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The transformative impact of the project-based learning approach on students' attitudes to own skills to cooperate and learn to learn in a teacher training program[1]

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Abstract

In education, fostering collaboration skills and cultivating a growth mindset are paramount for student success. This study aims to investigate the impact of the Curious Learning course on students' attitudes toward their collaboration skills and growth mindset within the Teacher Training program. Employing a Dual-Method Analysis approach, qualitative insights were gleaned from students' portfolios and lesson record microanalysis. At the same time, quantitative data were collected through a questionnaire measuring participants' attitudes toward collaboration and growth mindset. After completing the Curious Learning course, further analysis of the questionnaire and portfolio entries revealed that many students reflected more realistic perceptions of their collaboration skills and learning management abilities. These findings suggest that the course effectively enhances students' self-perception of collaboration skills and fosters a growth mindset within the learning process.

1 Introduction

Rethinking the teacher's perspective on teaching in the 21st century is an ongoing and transformative process that involves adapting to the digital age, shifting teaching paradigms, and cultivating essential skills for students' future success. Embracing technology, becoming facilitators of learning, promoting global citizenship, and nurturing social and emotional skills are essential elements in this transformative journey. By continually reflecting on their practices and

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embracing innovative approaches, teachers can have a profound impact on the lives of their students, preparing them to thrive in a world characterized by constant change and endless possibilities (Rose, Meyer, 2002).

In the latter half of the twentieth century, the discourse about alternative education revolved within the academic community. However, the events in the early years of the 21st century highlight the urgency for a paradigm shift in teachers' perspectives toward their teaching methods. Several international analyses, such as The Changing Nature of Work and Skills in the Digital Age, produced in 2019 by the European Commission's Joint Research Centre, point to significant transformations in the global labor market environment that require fundamental changes in education systems - their paradigms (see Figure 1).

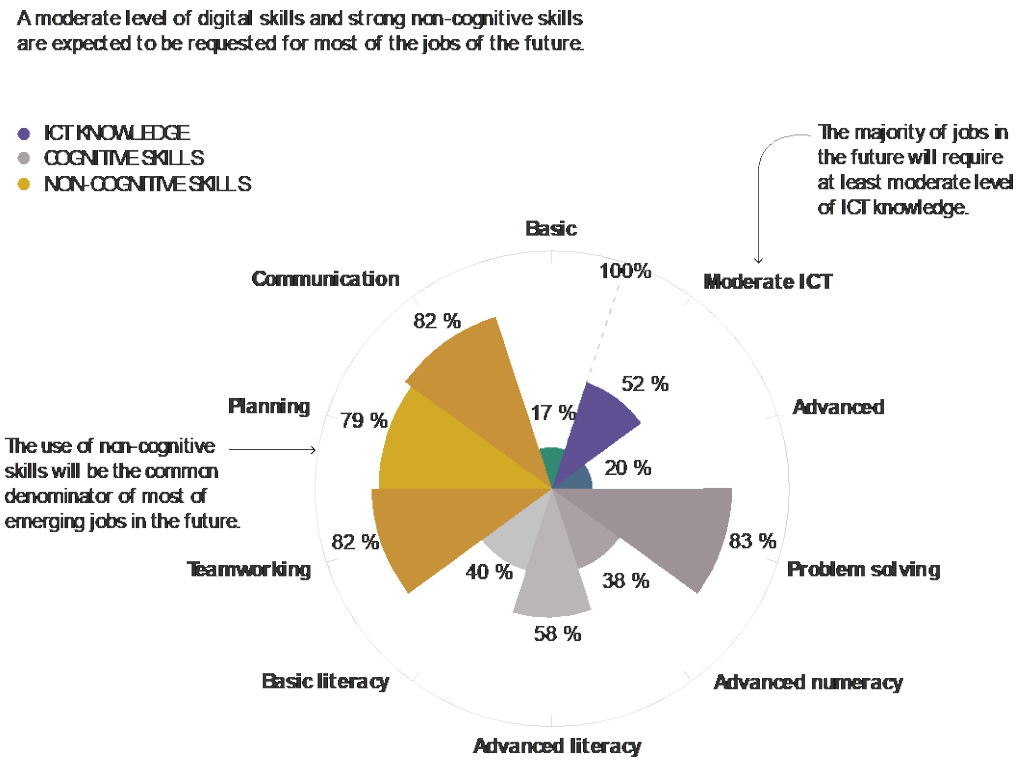

Figure 1 Average degree of importance of skills across jobs with a positive employment outlook, 2015-25, EU28

Note: The levels of skills were self-declared by surveyed workers.
Source: JRC from Cedefop (2016); Cedefop European skills and jobs survey; Cedefop European skills forecasts.

