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RESEARCH ARTICLE

Elementary school students' perceptions of technology education classes in southern Croatia

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Aim: To explore and analyze gender- and age-related differences in the experience of boredom during Technology Education classes among elementary school students.

Methods: The study included fifth-, sixth-, seventh- and eighth-grade students from three elementary schools in the Republic of Croatia (n = 286). The Classroom Boredom Scale was used to measure students' self-reported boredom, along with general information on gender and grade level. For each student, a mean score was calculated across all scale items. Because the distribution of mean scores deviated from normality, non-parametric tests (Mann–Whitney U test and Kruskal–Wallis test) were used.

Results: Girls showed slightly higher mean scores on boredom-related items than boys (P = 0.004). A statistically significant difference was also found between grade levels ($P < 0.001$), with sixth- and seventh-grade students reporting somewhat higher agreement with boredom-related statements compared with fifth- and eighth-grade students. This pattern was more pronounced among girls.

Conclusion: Increasing opportunities for active learning and practical work (e.g., designing technical artefacts, project-based learning, and group activities) may help sustain students' engagement in Technology Education. In addition, supporting girls' motivation and addressing gender stereotypes that may influence interest in technical subjects could further contribute to maintaining students' involvement and confidence in this domain.

Keywords: boredom; classroom experience; instruction; satisfaction; technology education

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Introduction

Technology Education is a compulsory subject in Croatian elementary school, which gives students the skills to navigate their environment (*1*). In today's world, technical literacy is essential, which emphasizes the need for strong STEM education (*2*). Researchers emphasize the early start of STEM learning (*3*, *4*). In the face of rapid technological change and global challenges, skills in science, technology, engineering and mathematics are essential for personal education, economic competitiveness and responsible citizenship. However, international research shows that even in developed regions such as Europe, the US and Australia, around 20% of students lack adequate skills in math or science, indicating an urgent need for improvement (*5*). Despite progress and greater attention to gender equality, women remain underrepresented in STEM education and careers across Europe. Closing this gap is both an issue of equality and a critical factor for economic and societal progress, especially as STEM fields increasingly drive innovation and provide solutions to global challenges (*6*).

Developing technology education in elementary schools is critical to equipping children with the skills to navigate an innovation-driven world and strengthen literacy and problem-solving skills. Encouraging girls to participate helps to break down gender stereotypes and ensures equal opportunities to explore technical careers. This promotes educational equity and enriches the STEM sector with diverse perspectives that are essential for innovation and economic growth. Teachers play a key role by fostering motivation, teaching with enthusiasm, maintaining a positive attitude, creating an inclusive environment and promoting engagement, which together supports student interest and success in STEM (*7*).

Current standards show that project-based STEM instruction promotes 21st century skills and builds student confidence. Teachers need to integrate science and engineering practices to promote real-world problem solving (*8*). Teaching should not be judged solely on knowledge transfer, as this neglects the emotions and reduces learning to obedience and reproduction (*9*). However, knowledge should not be overshadowed by emotions. Effective teaching requires a balance between knowledge and emotions as well as interaction and individual effort (*10*). Nevertheless, many students experience boredom in class (*11*).

Boredom in the classroom is a complex problem that is influenced by several factors (*12*, *13*). Common causes include low engagement, a lack of interactive content, limited teacher support and weak connections between lessons and students' lives (*14*). Yet aspects such as peer pressure, technology use and individual differences remain unexplored. As each school subject has unique characteristics, boredom should be studied within specific disciplines rather than in general (*15*). Although studies have examined the roots of boredom (*12*, *15*-*18*), none have focused on Technology Education. This gap highlights the need to analyze how boredom arises in this subject, which is the focus of the present research. The study aims to expand the understanding of boredom in the classroom and provide insights for teachers and researchers in Technology Education.

Methods

Participants and data collection

Fifth, sixth, seventh and eighth grade students from three elementary school in southern Croatia participated in this study (N = 286): Petar Kanavelić elementary school in Korčula (n = 150 students), Orebić elementary school (n = 105 students) and Ante Curać-Pinjac elementary school in Žrnovo (n = 31 students).

Prior to data collection, permission was obtained from the principals of the participating schools. The class teachers were informed about the purpose and objectives of the study. The questionnaire was completed during homework time or in Technology Education classes, with the prior consent of parents and students. The study was approved by the Ethics Committee of the Faculty of Science. The data was collected in May 2023 using pen-and-paper technique in groups. At the beginning of the lesson, students were given instructions on how to complete the questionnaire. They were informed that participation was completely voluntary and anonymous and that they could withdraw from completing the questionnaire at any time. They were reminded that all statements in the questionnaire related exclusively to Technology Education.

