Situational Interest in Geology Learning: What Learning Strategies Promote Student Interest in Geological Topics?

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Abstract

This study examines the various factors that may influence students' interest in studying geology. It is based on the experience that the geology learning content is often perceived by students and teachers as complex and difficult for students to understand. The research involved 9th-grade students in randomly selected elementary schools completing various tasks focused on geological observation, modelling, and timing in geology. They worked in groups on all tasks and had the opportunity to discuss the problem among themselves and with the teachers. The research investigation aimed to find out how significantly a particular teaching situation can influence the formation and development of students' interest in a learning topic and, consequently, in learning subject. We looked at the role of situational interest development, which can be triggered by a range of factors from appropriately chosen teaching strategies to the personality of the teacher. The results showed that high student interest was stimulated by methods that led to their direct involvement in the learning process. Methods based on modelling and observation of geological objects and phenomena were the most appreciated, while methods based on inductive deductive procedures with a higher degree of abstraction and numerical operations were slightly less appreciated. The instructional strategies that most engaged students also demonstrated a higher interest in the learning topics conveyed by these strategies. Thus, the research investigation highlighted the importance of deliberately shaping the learning environment in favour of developing situational interest to further stimulate deeper student interest in specific learning content.

Keywords: *interest in geology, situational interest, students' activation, learning topics, learning strategies, learning environments*

Introduction

The importance and development of students' interest in science has long been a key aspect of science education research. The process of forming interest in a particular content or object is complex and involves a range of psychological and pedagogical factors. An important concept in this discourse is situational interest, which can be a key aspect in fostering long-term student interest and engagement. Situational interest is characterized as a short-term interest activated by various external factors (cf. [1], [2], [3]).

Geology education has a complex position among science subjects in terms of student interest. It is difficult for students to perceive the spatiotemporal relationships between geological objects and processes; the learning content becomes too remote for their understanding ([4], [5]). Other studies point to the problem of forming students' research skills, where students have difficulty making scientific observations and connecting observed features to scientific terminology ([6], [7]). These difficulties make students feel dissatisfied and disinterested.

In the context of geology, situational interest can be elicited by teaching strategies that allow students to interact directly with geological objects and phenomena. The present research, conducted among students in selected elementary schools, aimed to identify the key factors that influence students' interest in geology and whether different teaching strategies can foster this interest.

Theoretical background

A comprehensive understanding of how students develop an interest in a topic or discipline can provide invaluable insights for refining pedagogical strategies, improving teaching and curriculum development. At the heart of this discourse is the conceptualization of interest as a multifaceted construct encompassing different dimensions and developmental trajectories. Hidi and Renninger [3] view interest as a relationship between an individual and an object or content in his or her life context, characterized by emotional and evaluative valences. Interest acts as an intrinsic motivator that enhances cognitive attention and effort within specific activities [8], thereby promoting effective learning and deeper understanding. In addition, interest often leads to increased intrinsic motivation and a sense of autonomy, which increases emotional engagement and goal attainment. Ryan and Deci [8] emphasize that intrinsic motivation, as opposed to extrinsic motivation, is key to sustaining long-term interest in an activity. This is supported by empirical studies that consistently demonstrate a link between intrinsic motivation, increased engagement, and sustained interest in specific objects or activities (e.g., [9], [10]; [11], [12]).

Developmental psychologists argue that the transformation of a transient, often emotionally driven interest in an object or content into a sustained interest is a gradual process. Krapp [2] offers an ontogenetic view of the emergence and development of interest and presents theoretical models that characterize its structural and dynamic aspects. He describes a natural development of interest involving the gradual differentiation and complexity of the relationship between the individual and objects of interest, typically based on personal meaning and emotionality (the "growth model"). However, this can further evolve through the principle of functional autonomy (cf. [13]), whereby initially peripheral or instrumental activities become central or internal drivers of interest ('channeling model'). This can lead to the emergence of a spectrum of interests based on qualitatively different relationships between individuals and their objects of interest, which potentially overlap and foster sustained interest in particular content or objects ('overlapping model'). For example, Krapp [2] illustrates how an initial interest in nature, driven by aesthetic appeal and emotional interaction, can evolve into more active exploration, cultivating other aspects of that interest (e.g., reading, information processing, observation, and documentation). Such a predisposition to nature may extend to a broader range of interests, including disciplines such as biology, geography, or physics, while synergistic integration may deepen the level of interest in specialized fields such as astronomy or medicine.