A moderate level of digital skills and strong non-cognitive skills are expected to be required for most jobs in the future. As technology-driven production processes become more complex and interconnected, workers are increasingly required to organize these processes and coordinate among themselves, often using digital tools. As shown in a Cedefop study (2016), most of the jobs that are anticipated to expand until 2025 require at least a moderate level of digital skills combined with strong non-cognitive skills (e.g., communication and teamwork) (see Figure 1). Another study (OECD, 2018) argues that to cope with unknown and evolving circumstances — which best characterizes expected future work environments — jobs will require workers to be equipped with diverse skills: cognitive and meta-cognitive skills (e.g., critical thinking, creative thinking, learning to learn and self-regulation); non-cognitive skills (e.g., empathy and collaboration); and digital skills (e.g., using new digital devices).

Today, we can already observe radical educational changes that have begun worldwide. Traditional classrooms are transitioning from teacher-centered environments to collaborative spaces that promote active learning. Collaborative and project-based learning approaches encourage students to work together on real-world problems, developing essential teamwork, communication, and problem-solving skills (Larmer et al. (2015).

In light of such evolving events, the needs of teacher practice must be reflected in Teacher Training Programmes. Johnmarshall Reeve, in his studies (2006, 2016), points out that many teachers receive traditional pedagogical training that emphasizes a teacher-centered, controlling approach to instruction. This training may not adequately prepare them to facilitate autonomous learning environments that support the development of key competencies such as collaboration, growth mindset, creative thinking, and other key skills for the 21st century. As a result, they may feel more comfortable with the familiar methods and struggle to adopt new strategies. Pedagogical training influences teachers' beliefs and practices in the classroom. When teachers are taught in a controlling paradigm, they may be less likely to shift to a more autonomous support style, as it requires a change in their beliefs about teaching and learning.

The Project-Based Learning (PBL) approach constructed by the Buck Institute of Education is appropriate for the shift in the Teacher Training Program (Figure 2).

Project-Based Learning (PBL) is a dynamic approach that engages students in real-world problems, encouraging collaborative inquiry, critical thinking, and creativity. Project-based learning (PBL) promotes collaborative skills and a growth mindset among students. Students learn to work effectively in diverse teams through teamwork, communication, and shared responsibility. PBL encourages students to embrace challenges, persist through setbacks, seek feedback, and celebrate progress. By emphasizing collaboration and a positive attitude toward learning, PBL equips students with essential skills and attitudes for academic success and beyond.

Figure 2 Gold standard PBL: Seven essential project design elements

Source: Buck Institute for Education, 2019

An important part of the so-called Gold Standards PBL are reflection and revision are crucial in

educators' professional development and learning, particularly when implementing new teaching approaches reflection and revision are crucial in educators' professional development and learning, particularly when implementing new teaching approaches (Kaasila, Lauriala, 2010). It bridges theory and practice (Wenger, 1998) and connects the educators' beliefs and their actual educating methods (Clarke, Hollingsworth, 2022). This process is essential to enhancing one's education skills (Mooro-Russo, Wilsey, 2014) and refining their current education practices (Hagevik et al., 2012). Enderle et al. (2014) and numerous other researchers highlight how educators can transform their beliefs through reflective analysis of classroom experiences. Additionally, Lin et al. assert that educators who engage in peer observations and discussions tend to focus more on posing inquiry-based questions.