Measurement tools and data analysis

The questionnaire used in this study consisted of general questions on gender and grade level as well as the original *Classroom Boredom Scale* (*19*) (**Table 1**). The Classroom Boredom Scale consists of 26 items designed to measure what students think and feel during class. It uses a Likert scale with 5 response options. Students indicated their agreement with the statements on a scale from one to five (1 – strongly disagree, 2 – mostly disagree, 3 – neither agree nor disagree, 4 – mostly agree, 5 – strongly agree). As the study was based on the use of an already validated scale, we did not conduct a factor analysis for this sample, as the validation of the instrument had already been carried out by the authors (*19*). Instead, the reliability coefficient was checked, and Cronbach's alpha for the entire scale was calculated.

For each participant, the mean score on the Classroom Boredom Scale (CBS) was calculated as the arithmetic average of all 26 Likert-type items (1 = strongly disagree to 5 = strongly agree). The distribution of these mean scores was examined using the Kolmogorov-Smirnov test, which indicated a deviation from normality. Accordingly, descriptive statistics are presented as the median of the mean scores and the interquartile range (IQR). Differences between groups were analysed using nonparametric tests (Mann–Whitney U test and Kruskal–Wallis test), followed by Dunn's post-hoc test for multiple comparisons.

The Classroom Boredom Scale does not contain validated cut-off scores for classifying levels of boredom. Therefore, CBS results should be interpreted solely as a continuous measure, where higher mean scores indicate stronger agreement with boredom-related statements, and lower scores indicate weaker agreement. Interpretation is based on relative differences between groups, rather than on absolute categories such as "low," "high,"

Table 1. Statements in the Classroom Boredom Scale (*19*)*

1. During class I find it easy to focus.
2. During class I often catch myself worrying (thinking) about other things.
3. During class feel like time drags.
4. During class I rarely feel enthusiastic.
5. During class I feel like I'm in a situation where I have to do pointless stuff.
6. During class I feel like most of the stuff I have to learn is monotonous and repetitive.
7. During class I often catch myself not knowing what to do with myself.
8. During class I mostly just sit there and do nothing.
9. During class I feel incredibly bored.
10. During class I feel like I'm not making the most of my abilities.
11. During class I feel tired.
12. During class I can usually hardly wait for the class to be over.
13. During class my attention often drifts.
14. During class I often think that schoolwork is pointless.
15. During class I need more support to learn stuff than other students.
16. During class I'm rarely interested in the lessons.
17. During class I don't feel challenged.
18. During class I would like to run away.
19. During class I feel so tired that I can barely keep my eyes open.
20. During class I often want to rest my head on the desk.
21. During class I often wonder what I'm even doing there.
22. During class I feel like I'm just wasting my time.
23. During class I feel impatient.
24. During class I don't really feel like doing anything.
25. During class we mostly learn stuff that has nothing to do with real life.
26. During class I feel beat up.

*The responses were on the scale from 1 to 5 (1 – strongly disagree, 2 – mostly disagree, 3 – neither agree nor disagree, 4 – mostly agree, 5 – strongly agree).

or "intense" boredom. Statistical analysis of all data was performed using IBM's Statistical Package for the Social Sciences (SPSS) software. Statistical significance was set at $\alpha = 0.05$ ($P < 0.05$).

Results

The gender distribution was unbalanced, with slightly more boys (n = 157, 54.9%) than girls (n = 129, 45.1%). Most of the participants were 8th-graders (n = 89, 31.1%), followed by 6th-graders (n = 84, 29.8%), 5th-graders (n = 61, 21.3%) and 7th-graders (n = 52, 18.2%).

The Classroom Boredom Scale demonstrated high internal consistency in this sample (Cronbach's alpha = 0.89). Compared to boys (median = 2.96; IQR = 2.46–3.51), girls (median = 3.15; IQR = 2.58–3.65) reported slightly higher agreement with boredom-related statements in Technology Education classes ($P = 0.004$) (**Figure 1**).

