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Integrating Unplugged Computational Thinking Across Curricula: A Qualitative Study of Students' and Teachers' Perspectives

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Integrating computational thinking into the K-12 curriculum presents challenges due to the lack of a standardized approach. This study examines the use of "unplugged" computational thinking—activities that do not require digital devices—in teaching mathematics and language arts to tenth-grade students. The instructional method followed phases such as abstraction, decomposition, algorithms, evaluation, and generalization. Data were collected through focus groups with teachers and a sample of students from both subjects and analyzed qualitatively to capture their perspectives. The findings suggest that unplugged computational thinking increased student engagement and helped achieve learning objectives. Both teachers and students reported that this approach fostered deeper conceptual understanding and enhanced the educational experience by developing skills in problem-solving, collaboration, and perseverance (grit). Teachers observed that students could explore and articulate their thoughts more expansively compared to traditional methods, leading to a richer understanding of the material. Students emphasized that integrating computational thinking, fostering grit, and encouraging collaboration are crucial for enriching their educational experiences and creating a supportive, effective learning environment.

Keywords: unplugged, computational thinking, problem solving, grit, collaboration, qualitative

INTRODUCTION

The core problem addressed in this work is the challenge of effectively integrating computational thinking into the K-12 curriculum across various subjects, including both STEM and non-STEM areas. Despite its recognized importance for developing critical problem-solving skills across multiple disciplines, there is no clear consensus on the

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best methods for incorporating computational thinking in educational settings. "Unplugged" computational thinking—activities that don't rely on digital devices—is used as a strategy to foster these skills through hands-on, interactive learning experiences. This approach aims to enhance students' understanding of computational concepts and improve their ability to apply these concepts to real-world problems, thereby supporting broader educational objectives such as enhanced problem-solving capabilities, collaboration, and grit.

Computational thinking

Computational thinking involves solving problems, designing systems, and understanding human behaviour, based on fundamental concepts taken from computer science (Wing, 2006, p. 33). Computational thinking is fundamental to computer science. Skills such as abstraction, decomposition, algorithmic thinking, pattern recognition, evaluation, and generalization are important across multiple disciplines (Rehmat et al., 2020). However, there has been no consensus on how to integrate computational thinking within K-12 subjects.

Computational Thinking can be divided into domain-specific and domain-general (Tsai et al., 2021). Domain-specific refers to the skills that are required to solve programming problems. Domain-general, on the other hand, refers to the skills that are required to solve people's everyday problems, across all domains. This can be achieved using unplugged computational thinking (Tsai et al., 2021).

Unplugged computational thinking

Unplugged computational thinking is a pedagogical strategy (Busuttil & Formosa, 2020) that uses computational concepts and problem solving (Tsarava et al., 2017; García-Peñalvo et al., 2016) to address learning challenges (Bell et al., 2009). This is done through hands-on activities and without the use of digital devices.

Lessons that integrate unplugged computational thinking into school subjects (e.g. Language Arts, Mathematics, Art, Science, etc.) have been shown to help students develop computational thinking and other higher-order thinking skills (Azeka & Yadav, 2021; Tannert et al., 2021). Over a series of lessons, the different phases of computational thinking have been used to help students learn a range of subjects in different contexts (Peel et al.2021; Grover, 2021a). Using this approach, unplugged activities have been shown to positively impact student interest levels and motivation (El-Hamamsy et al., 2022; Tonbuloğlu & Tonbuloğlu, 2019), as well as participation and collaboration in the classroom (Rodriguez et al., 2017; Cortina, 2015).

By incorporating unplugged computational thinking into the school curriculum students develop computational thinking skills while making sense of the process. This results in convergent learning (i.e. the application of knowledge to real-life problems) (Buitrago-Flórez et. al, 2021; Maya et. al, 2021) and greatly improves the students' ability to solve a problem by breaking it down into a sequence of steps (Peel et. al, 2021). In this sense, basic computational thinking practices help students understand concepts beyond computer science, such as ambiguity tolerance, persistence, and collaboration in both STEM and non-STEM classes (Perez, 2018).

Grit

Grit refers to perseverance and passion for long-term goals (Duckworth et al., 2007). It has shown predictive validity for success and performance in different social contexts, such as work and school (Duckworth et. al, 2007; Wolters & Hussain, 2015).