In their research, Monet and Etkina (2008) emphasize that educators encountered challenges when reflecting on their learning within the context of continual professional development programs (CPDs) and frequently held misconceptions regarding their classroom practices. Their self-assessments of their education practices often proved inaccurate and occasionally even erroneous (Capps, Crawford, 2013). The correlation between self-declared competence and actual performance was inadequate (Stolp, Zabrucky, 2009). Feldman and Ozalp (2019) raise questions about educators' self-reports, as there exists the possibility that they lack the knowledge, comprehension, or skills necessary to accurately evaluate their accomplishments, often leading to unawareness of their shortcomings and an overestimation of their abilities (Maderick et al., 2016).

The observed discrepancy between the science educators' self-reported practices, pedagogical preferences, and classroom activities has been examined (Hutner, Markman, 2016). According to the authors, educators' actions in the classroom are purpose-driven, reflecting their determination to achieve specific objectives for each class. The educators' beliefs and knowledge serve as intermediary factors that suggest potential pathways to attain these objectives.

It appears that educators' beliefs lead them to be attuned and responsive to specific occurrences within the science classroom (Crawford, 2007). Meschede et al. (2017) also emphasize that more than merely declarative knowledge is required to effectively recognize and interpret classroom dynamics professionally, suggesting that practical experience plays a crucial role in this process. Furthermore, they refer to Blömeke et al. (2012) competence model, which characterizes it as a transformation of predispositions encapsulated by educators' knowledge and beliefs regarding professional insight and, consequently, their performance in the classroom.

In their 2019 study, Kotuľáková et al. explored how educators comprehend the implementation of inquiry-based instruction. Their approach involved prompting educators to engage in self-reflection regarding their educating practices and then comparing their self-assessments with those conducted by researchers. The disparities between these two perspectives were found to be statistically significant.

Educators tended to misinterpret and overestimate their performance, as well as the performance of their learners. Previous studies also described this phenomenon (Feldman, Özalp, 2019; Savasci, Berlin, 2012).

Research by Kotuľáková et al. (2019) contributes to the relatively limited body of literature that has explored educators' self-perception of their instructional practices and compared it with researchers' observations of classroom lessons. Specifically, the study evaluated science educators' ability to reflect on inquiry-based science lessons, revealing that their self-assessments

tended to significantly overestimate their performance compared to the observations made by researchers. Educators primarily focus on meeting curriculum-defined objectives, often overlooking the crucial process of working with evidence to construct knowledge within a community of learners, which has been shown to have the most substantial impact on student learning outcomes.

We are investigating the possibility of implementing Project-Based Learning into our Teacher Training Program through an elective course called Curious Learning. The course implementation incorporates project-based learning, design thinking methodologies, and STEM learning environments. Our qualitative-quantitative analysis indicates (more in 3 Findings) that the practical use of this approach leads students to modify their multiple beliefs and become more congruent in their attitudes toward their collaborative skills and growth mindset.

2 Method

We use a Dual-Method Analysis, combining qualitative insights from students' portfolios and lesson record microanalysis with quantitative data from a questionnaire. The questionnaire focuses on gauging participants' attitudes toward their collaboration skills and cultivating a growth mindset within the learning process. The quantitative part of the analysis used an experimental model with a pre-test and post-test single-group experimental model as the descriptive research method. The qualitative part of the analysis used students' online portfolios with their reflections during the Curious Learning course and focus group interviews before and after this course.

Our analysis was conducted systematically and sequentially. We began with the quantitative data analysis from the pre-test and the qualitative data analysis from the focus group. After participants were exposed to the Curiosity Learning courses, we repeated the process, analyzing the quantitative data from the post-test, the qualitative data from the second focus group, and online portfolios.

This research analysis aims to investigate the impact of the Curious Learning course on the self-perception skills of collaboration and the growth mindset of students in the Teacher Training program. The study was conducted during the 11-week course period in the winter semester of the 2022-2023 academic year.

A Dual-Method approach can be particularly appropriate in studies with small sample sizes. That is one reason why we use it in our research study. Integrating qualitative and quantitative methods allows researchers to leverage the strengths of each approach to compensate for the limitations of the other. Qualitative methods can provide rich, detailed insights into participants' experiences, perceptions, and contexts, even in small samples. Meanwhile, quantitative methods can help quantify the data's relationships, patterns, or trends, providing additional validation and context to qualitative findings. The roots of Dual-Method analysis can be traced back to the emergence of mixed-methods research in the late 20th century. During the latter half of the 20th century, there was a paradigm shift in the social sciences towards recognizing the limitations of mono-method approaches. Scholars began to advocate for integrating qualitative and quantitative methods to address the complexities of social phenomena more effectively. Key works in the field, such as Donald Campbell and Julian Stanley's (1963) and Robert Yin's (2017), played significant roles in promoting the idea of methodological pluralism and integrating multiple research approaches.

