another question to consider is how to handle the incomplete answers. In this study, such data was not used, but another option would be to assume that such students had very low levels of interest. However, it is not certain that the lack of interest was the sole reason behind not answering. As mentioned in the methodology section, each student received their questions at a unique time and had the option to skip answering. While such a design did little to impede the workflow, it put much more responsibility on the students themselves to notice the questionnaires and deal with them. Dejonckheere and Erbaş, (2021) have pointed out that the unpredictability of the questionnaire appearance can result in a higher burden and lower compliance. A design where all the students answer at the same time would have likely provided more responses, on the account of interrupting the workflow. However, it is still important to keep students from guessing when questions are asked, as it can affect their responses.

https://doi.org/10.33225/jbse/23.22.1063

Conclusions and Implications

The aim of this study was to predict situational interest using gender, grade, individual interest and particularly the instructional activities the students engaged in. A related goal was to assess the suitability of the chosen data collection method based on the students' response rate. Individual interest was a strong predictor of situational interest, but contrary to previous studies its correlation with situational interest increased with time, not decreased. The cause of this trend is unknown and requires further studying. Previous measures of situational interest were also significant in predicting the next measures. There were no differences between genders and grades in individual or situational interest. Instructional activities were not a significant predictor and could not be distinguished from one another based on situational interest. This is likely not connected to the sample size but to the context and topic in which the activities were situated.

As the module progressed, a decline in the situational interest questions' response rates was noted. Possible explanations for this decline are fatigue, lack of interest, a language barrier, and the way the data collection was organised. While the chosen data collection method had little impact on the workflow, it negatively affected the amount of collected data. In future, it is recommended to avoid having each student answer their questions at unique times, as answering simultaneously can help alleviate the responsibility and burden put on students.

Acknowledgments

The study was supported by a grant from the European Commission / H2020 (952470, SciCar).

Declaration of Interest

The authors declare no competing interest.

References

Abrahams, I., & Millar, R. (2008). Does practical work really work? A study of the effectiveness of practical work as a teaching and learning method in school science. *International Journal of Science Education*, *30*(14), 1945–1969. https://doi.org/10.1080/09500690701749305

Abrahams, I., & Reiss, M. J. (2012). Practical work: Its effectiveness in primary and secondary schools in England. *Journal of Research in Science Teaching*, *49*(8), 1035–1055. https://doi.org/10.1002/tea.21036

Bahtaji, M. A. A. (2023). Examining the physics conceptions, science engagement and misconceptions of undergraduate students in STEM. *Journal of Baltic Science Education*, *22*(1), 10–19. https://doi.org/10.33225/jbse/23.22.10

Barmby, P., & Defty, N. (2006). Secondary school pupils' perceptions of physics. *Research in Science and Technological Education*, *24*(2), 199–215. https://doi.org/10.1080/02635140600811585

Beymer, P. N., Rosenberg, J. M., & Schmidt, J. A. (2020). Does choice matter or is it all about interest? An investigation using an experience sampling approach in high school science classrooms. *Learning and Individual Differences*, *78*, Article 101812. https://doi.org/10.1016/j.lindif.2019.101812

Blajvaz, B. K., Bogdanović, I. Z., Jovanović, T. S., Stanisavljević, J. D., & Pavkov-Hrvojević, M. V. (2022). The jigsaw technique in lower secondary physics education: Students' achievement, metacognition and motivation. *Journal of Baltic Science Education*, *21*(4), 545–557. https://doi.org/10.33225/jbse/22.21.545

Debacker, T. K., & Nelson, R. M. (2000). Motivation to learn science: Differences related to gender, class type, and ability. *The Journal of Educational Research*, *93*(4), 245–254. https://doi.org/10.1080/00220670009598713

Dejonckheere, E., & Erbaş, Y. (2021). Designing an experience sampling study. In I. Myin-Germeys & P. Kuppens (Eds.), *The open handbook of Experience Sampling Methodology: A step-by-step to designing, conducting, and analyzing ESM studies* (pp. 33–70). Center for Research on Experience Sampling and Ambulatory Methods Leuven.

Eisele, G., Vachon, H., Lafit, G., Kuppens, P., Houben, M., Myin-Germeys, I., & Viechtbauer, W. (2020). The effects of sampling frequency and questionnaire length on perceived burden, compliance, and careless responding in experience sampling data in a student population. *Assessment*, *29*(2), 136-151. https://doi.org/10.1177/1073191120957102

Eisele, G., Kasanova, Z., & Houben, M. (2021). Questionnaire design and evaluation. In I. Myin-Germeys & P. Kuppens (Eds.), *The open handbook of Experience Sampling Methodology: A step-by-step to designing, conducting, and analyzing ESM studies* (pp. 71–90). Center for Research on Experience Sampling and Ambulatory Methods Leuven.