A framework for understanding the genesis of interest in the context of the learning environment has been proposed by Hidi and Renninger [3]. It is a four-stage model of interest development, examines the development and maintenance of interest from a psychological and pedagogical perspective, and delineates how interest in specific content may develop and deepen. It emphasizes the situational development of interest (stages (1) "elicited" and (2) "sustained situational interest") as the initiating stages of individual and sustained interest development (stages (3) "developing" and (4) "well-developed individual interest"). The authors emphasize that interest is a dynamic, developmental phenomenon susceptible to a variety of influencing factors, involving affective and cognitive components significantly affecting attention, goals, learning levels, and self-regulation. Situational interest can be triggered by external stimuli such as surprising information, identification with a particular person, or personal meaning. Such factors in educational settings tend to be, for example, interesting learning topics, activating learning strategies or practical experiences. These can further reinforce and continuously develop the interest generated. Hidi and Renninger [3] also point out that such transient interest can serve as a precursor for repeated engagement with specific content in the future.

In respect to the educational environment, it can be concluded from the above that the attractiveness of the educational environment, the relevance of educational topics and the personality of the teacher have a key influence on the formation and maintenance of students' interest in science education ([2], [3], [14] , [15], [16], [17]).

Methodology

The design of the research inquiry into students' interest in geological topics was a qualitative research based on grounded theory (cf. [18]). A total of 168 Year 9 students from three elementary schools who had taken a geology course during the school year were involved in the inquiry. The lessons were taught individually for each of the six participating school classes (there were always two classes from each elementary school) in a specialized classroom for geology instruction.

For our research, we created a set of nine tasks of an inductive-deductive nature, which were designed to help students gradually figure out how geological data are acquired and interpreted. Each school class always participated in a two-hour classroom session in which its students worked in groups of four to five on the assigned tasks. At the end of the learning activities, students were asked to evaluate in their own words, in writing, how they found each learning task interesting and why. The students' responses were then analysed, and open coding was used to identify key concepts and categories influencing students' interest in different research methods and ways of knowing in geology. Based on this, three main categories and their key concepts were identified and evaluated in some way by the students (see Table 1). The statistical significance of student responses divided into individual categories was statistically evaluated using the chi-square goodness-of-fit method, and the possible dependence of a particular type of response on individual schools, and the resulting statistical differences between the responses of students from each type of school, was tested by analysis of variance (ANOVA).

Table 1 Assessment categories of student interest in selected geological topics identified by grounded theory coding.

Categories	Concepts
Learning topic	Rock formation and properties Geological processes and structures in the landscape Time in geology- relative ages of rocks Time in geology- absolute timing
Learning strategy	Observations Geological sketch of observed structures Modelling of geological structures Inductive-deductive methods
Learning environment	Time consumption of the learning activity Teaching style Teacher's personality Students' relationship to geology

Results

The first task the students had to work on was about the properties of rocks. Students were presented with different types of rocks (e.g. coarse-grained granite, fine-grained sandstone, limestone with fossil remains) in work groups. Their task was to observe the rock, describe its structure and, based on what they described, try to deduce how the rock might have formed. To support their deliberate observation, the students were also asked to draw the observed rock and its structure. In completing the task, the teacher supported them with guiding questions to encourage students' thinking about the problem. The majority of students positively evaluated both the thematic focus of the learning task (82 % of relevant responses) and the chosen teaching strategies. Observation was rated positively by 81 % and drawing by 73 % of valid responses. The activity was viewed negatively by an identical 2 % of students for both the learning topic and the chosen teaching strategy. The remainder of the valid responses did not rate the activity.

The second task was designed to introduce students to the importance of modelling in geology. At the beginning, students were shown photographs of wrinkled sediments in the landscape. Students were asked to name this structure (a fold), and to think about how such structures form in the landscape. After discussing the problem together, the students were asked to model the process that leads to the formation of a furrow using plasticine. In total, 84 % of the students were interested in modelling, and 67 % in the issue of geological processes and their form in the landscape.