2.1 Design

The Pre-test: Before the intervention, a pre-test was conducted to measure participants' attitudes toward their cooperation skills and growth mindset. A scale assessing attitudes to skills to cooperate and growth mindset skills was administered as a pretest.

After the pre-test, we conducted a focus group to gather qualitative data on participants' attitudes, beliefs, and perceptions related to the reflection of their ability to cooperate, collaborate, and grow up mindset.

Curiosity Learning courses: Participants attended curiosity learning courses for a designated period. The courses incorporated a project-based learning approach and STEM environments (Micro. Bit, Paper Circuits, Bare Conductive) to enhance participants' cooperation skills and growth mindset. In the first course, the students were set up for the following challenge: In smaller working groups, prepare and verify project-oriented two-hour teaching during which their students (in elementary school) will develop a key skill for the 21st century - cooperation, using the STEM educational environment. Individual sessions were designed to meet the golden standard of PBL Works (Buck Institute for Education). The use of STEM educational environments and the PBL approach supports and stimulates the skills necessary for cooperation and collaboration (Ellis, 2021; Price et al., 2019) and also stimulates a mindset focused on the need for continuous learning (Saavedra et al., 2019; Thomas, 2000).

The courses were structured and conducted in an interactive environment that encouraged student engagement.

The 11-week course planning was carried out using the following headings.

Week 1: Introduction and a short lecture by a specialist from private company Accenture about Skills and Competencies for the 21st. Century

Week 2: Creation of your portfolio via Google Sites and instruction on how to do reflection.

Week 3: Experiential introduction to STEM Environments.

Week 4: Legoman – Collaboration and cooperation in the classroom (division into teams and training focus on team collaboration and cooperation).

Week 5: Training focuses on planning via the Flow concept and communication via the Radical Candor concept.

Week 6: Team mentoring provided by mentors outside the academic environment.

Week 7: Preparing the lesson—teamwork on the challenge: "Prepare a lesson where students will develop the skill of cooperating via the STEM environment."

Week 8: Preparing the lesson.

Week 9: Concentrated preparation at the partner school, where the students will teach their lesson.

Week 10: Team teaching of a project-oriented lesson at a partner school.

Week 11: Reflexion, revision, and feedback.

Individual homework was completed by students after each lesson: made a structured reflection on the course (via Google Sites) into their portfolio, which included reflecting on one's ability to cooperate in a group and learn to learn.

Post-test: After completing the curious learning course, a post-test was administered to measure

participants' attitudes toward their cooperation skills and growth mindset. The same scale was used in the pretest as in the posttest.

After the post-test, we followed the same procedure to gather qualitative data on participants' attitudes, beliefs, and perceptions related to reflection, the changes in their self-perceived ability to cooperate/collaborate, and the growth mindset.

2.2 Participants and procedure

The research sample consisted of students in a Curious Learning elective course. It was a small group in scope. The structure of the research sample is shown in Table 1.

Table 1 Demographic characteristics of the participating university students

Variable	Category	f
Grade Level	First year of study in Magister degree	5
	Third year of study in Bacalar degree	7
	Second year of study in Bacalar degree	1
Gender	Female	12
	Male	1
Department of Education	Department of Special Education	3
	Department of Primary Education	5
	Department of Pre-primary Education	3
	Department of Ethics and Civic Education	2

The sample's distribution in terms of grade level was as follows: 38% (f=5) of the students were in the 1st Magister grade, 54% (f=7) were in the 3rd Bacalar grade, and 8% (f=1) were in the 2nd Bacalar grade. This distribution indicated that the study included students of various grades.

The gender distribution is as follows: 92% (f=12) of the students are female, while 8% (f=1) are male. This distribution shows that most of the sample consisted of female students.