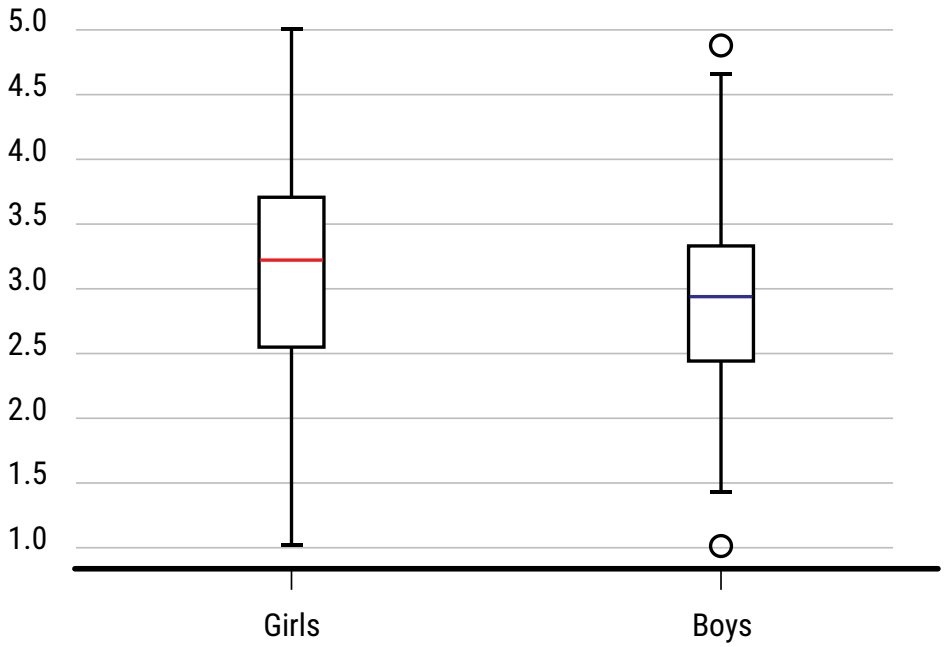

Figure 1. Box-and-whisker plot of mean Classroom Boredom Scale (CBS) scores for girls and boys in elementary school. The central lines indicate group medians; boxes represent interquartile ranges (IQRs), and whiskers show the full range of mean scores. Girls showed slightly higher mean agreement with boredom-related statements than boys, consistent with the difference in medians (Mann–Whitney U test).

Additional item-level analysis showed several statistically significant gender differences. Girls more frequently agreed with the statement *"I rarely feel excited in class"* (U = 8452.00; *P* = 0.014) and *"I feel incredibly bored in class"* (U = 8464.00; *P* = 0.014). Girls also more often agreed with *"Sometimes I feel so sleepy in class that I can hardly keep my eyes open"* (U = 8542.00; *P* = 0.020) and *"I don't feel like doing anything in class"* (U = 8727.00; *P* = 0.040), indicating relatively lower motivation and willingness to participate. The lowest median boredom scores were observed among fifth-grade students, while sixth- and seventh-grade students showed higher median scores, followed by a slight decrease among eighth graders (**Table 2**).

Table 2. Classroom Boredom Scale scores (median, interquartile range) in technology education classes for students from the 5th through the 8th grade of primary school (n = 286)

School grade			
5th (n=61)	6th (n=84)	7th (n=52)	8th (n=89)
2.73 (2.10 – 3.15)	3.17 (2.51 – 3.72)	3.23 (2.89 – 3.58)	2.88 (2.27 – 3.38)

*The Classroom Boredom Scale consists of 26 items rated on a five-point Likert scale (1 = strongly disagree to 5 = strongly agree). For each student, a mean score was calculated, yielding a possible range from 1.00 to 5.00, where higher values indicate stronger agreement with boredom-related statements.

A statistically significant difference in boredom scores was found across grade levels (H = 19.97; P < 0.001). Following the significant Kruskal–Wallis test, Dunn's post-hoc analysis identified the specific group differences (**Table 3**). Fifth-grade students had significantly lower boredom scores than both sixth- and seventh-grade students. No significant

difference was found between fifth- and eighth-grade students or between sixth- and seventh-grade students. Sixth- and seventh-grade students reported significantly higher boredom scores than eighth-grade students.

Table 3. Post-hoc analysis of Classroom Boredom Scale scores in Technology Education classes for students from the 5th to the 8th grade

Comparisons		*z*-statistics	*P*-value*
Group 1	Group 2		
5th grade	6th grade	4.71	< 0.001
5th grade	7th grade	5.02	< 0.001
5th grade	8th grade	1.17	0.242
6th grade	7th grade	0.89	0.376
6th grade	8th grade	3.93	< 0.001
7th grade	8th grade	4.32	< 0.001

*Dunn's post-hoc test – correction of the statistical significance level $\alpha = 0.05$ ($P < 0.008$).