This was followed by tasks focusing on the relative determination of the age of rocks. The third task contained three questions, which the students had to answer on their own and/or after a group discussion: Q 1: *What can all fossils be?* Q 2: *What effect does time have on the formation and preservation of fossils?* Q 3: *Why do we find fossils in some rocks and not in others?* After that, the students shared their answers with others and discussed them with the teacher. This was followed by a fourth task that allowed students to work directly with specific fossils. Using a simplified atlas and a stratigraphic table, they were asked to identify three fossils each within the group, identify the period of their occurrence and rank them from oldest to youngest fossil using the stratigraphic table. In the fifth task, they had to use a picture of a sequence of rock layers to infer which layers are the oldest and which are the youngest and explain why. This group of tasks and the way of solving them interested 63 % of students, while 4 % of respondents found it uninteresting.

The last, sixth task focused on the absolute dating of rocks. After a common introduction to the subject and an introduction to the basic concepts, the principle of half-life was explained to the students using a visual animation. They were then asked to solve the following numerical example: *Radiometric measurements have shown that exactly 25 % of the radioactive carbon nuclei are present in rock A (the half-life of carbon is 5 730 years)? How old is this rock?* Students showed the lowest level of interest in this task, with only 51 % of students finding it interesting. Conversely, a full 10 % said they were not interested in the task at all.

The following table provides a quantified view of the students' perceptions of the individual learning activities and topics that received attention. The highest values for a positive relationship are achieved for the learning topic *the way rocks are formed and their properties* (74.1 %), and for a negative relationship for the topic *time in geology*- absolute timing (10.0 %). For the instructional strategies evaluated, activities *observation* (81.1 %) and *modelling geologic structures* (81.4 %) are highly positively rated. The frequency of expressing negative attitudes is balanced and ranges approximately between 1% and 2% of the relative abundance of student responses. (see Table 2).

Table 2 Students' interest in geological learning topics and strategies.

Categories	**Concepts**	**Relative frequency of student interest ratings in relation to the concept (%)**		
		Positive attitude	Negative attitude	Neutral attitude
Learning topic	Rock formation and properties	74.1	2.2	23.3
	geological processes and Structures in the landscape	66.7	1.1	32.2
	Time in geology- relative ages of rocks	63.3	4.4	32.2
	Time in geology- absolute timing	51.1	10.0	38.9
Learning strategy	Observations	81.1	2.2	16.7
	Geological sketch of observed structures	73.3	1.1	25.6
	Modelling of geological structures	84.4	2.2	13.3
	Inductive-deductive methods	61.1	1.1	37.8

Statistical significance of differences in the frequencies of positive and negative evaluations of individual learning activities was also tested by chi-square goodness-of-fit test at the significance level of $p < 5$. Statistical significance was confirmed for highly positive evaluations of all learning topics and strategies. At the same time, a statistically significant difference was confirmed for the negative evaluation of the learning topic *time in geology- absolute time determination* when compared to the negative evaluation of the other instructional topics. The possible dependence of students' ratings of interest in instructional topics and strategies in relation to school types was tested by ANOVA analysis of variance. However, this test did not confirm statistical significance.
In addition to the actual assessment of interest in specific learning topics and strategies, students often cited other influences that affected their interest. Thus, students rated the overall teaching style and approach of the teacher, the inclusion of teaching methods they were not used to from regular classes, the interest of the chosen topics, their understanding of the content, and whether or not they liked geology. These responses were then conceptualized and structured into a category identified as *learning environment*. The quantification of each response is presented in the following table (see Table 3).

Table 3 Possible influence of selected factors of the learning environment on students' interest in the geological learning topics

Category	**Concepts**	**Relative frequency of occurrence in student responses (%)**		
		total	Of which positively evaluated	Of which negatively evaluated
Learning environment	Time consumption of the learning activity	7.8	0	7.8
	Learning content	23.2	11.1	12.2
	Teaching style	12.2	12.2	0
	Teacher's personality	3.3	3.3	0
	Students' relationship to geology	12.3	0	12.3

Many of the students were concerned with *learning content*, with 23.2 % of the students, with the ratio of positive and negative responses more or less even. Approximately 12 % of students' responses were negative about timekeeping in geology, particularly the activity based on calculating half-lives. The reason often cited was reluctance to count and tiredness, as this activity was only included at the end of the teaching block. On the contrary, 11.1 % of the students appreciated the interestingness of the chosen topics positively. *Time-consuming* was mentioned in less than 8% of the students' answers. Its negative evaluation was related to the overall length of the lesson and the fatigue they felt at the end. Overall, they also commented positively on *the teaching style* (about 12 % of the responses) and *the personality of the teacher*, which was mentioned by about 3 % of the students. In the teaching style, students appreciate most group work and sharing ideas with classmates in the group and with the teacher. The last concept evaluated was the *students' relationship with geology*. Students who mentioned this rated it negatively overall (all 12.3 % responses). However, about 7 % of these students also stated that although they did not enjoy/enjoy geology, the teaching topics and tasks presented were interesting.