Grit initially comprised two dimensions: perseverance of effort and consistency of interest or passion (Duckworth et al., 2007; Duckworth & Quinn, 2009). The former refers to a tendency to work hard despite obstacles, challenges, and failures; while the latter is about focusing on the same goal or interest over time (Duckworth et al., 2007; Duckworth & Quinn, 2009).

Subsequent findings have added a third dimension to this construct: adaptability to situations. This refers to an individual's ability to effectively adapt to the changing circumstances of life. As a dimension, it encompasses factors such as appreciation of change, desire for improvement, flexibility of plans, and maintaining harmonious relationships in diverse contexts (Datu et al., 2016; Datu et al., 2017; Houston et al., 2021).

Collaboration

Collaboration is one of the four so-called 21st century skills, better known as the 4Cs (Wahyuddin et al., 2022; Lund-Diaz et al., 2016). Within the context of teaching, collaboration involves learners engaging and sharing responsibilities with one another to jointly accomplish a task and achieve a shared learning goal (Kembara et al., 2019; Varela et al., 2019). Within computational thinking, collaboration is considered a key practice, encouraging students to coordinate their efforts and negotiate their roles in solving a class problem by following the phases of CT (Yadav et al., 2017; Perez, 2018).

Although initially presented as a technique for meeting specific learning objectives, this relationship between collaboration and computational thinking suggests that collaboration should be considered an end in itself (Perez, 2018). Collaborative skills that enable coordination and cooperation among peers should therefore be developed from a young age (Varela et al., 2019).

Students' and teachers' perspectives of unplugged activities during STEM and non-STEM classes

Computational thinking is considered a key element of problem solving within STEM (Angraini et al., 2023; Bounou et al., 2023). In Mathematics, for example, algorithmic thinking is commonly used to model and quantify a real-world problem (Bounou et al., 2023; Blum & Ferri, 2009). Breaking down curricular barriers by developing mathematics through computer science and computational thinking can help students understand the subject in greater depth and apply their knowledge more effectively outside of the classroom (Beck et al., 2024; Shehzad et al., 2023).

Language, on the other hand, is also key for fostering computational thinking skills. It is through language that students can articulate and reflect upon the different phases of computational thinking (Bounou et al., 2023; Yeni et al., 2022). Computational thinking must therefore be integrated across language-based classes, such as language arts and modern foreign languages (Hsu & Liang, 2021; Parsazadeh et al., 2021; Nesiba et al., 2015).

Students' and teachers' perspectives on developing computational thinking skills through plugged-in activities during technology classes have already been investigated (Wong & Cheung, 2020; Avcı & Deniz, 2022; Chevalier et al.,2022). However, such perspectives have not been studied in the context of a cross-curricular and unplugged approach (Jin & Harron, 2023; Kourti et al., 2023). Our qualitative study therefore aims to further our understanding of using unplugged computational thinking activities to solve problems in both STEM and non-STEM subjects (Suarez et al., 2022).

Our research is therefore guided by the following questions: "What is students' perspective of the role of unplugged computational thinking activities in both STEM and non-STEM subjects?" and "What are teachers' perspective of the influence of unplugged computational thinking activities on their students' work in both STEM and non-STEM subjects?"

METHOD

Research model and procedure

To answer our research questions, we designed and implemented a series of unplugged activities for tenth-grade mathematics and language arts. The strategy was based on the different phases of computational thinking, namely: abstraction, decomposition, algorithms (ordered series of steps), evaluation, and generalization (Andrian & Hikmawan, 2021). Appendix B provides two examples to illustrate the five questions that aim to develop each of the phases of computational thinking: one example of a language arts class and another for a mathematics class,

The intervention took place across four consecutive sessions held over a period of four weeks. During this time, students completed activities during their regular mathematics and language arts classes (i.e. activities were completed during 4 language arts classes and 4 mathematics classes). The contents covered during the mathematics classes included operations with polynomials, algebraic identities, linear models, and systems of linear equations. The contents covered during the language arts classes included the writing process and discourse markers, textual prototypes, verbal reasoning, and expository writing (i.e. journalistic and school texts).

At the beginning of the intervention, the participants were grouped into teams in order to encourage collaborative work among the students. Each team ideally had three participants, with each participant fulfilling a specific role. These roles included an instigator, a challenger, and a summarizer, and were rotated throughout the four-week intervention. The instigator was responsible for sourcing and proposing the materials to be used during the collaborative task. The challenger was responsible for providing counterarguments and feedback on the materials selected by the instigator. Finally, the summarizer was responsible for coordinating, compiling, systematizing, and consolidating the contributions made during the activity as well as presenting the results of the team's work to their classmates and the teacher.