The distribution of students across various academic departments was delineated as follows: The Department of Special Education accounted for 23% of the student cohort (f=3); the Department of Primary Education comprised 39% (f=8); the Department of Pre-primary Education represented 23% (f=3); and the Department of Ethics and Civic Education encompassed 15% (f=2).

Demographic Information Form: The demographic information form consisted of questions related to sex, academic department, and grade level, tailored to align with the purpose of the study rather than collecting personal information about the students.

2.3 Instrument

Self-perception of Cooperation and Growth Mindset Scale: We used a questionnaire of our construction in the research. The basic structure of the questionnaire is based on the ABC model of attitudes (Allport, 1954). Therefore, the questionnaire asks about the affective, cognitive, and behavioral components of attitude. For the items for the "cooperation skill" domain, we based them on the Team Skills Scale (TSS) and the Interpersonal Skills Inventory (ISI). Like the TSS, the ISI was developed by researchers at the University of Sheffield. For the items for growth mindset, we based on the Growth Mindset Inventory (GMI) and The Dweck Mindset Measure (DMM). Both of them were developed by Carol S. Dweck and her colleagues in mindset research. The questionnaire has 21 items, of which 19 use the full Likert scale, and two are open questions. Self-perception of Cooperation and Growth Mindset Scale: We used a questionnaire of our

construction in the research. The basic structure of the questionnaire is based on the ABC model of attitudes (Allport, 1954). The questionnaire has 21 items, of which 19 use the full Likert scale, and two are open questions. All 18 items were scored on a 7-point Likert scale (1 = “not at all true” and 7 = “very true”).

We did not use standard statistical techniques to explore the validity of a questionnaire's item structure because a small sample size, such as 13 respondents, may yield unreliable results. We used more appropriate methods, which we present in section 2.5, Validity, reliability, and ethical considerations.

2.4 Data analysis

The analysis of the data obtained from the research applications was conducted using JASP 0.17.2.1.

In our study, we employed non-parametric tests, such as the Wilcoxon signed-rank test, for our data analysis due to the small sample size of our dataset. Non-parametric tests do not rely on assumptions about the underlying distribution of the data, making them robust and appropriate for analyses involving small sample sizes. As such, the assumption of normality is unnecessary for our analysis (Hendl, 2006). Therefore, in light of our sample size, we decided not to perform a normality test to test for normality and proceeded directly with non-parametric analyses to ensure the validity and robustness of our findings.

The Wilcoxon signed-rank test is a non-parametric test that does not rely on assumptions of normality, making it suitable for use with small sample sizes and data that are not normally distributed (Komárik, 2001). By opting for the Wilcoxon signed-rank test, we could assess differences between paired measurements from the same sample while accounting for the assumed non-normality of our data. This allowed us to conduct a reliable analysis that provided valid results, even with a limited sample size.

Overall, the use of the Wilcoxon signed-rank test was justified based on the characteristics of our data and the need for a statistical test that could accommodate the non-normal distribution and small sample size of our dataset. This choice ensured the validity and integrity of our analysis, leading to meaningful conclusions and insights for our research.

We used content analysis to analyze the qualitative data from students' online portfolios and focus groups.

2.5 Validity, reliability, and ethical considerations

To evaluate our questionnaire's validity, we used several methods. Subjectively, we assessed the face validity of our questionnaire by reviewing the items to ensure they appeared to measure what they were intended to measure. We asked colleagues in our research team to review the questionnaire and provide feedback on its clarity and relevance. We conducted a pilot test of the questionnaire with a small sample (13 respondents). This allowed us to gather initial feedback on the items' clarity, comprehensibility, and appropriateness. We paid attention to any ambiguities or misunderstandings reported by participants. We also supplemented quantitative analyses with qualitative data collected alongside the questionnaire responses. Items with open-ended questions were part of the questionnaire; we also had respondents' responses in individual portfolios that provided insights into participants' interpretations of items in the questionnaire.