Discussion

This study shows an insight into the teaching of geology with an emphasis on the impact of different teaching strategies on interest in geological content. One of the key findings is that students value demonstrative and hands-on methods that allow them to work directly with rock material or visualize geological processes. This is supported by positive evaluations of tasks that focused on hands-on exploration of rocks and geological processes. This is particularly evident in the evaluation of the teaching strategies of observing and modelling geological structures, which aroused the interest of more than 80% of all students interviewed. This high situational interest in observing and modelling geological objects may be influenced by how these teaching strategies directly engage students and allow them to engage in hands-on exploration and experimentation. For example, students were surprised by how the structure of a rock can provide information about the nature of the environment in which it was formed. Thus, direct interaction with the natural world, combined with group work and appropriately guided discussion, can significantly aid deeper understanding and make connections between theoretical concepts in the students' learning process (cf. [7], [19], [20]). At the same time, it can be stated that the student's interest in observing rocks and modelling geological structures also stimulated their interest in the content of the curriculum presented by these learning activities. Teaching focused on the structure and formation of rocks, identification of fossils and geological processes was positively evaluated by a significant majority of students. This fact could indicate the interconnection of situational interest, which arises primarily as a student's personal interest in an interesting or unusual situation, with the student's deeper engagement with the learning content related to the situation (cf. [3]). It is interesting to note that although some topics, such as absolute timekeeping in geology, may be difficult for students, there is still a level of interest. The difficulty of this topic is due to its high level of abstractness in understanding the spatial-temporal relationships of geological events and objects, which is reflected in students' disinterest and overall dislike of the topic (cf. [4], [5]). In our research, it did not go unnoticed that although a statistically significant 10% of students reported that the task aimed at calculating the absolute age of a rock did not interest them, half of the students were still interested in the topic. This may indicate that even if some activities are more challenging, they can still provide a valuable learning experience for a proportion of students. The interest of some of the students here may have stemmed from the interest in the issue of determining the age of rocks, which is not commonly included in mainstream teaching, and the overall interdisciplinary approach of geology to investigating the Earth's geological past.

Another key aspect that emerges from the results is the importance of the learning environment and the role of the teacher in the learning process. Students often reported that the teaching style, the personality of the teacher and their own relationship with geology influenced their interest and perception of the learning activities. For the most part, the lessons were based on a problem-based learning style, and students had many opportunities to discuss their ideas and validate their relevance with the teacher and other classmates. By making the individual learning tasks logically related to each other, allowed students to appropriately use inductive-deductive learning strategies and to become aware of the interrelationships between the findings.

Some of the students who stated that they had never been interested in learning about geology, yet were intrigued by the learning unit illustrate the importance of situational interest here. This highlights the importance of pedagogical skills, the motivational role of the teacher, and the adaptation of teaching strategies to the needs and interests of the students.

Conclusion

Based on the results and discussion provided, here are five key points summarizing the main conclusions of the study:
(1) Hands-on exploration increases engagement: tasks that involved direct interaction with geological materials, such as observing rocks and modelling geological structures, significantly increased student interest. More than 80% of students found these activities engaging, highlighting the importance of hands-on, demonstration-based methods in geology education.
(2) Positive acceptance of hands-on strategies in teaching topics: Activities focused on a rock formation, geologic processes, and modelling received high positive ratings from students, indicating that teaching strategies that allow students to visualize and directly engage with geologic concepts promote deeper understanding and interest.
(3) Tasks with abstract concepts: while the hands-on tasks received considerable interest, topics such as absolute time measurement in geology presented a challenge due to their abstract nature. Despite this difficulty, approximately half of the students found value and interest in these topics, suggesting that even complex topics can find resonance with some students.
(4) The importance of the learning environment and pedagogical skills: the study highlights the key role of pedagogical skills and the need for teachers to adapt their strategies to the needs and interests of students. Although some students were initially uninterested in geology, effective teaching methods could stimulate their curiosity, highlighting the motivational role of the teacher in shaping the learning experience.
In essence, the study emphasizes the value of hands-on teaching methods and problem solving in geology while highlighting the key role of the learning environment and teacher's approach in promoting student engagement and understanding.

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