European Commission. (2022). *Digital Economy and Society Index (DESI) 2022: Digital public services*. European Union. https://digital-strategy.ec.europa.eu/en/library/digital-economy-and-society-index-desi-2022

ISSN 1648–3898 /Print/
ISSN 2538–7138 /Online/

Fidan, M., & Tuncel, M. (2021). Developing a self-efficacy scale toward physics subjects for lower-secondary school students. *Journal of Baltic Science Education*, *20*(1), 38–49. https://doi.org/10.33225/jbse/21.20.38

Häussler, P. (1987). Measuring students' interest in physics - design and results of a cross-sectional study in the Federal Republic of Germany. *International Journal of Science Education*, *9*(1), 79–92. https://doi.org/10.1080/0950069870090109

Häussler, P., Hoffman, L., Langeheine, R., Rost, J., & Sievers, K. (1998). A typology of students' interest in physics and the distribution of gender and age within each type. *International Journal of Science Education*, *20*(2), 223-238. https://doi.org/10.1080/0950069980200207

Hektner, J. M., Schmidt, J. A., & Csikszentmihalyi, M. (2007). *Experience sampling method: Measuring the quality of everyday life.* Sage.

Hidi, S., & Baird, W. (1988). Strategies for increasing text-based interest and students' recall of expository texts. *Reading Research Quarterly*, *23*(4), 465–483. https://doi.org/10.2307/747644

Hidi, S., & Renninger, K. A. (2006). The four-phase model of interest development. *Educational Psychologist*, *41*(2), 111–127. https://doi.org/10.1207/s15326985ep4102_4

Hockly, N. (2018). Blended Learning. *ELT Journal*, *72*(1), 97–101. https://doi.org/10.1093/elt/ccx058

Hoffmann, L. (2002). Promoting girls' interest and achievement in physics classes for beginners. *Learning and Instruction*, *12*(4), 447–465. https://doi.org/10.1016/S0959-4752(01)00010-X

Krajick, J., & Merritt, J. (2012). Engaging students in scientific practices: What does constructing and revising models look like in the science classroom? Understanding a framework for K–12 science education. *Science Teacher*, *79*(3), 38–41.

Krapp, A., Hidi, S., & Renninger, K. A. (1992). Interest, learning, and development. In K. A. Renninger, S. Hidi, and A. Krapp (Eds.), *The role of interest in learning and development* (pp. 3–25). Lawrence Erlbaum Associates.

Krapp, A., & Prenzel, M. (2011). Research on interest in science: Theories, methods, and findings. *International Journal of Science Education*, *33*(1), 27–50. https://doi.org/10.1080/09500693.2010.518645

Lamanauskas, V. (2022). Natural science education in primary school: Some significant points. *Journal of Baltic Science Education*, *21*(6), 908–910. https://doi.org/10.33225/jbse/22.21.908

Lavonen, J., Ávalos, B., Upadyaya, K., Araneda, S., & Salmela-Aro, K. (2021). Upper secondary students' situational interest in physics learning in Finland and Chile. *International Journal of Science Education*, *43*(5), 1–20. https://doi.org/10.1080/09500693.2021.1978011

Nespor, J. (2006). Finding patterns with field notes. In J.L. Green, G. Camilli, & P.B. Elmore (Eds.), *Handbook of complementary methods in education research* (pp. 297-308). Lawrence Erlbaum

Nguyen, T. D., Cannata, M., & Miller, J. (2018). Understanding student behavioral engagement: Importance of student interaction with peers and teachers. *The Journal of Educational Research*, *111*(2), 163–174. https://doi.org/10.1080/00220671.2016.1220359

OECD. (2017). *PISA 2015 Assessment and Analytical Framework Science, Reading, Mathematic, Financial Literacy and Collaborative Problem Solving: Science, Reading, Mathematic, Financial Literacy and Collaborative Problem Solving*. OECD Publishing. https://doi.org/10.1787/9789264281820-en

Pekrun, R., Vogl, E., Muis, K. R., & Sinatra, G. M. (2017). Measuring emotions during epistemic activities: The epistemically-related emotion scales. *Cognition and Emotion*, *31*(6), 1268–1276. https://doi.org/10.1080/02699931.2016.1204989

Phillippi, J., & Lauderdale, J. (2018). A guide to field notes for qualitative research: Context and conversation. *Qualitative Health Research*, *28*(3), 381–388. https://doi.org/10.1177/1049732317697102

Quinlan, K. M. (2019). What triggers students' interest during higher education lectures? personal and situational variables associated with situational interest. *Studies in Higher Education*, *44*(10), 1781–1792. https://doi.org/10.1080/03075079.2019.1665325

Radulović, B., Dorocki, M., Olić Ninković, S., Stojanović, M., & Adamov, J. (2023). The effects of blended learning approach on student motivation for learning physics. *Journal of Baltic Science Education*, *22*(1), 73-82. https://doi.org/10.33225/jbse/23.22.73

Renninger, K. A., Bachrach, J. E., & Hidi, S. E. (2019). Triggering and maintaining interest in early phases of interest development. *Learning, Culture and Social Interaction*, *23*, Article 100260. https://doi.org/10.1016/j.lcsi.2018.11.007

Roberts, D. A., & Bybee, R. W. (2014). Scientific literacy, science literacy, and science education. In N. G. Lederman and S. K. Abell (Eds.), *Handbook of research on science education* (Vol. 2, pp. 729–780). Lawrence Erlbaum.