The reliability of the questionnaire assessing collaboration was evaluated using the split-half reliability test (Komárik, 2001). The final Spearman's rho coefficient yielded a value of 0.502, indicating a moderate positive correlation between the two halves of the questionnaire. However, the p-value associated with this correlation was 0.168, suggesting that the correlation observed may not be statistically significant. This indicates that while there is some degree of consistency between the two halves of the questionnaire, his reliability may be limited. The reliability of our questionnaire was also evaluated using Cronbach's alpha coefficient (Hendl, 2006). For the cooperate scale, the final Cronbach's alpha value was calculated at 0.824, indicating a high level of internal consistency among the items measuring cooperation. Similarly, for the Growth Mindset scale, Cronbach's alpha coefficient was 0.785, suggesting a solid level of internal reliability among the items assessing growth mindset. These high alpha values indicate that the items within each scale are highly correlated, demonstrating the questionnaire's robustness and consistency in measuring both cooperation and growth mindset constructs.

Ethical considerations: This study adhered to ethical principles outlined by relevant professional associations and institutional guidelines governing research involving human participants. Before data collection, informed consent was obtained from all participants, who were fully informed about the study's purpose, procedures, potential risks, and benefits. Participants were assured of confidentiality and anonymity, and their personal information was securely stored to prevent unauthorized access. Respect for participants' autonomy and privacy was maintained throughout the research process. Participants were made aware of their right to withdraw from the study at any time without repercussions.

Additionally, measures were taken to minimize potential harm or discomfort to participants, and appropriate support was provided in case of distress. The recruitment and selection of participants were conducted in a fair, inclusive, and non-discriminatory manner, ensuring representation from diverse populations. All participants were treated with respect and dignity, and their contributions to the study were valued. This study was conducted with transparency, integrity, and adherence to ethical standards. All research procedures and findings were accurately reported, fully disclosing any potential conflicts of interest or funding sources.

3 Findings

Looking at Table 2 with descriptive statistics, we can see from the mean score values that there are differences between the measured values in the Pre-test and Post-test. The average score in the pre-test is lower in individual dimensions of attitudes than in the post-test. Descriptive statistics, which we made for individual respondents, showed us that while some respondents experienced a significant increase in the average score in the measured scales in the post-test, some experienced a substantial decrease.

Table 2 Descriptive statistics

	Mean	Std. Dev.	Coeff. of var.	Var	Min.	Max.
Pre_test	4.248	1.444	0.340	2.084	1.000	7.000
Post_test	4.632	1.492	0.322	2.225	1.000	7.000
Pre_Coop	4.214	1.389	0.330	1.928	1.000	6.000
Post_Coop	4.538	1.517	0.334	2.302	1.000	6.000
Pre_GM	4.282	1.502	0.351	2.256	1.000	7.000
Post_GM	4.726	1.466	0.310	2.149	1.000	7.000
Pre_Coop_Cog	4.333	1.177	0.272	1.386	2.000	6.000

	Mean	Std. Dev.	Coeff. of var.	Var	Min.	Max.
Post_Coop_Cog	4.641	1.646	0.355	2.710	1.000	6.000
Pre_Coop_Af.	4.308	1.379	0.320	1.903	1.000	6.000
Post_Coop_Af.	4.513	1.467	0.325	2.151	1.000	6.000
Pre_Coop_Beh	4.308	1.379	0.320	1.903	1.000	6.000
Post_Coop_Beh	4.462	1.466	0.329	2.150	1.000	6.000
Pre_GM_Cog	4.615	1.388	0.301	1.927	1.000	6.000
Post_GM_Cog	5.026	1.135	0.226	1.289	1.000	6.000
Pret_GM_Af	4.308	1.575	0.366	2.482	1.000	7.000
Post_GM_Af.	4.667	1.675	0.359	2.807	1.000	7.000
Pre_GM_Beh	3.923	1.494	0.381	2.231	1.000	6.000
Post_GM_Beh	4.487	1.520	0.339	2.309	1.000	6.000

A non-parametric Wilcoxon signed-rank test verified the statistical significance of differences between pre-test and post-test measurements. Table 3 shows the significant differences.