Discussion

This study examined students' experiences of boredom in Technology Education by analysing relative differences in their responses on the Classroom Boredom Scale. Previous research has shown that boredom is a frequent classroom phenomenon and is associated with reduced motivation, engagement, and learning outcomes (*15–17*). Boredom commonly arises when instructional tasks are insufficiently stimulating, do not align with students' cognitive development, or lack opportunities for active involvement (*20*). Factors such as perceived meaninglessness of tasks, uninspired teaching practices, and unengaging content have also been identified as contributors (*21*). Daschmann (*14*) similarly emphasized that lesson content, students' emotional states, and teacher characteristics affect how boredom is experienced.

In our study, girls reported slightly higher mean scores on boredom-related items than boys, indicating relatively stronger agreement with boredom statements. This is broadly consistent with Purković et al. (*22*), who found that boys tend to express greater interest in technical domains. Differences in content preferences may partially explain this pattern: boys often show more interest in automation and robotics, while girls may prefer technical drawing. As noted by Suman and Purković (*23*), while gender differences in the delivery of instruction may be limited, differences in content preferences are common, with many girls favouring drawing or woodworking activities, although some express limited interest. Prior research also reports lower average interest among girls in technical subjects (*24*, *25*). These findings suggest that diversifying content complexity and incorporating activities appealing to varied interests may enhance engagement among both genders.

Al-Amri (*26*) reported that student boredom can evoke negative emotions in teachers, including frustration and self-doubt, highlighting the need for emotionally responsive pedagogical approaches that promote positive emotions in the classroom. Training in cognitive reappraisal may be beneficial for teacher well-being. Research on emotion regulation in

STEM education remains limited; Wang and Yin (*27*) point out substantial gaps, including overly broad constructs and the lack of context-specific theoretical frameworks.

Regarding grade-level differences, our results showed relatively lower boredom scores among fifth and eighth graders, and somewhat higher scores among sixth and seventh graders. This pattern aligns with findings by Jagić and Jurčić (*28*), who reported greater satisfaction among younger students compared to older ones. Fifth graders tend to display higher satisfaction, trust in teachers, and stronger classroom relationships (*29*). Perone et al. (*18*) observed that students' boredom often increases with age, particularly during adolescence. Developmental factors may help contextualize these tendencies: students aged 10–12 typically operate within Piaget's (*30*) concrete operational stage, which supports curiosity and task engagement, while the transition toward the formal operational stage in later grades may be accompanied by increased critical thinking and reduced interest in routine tasks. Jurčić (*31*) found that younger students often report greater school satisfaction, whereas older students more frequently express negative emotions and reduced enjoyment of learning (*32*), along with lower levels of teacher engagement (*33*). Resistance to authority, characteristic of adolescence (*34*), may also influence students' perceptions. The slightly lower boredom scores observed among eighth graders in our study may relate to the anticipation of transitioning to high school, which often intensifies in spring (*35*).

To address variations in engagement across grades, curricula may benefit from incorporating practical, research-based, and interdisciplinary activities (*36*). Although research on the use of technology to reduce boredom is limited, innovative applications appear promising for sustaining attention and improving instructional quality (*37*). While boredom cannot be fully eliminated, reducing it may positively affect motivation, engagement, and the overall classroom experience (*38*). Supportive classroom environments – through group work, field activities, and visits to relevant institutions – can help stimulate interest. Emphasizing hands-on work and independent design tasks may also encourage creativity and sustained engagement in Technology Education.

This study has several limitations. The sample included only three Croatian elementary schools, which reduces generalizability. Data were based on student self-reports and collected at a single time point, preventing insight into possible fluctuations across the school year. Important factors such as academic performance, socioeconomic status, motivation, and prior knowledge were not examined, nor were comparisons with other subjects. In addition, research on classroom boredom remains limited both globally and in Croatia, which restricts broader contextualization of the findings.

In conclusion, girls showed slightly higher agreement with boredom-related statements than boys, and mean scores were relatively higher in sixth and seventh graders. Fifth graders, who typically respond well to hands-on and concrete tasks, reported lower boredom, while early adolescents showed somewhat increased agreement with boredom items. Aligning teaching methods with developmental stages – for example, using practical activities for younger students and more open-ended, creative projects for older students – may help sustain engagement. Integrating technical content with students' interests, such as sports, music or games, could further enhance motivation, particularly among girls and early adolescents.

Provenance: The article is based on the thesis "Pupils' experience in Technology Education" by Andrea Brčić, BS at the University of Split Faculty of Science, under the supervision of Assistant Professor Anna Alajbeg, and is deposited in the Dabar repository.

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