Rotgans, J. I., & Schmidt, H. G. (2011). Situational interest and academic achievement in the active-learning classroom. *Learning and Instruction*, *21*(1), 58–67. https://doi.org/10.1016/j.learninstruc.2009.11.001

Rotgans, J. I., & Schmidt, H. G. (2017). Interest development: Arousing situational interest affects the growth trajectory of individual interest. *Contemporary Educational Psychology*, *49*, 175–184. https://doi.org/10.1016/j.cedpsych.2017.02.003

Rotgans, J. I., & Schmidt, H. G. (2018). How individual interest influences situational interest and how both are related to knowledge acquisition: A microanalytical investigation. *The Journal of Educational Research*, *111*(5), 530–540. https://doi.org/10.1080/00220671.2017.1310710

R Core Team. (2022). *R: A Language and Environment for Statistical Computing* (4.2.2) [Computer software]. https://www.R-project.org/

Palmer, D. (2004). Situational interest and the attitudes towards science of primary teacher education students. *International Journal of Science Education*, *26*(7), 895–908. https://doi.org/10.1080/0950069032000177262

Tapola, A., Veermans, M., & Niemivirta, M. (2013). Predictors and outcomes of situational interest during a science learning task. *Instructional Science*, *41*(6), 1047–1064. https://doi.org/10.1007/s11251-013-9273-6

Vilhunen, E., Tang, X., Juuti, K., Lavonen, J., & Salmela-Aro, K. (2021). Instructional activities predicting epistemic emotions in Finnish upper secondary school science lessons: Combining experience sampling and video observations. In O. Levrini, G. Tasquier, T. G. Amin, L. Branchetti, & M. Levin (Eds.), *Engaging with Contemporary Challenges through Science Education Research: Selected papers from the ESERA 2019 Conference* (pp. 317–329). Springer International Publishing. https://doi.org/10.1007/978-3-030-74490-8_25

https://doi.org/10.33225/jbse/23.22.1063

Vilhunen, E., Lavonen, J., Salmela-Aro, K., & Juuti, K. (2022). Luonnontieteen opetuksen ja opiskelun työtapojen yhteys lukiolaisten tilannekohtaiseen sitoutumiseen [Upper secondary school students' situational engagement in science instructional activities]. *Kasvatus*, *53*(3), 245–258. https://doi.org/10.33348/kvt.120240

Zirkel, S., Garcia, J. A., & Murphy, M. C. (2015). Experience-sampling research methods and their potential for education research. *Educational Researcher*, *44*(1), 7–16. https://doi.org/10.3102/0013189X14566879

Received: *September 06, 2023* Revised: *October 03, 2023* Accepted: *November 12, 2023*

Cite as: Neito, R., Vilhunen, E., Lavonen, J., & Reivelt, K. (2023). Predicting situational interest by individual interest and instructional activities in physics lessons: An experience sampling approach. *Journal of Baltic Science Education*, *22*(6), 1063-1073. https://doi.org/10.33225/jbse/23.22.1063

Rauno Neito
(Corresponding author)
PhD Student, Department of Physics Education, University of Tartu, W. Ostwaldi 1, 50411, Tartu, Estonia.
E-mail: rauno.neito@ut.ee
ORCID: https://orcid.org/0000-0002-8418-0293

Elisa Vilhunen
PhD, Postdoctoral Researcher, Faculty of Educational Sciences, University of Helsinki, P.O 9 (Siltavuorenpenger 5A), 00014, Helsinki, Finland.
E-mail: elisa.vilhunen@helsinki.fi
ORCID: https://orcid.org/0000-0003-2612-8267

Jari Lavonen
PhD, Professor, Department of Teacher Education, Faculty of Educational Sciences, University of Helsinki, P.O 9 (Siltavuorenpenger 5A), 00014, Helsinki, Finland.
E-mail: jari.lavonen@helsinki.fi
ORCID: https://orcid.org/0000-0003-2781-7953

Kaido Reivelt
PhD, Researcher, Department of Physics Education, University of Tartu, W. Ostwaldi 1, 50411, Tartu, Estonia.
E-mail: kaido.reivelt@ut.ee