Table 3 Paired Samples T-Test (Wilcoxon signed-rank test)

Measure 1		Measure 2	W	z	p
Pre_test	-	Post_test	4822.500	-3.604	< .001***
Pre_Coop	-	Post_Coop	1256.500	-2.057	0.037*
Pre_GM	-	Post_GM	1172.000	-3.008	0.002**
Pre_GM_Beh	-	Post_GM_Beh	108.000	-2.561	0.008**

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

We worked with two alternative hypotheses: measure 1 ≠ , measure 2, and measure 1 < measure 2. We confirmed both hypotheses. The mean scoring of the pretest is significantly lower than that of the posttest. Extending these findings to an analysis of portfolio entries, we confirmed that many students in our research set reflected more realistic perceptions of their skills to collaborate and manage their learning. Especially we can see (table 3) that there was a significant difference in the behavioral dimension of attitudes for the area of growth up mindset.

Qualitative analysis of student portfolios appropriately completes a deeper look at changes in self-perception. Here are a few statements that students wrote down as reflections on their learning:

"I did not know how difficult it was to control one's learning autonomously. It was often tough, and sometimes I had a headache. I did not mind; I wanted to know more - to go forward - further." (resp. 3, after week 5)

"I thought that I could work well in a group, that it was my strong point; as it turned out, the reality is a little different." (resp. 8, after week 4)

The reflections recorded in the students' portfolios became more refined and specific from week to week, such as *"I know I need to improve my planning"* or *"I realize how important it is not to take everything personally in group work."*

Frequent cognition of the process allowed students to be more in control of their learning and thus achieve the group's agreed-upon goal.

The differences in Table 4 were revealed by analyzing the qualitative data from the first and second focus groups.

Table 4 Comparison of findings from focus groups in two domains – cooperation/collaboration and growth mindset.

First focus group – before exposed	Second focus group – after exposed
cooperation/collaboration	*cooperation/collaboration*
Respondents' prevailing belief is that the ability to work together in a group comes naturally and does not need to be taught.	They find the skills of cooperation and collaboration difficult to learn and feel the need to practice and improve them.
Respondents prefer to work together by choosing who will be their partner in the group.	Respondents agreed that a heterogeneous group is necessary to progress toward a goal. They perceived group work as more effective if they divided randomly rather than according to their preferences.
Respondents feel more secure when they can choose their group members, a process known as 'self-selection. ' This allows them to work with individuals they trust and feel comfortable with.	They considered it crucial for good progress towards the goal that group members know each other (each other's strengths and weaknesses) and the process of planning and dividing tasks.
There is a belief that the group progresses faster towards the goal if members know and like each other.	They found getting along with each other the most challenging part of the group work, and they accepted that not everyone in the group responded according to their expectations.
They see group cooperation with a random selection of group members as stepping out of their comfort zone, which they would rather avoid.	
Respondents generally considered themselves tolerant of specifics in other people's behavior.	
Growth mindset (learn to learn)	*Growth mindset (learn to learn)*
All participants considered the ability to learn continuously to be crucial.	They find learning important but difficult if no one tells them exactly what to do. On the other hand, it is more fun if they can learn in a way that allows them to be active in their learning.
They expect stimuli for their learning to come from outside.	They consider it an advantage for their learning if they can ask questions, freely search for information, and compose it into their conceptual maps—knowledge.
They do not consider themselves as agents of their actions.	Respondents communicated greater confidence in using technology (STEM components).
They do not consider themselves sufficiently smart in science and mathematics.	

We analyzed the content of the focus group transcripts to identify key concepts, ideas, or patterns, and they are in Table 4. Just as there were significant differences between the pre-test and post-test in both domains (cooperation/collaboration and growth mindset), qualitative data analysis suggests significant qualitative shifts in thinking about one's abilities post-exposure.

4 Discussion

The study employs a dual-method analysis, combining qualitative insights from students' portfolios and lesson record microanalysis with quantitative data from a questionnaire. The questionnaire focuses on gauging participants' attitudes toward collaboration and cultivating a growth mindset within the learning process. Our research contributes valuable insights into the efficacy of the transformative impact of the Project-Based Learning approach, shedding light on changing students' self-perception of skills cooperation and growth mindset in teacher training

programs.

Most educators in Slovakia do not prioritize cultivating curiosity as an essential element for effective learning (NUCEM, 2021). This insight prompts a deeper inquiry into the dynamics shaping the motivational landscape within Slovak schools, particularly within the Teacher Training Program.

We use a methodology that employs an inquiry-based research design (Fraenkel, 2011), anchoring our exploration of transformative revisions in teacher training programs. Guided by three key rationales—Shifting the educational landscape, enhancing student outcomes, and addressing inclusivity and diversity—we integrate Collaborative Partnerships, Pedagogical Innovation (project-based learning and STEM), and Continuous Professional Development. Embedded within our Teacher Training program, notably in the Curious Learning course, our inquiry-based approach complements qualitative analyses of students' portfolios and microanalyses of lesson records. Simultaneously, we utilize a tailored questionnaire to quantitatively assess participants' attitudes toward collaboration and embracing a growth mindset. This methodological design enriches our understanding of the transformative impact on teacher training, emphasizing the importance of inquiry-based approaches in shaping adaptive and effective educational practices. Implementing the Curious Learning course within the Teacher Training Program yielded significant outcomes aligned with the program's overarching objectives. Our findings reveal a transformative impact on students' self-perception and attitudes towards collaboration and learning mindset. Through engagement with the Curious Learning course, students exhibited a notable shift in their self-image, gaining a more realistic assessment of their ability to collaborate effectively. The course provided a dynamic platform for students to experience firsthand the challenges and rewards of collaborative endeavors, fostering a more grounded understanding of their interpersonal skills.

Adopting Project-Based Learning (PBL) within a STEM learning environment has shown promising results in stimulating positive changes in students' attitudes toward collaboration and learning to learn. These findings align with existing studies, emphasizing the transformative potential of PBL in fostering students' engagement (Thomas, 2000), teamwork (Price et al., 2019), and intrinsic motivation (Ellis, 2021; Saavedra et al., 2019). The hands-on, inquiry-based nature of PBL enhances students' understanding of STEM concepts and equips them with essential 21st-century skills.

Moreover, the intervention positively influenced students' adoption of a growth mindset toward learning. The immersive nature of the Curious Learning experience prompted students to recognize the inherent challenges in autonomously controlling their learning journey. Despite the acknowledged difficulty, students reported a strong motivation derived from this autonomy. Notably, the experience was described as positively shaping and, in some instances, physically demanding—a testament to the profound impact of the course on students' perception of self-directed learning. These results underscore the efficacy of the Curious Learning course in not only reshaping students' self-image but also instilling a growth-oriented mindset, aligning seamlessly with the goals of the Teacher Training Program.

In conclusion, our comprehensive exploration of student motivation, pedagogical strategies, and transformative interventions within the Slovak Teacher Training Program illuminates critical insights with profound implications for the educational landscape. The introduction of the Curious Learning course emerges as a pivotal stride in this direction. The course catalyzes students'

realistic self-perception. It is a transformative force that shapes attitudes toward collaboration (Kaasila & Lauriala, 2010) and fosters a growth mindset (Dweck, 2017). Recognizing the challenges inherent in autonomous learning and the students' acknowledgment of its motivational potency signifies a paradigm shift in educational approaches. While the Curious Learning course demonstrates its efficacy in student outcomes, aligning educators' perspectives with the transformative potential of cultivating curiosity becomes imperative. Our research underscores the intricate interplay between student motivation, pedagogical strategies, and the impact of transformative interventions.

4.1 Limitations and future directions

While this study provides valuable insights into the transformative potential of a Project-Based Learning approach to the self-perception of students in The Teacher Training Program, it is important to acknowledge several limitations that may have impacted the findings and interpretations. Firstly, the study's small sample size limited the generalizability of the results. With a limited number of participants, the findings may not represent the broader population, and caution should be exercised when extrapolating the results to other contexts or populations.

Another limitation of the study lies in constructing the questionnaire for data collection. While the questionnaire was designed to measure students' self-perception of skills to cooperate and growth mindset, evaluation and validation with a small sample size may have introduced potential biases or inaccuracies in the measurement. Future research should prioritize the validation of the questionnaire through robust psychometric testing, including assessments of reliability, validity, and factor structure, to ensure the accuracy and consistency of measurement.

In conclusion, while this study has its limitations, it sets the stage for further exploration and investigation into the Transformative process of the Teacher Training Programs.

5 Statement of researchers

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