The activities used during the intervention considered the different dimensions of grit (Duckworth, 2016) (see Appendix B). These were intended to be practical, energizing activities that could be applied to the students' everyday lives in order to make the content more familiar. The activities also looked to motivate the students and encourage them to work collaboratively within their teams (Hwang & Nam, 2021).

At the beginning of each session, the students were presented with the activity that had to be completed, as well as the questions that needed to be answered. Each of these questions was associated with a different phase of computational thinking. As the intervention took place during the pandemic, the activities were completed online, with the collaborative work taking place during in 15-minute breakout sessions on Zoom. At the end of each session, the students returned to the main room, where the communicator on each team presented their results to the rest of the class. After each answer, the teacher provided feedback to the team on which aspects were correct and which could be improved.

Research context and sample

The study was carried out in a high school located in Xalapa, Mexico. This school is characterized by providing weekend education to students who work from Monday to Friday.

The sample consisted of students from a tenth-grade high school class. While there were 17 students who participated in at least one intervention in either subject, the sample only included students who participated in at least three of the four interventions in each subject. This criterion was met by ten of the students (6 male and 4 female whose average age was 17.3 years). The same students participated in both the language arts and mathematics classes.

Two female teachers also participated in the intervention (one for each subject). The language arts teacher was 50 years old at the time of the intervention and held a degree in Communication Studies. She had been teaching the class for 3 years. The mathematics teacher was a 27-year-old industrial engineer and had been teaching the class for one year.

Data collection and data analysis

Data was gathered using focus groups (Busetto et al., 2020; Gibbs, 2012). Two focus groups were formed: the first comprising the ten students highlighted previously, and the second comprising the two teachers.

Responses were collected during the focus groups by using a theme-based script that included certain trigger questions about unplugged computational thinking, grit, and collaboration (see Appendix A). The aim of these was to uncover the teachers' and students' perspectives of role of the unplugged computational thinking activities completed during the intervention.

Our two research questions regarding the perspective of students and teachers in the use of unplugged computational thinking activities were answered using thematic analysis

(Braun & Clarke, 2012; Castleberry & Nolen, 2018) by coding the responses given during the focus groups.

Two focus groups were conducted, one with students and one with teachers, using a question script (Appendix B). Subsequently, the steps of the thematic analysis (Braun & Clarke, 2012) were carried out in the data of each focus group: 1) Familiarize with the data; 2) Generate codes from the data; 3) Generate themes from the codes (categories and subcategories); 4) Review potential themes; 5) Define the themes to report in a table. The result of this were three broad categories that captured recurring patterns found in the transcripts of the students' and teachers' responses: Tables 1 and 2

FINDINGS AND DISCUSSION

In this section, we explore each of the categories and subcategories that emerged from the thematic analysis. We then compare these to the findings from the literature by describing the coding of the students' responses with the aim of answering our research question: What is students' perspective of the role of unplugged computational thinking activities in both STEM and non-STEM subjects?

The categories and subcategories from the students focus group are presented in Table 1 below:

Table 1
Students categories

Category	Subcategory	Coded response
Computational thinking	Phases of computational thinking	Ordered steps Breaking down the problem into parts Better understanding of the problem to be solved
Grit	Perseverance of effort	Having to make an initial effort Easier as the activity went on Managing to complete the activity
	Passion (Consistency of interest)	More interesting and entertaining Pleasant experience Positive way of working
	Adaptability to situations	Handle situations differently New and different way of learning Change of approach as a positive Preparation for the future Easier and more practical way of working
Collaboration	Student integration	Spending time with classmates Mutual support Sharing different ideas and ways of thinking
	Collaborative learning	Solving problems as a team Working collaboratively gives confidence Encourages peer learning

The first category to emerge from the thematic analysis of the students' responses was computational thinking. Within this category, the only subcategory to emerge was the phases of computational thinking. The coded responses included references to a set of ordered steps (i.e. algorithm) and breaking the problem down into parts (i.e.

decomposition), which helped the students have a better understanding of the problem to be solved (Suarez et al., 2022; Peel et al., 2021).

Three subcategories emerged for the second category, grit, the first of which was perseverance of effort. In this case, responses referred to having to make an effort at the beginning, finding the activity easier as it went on, and managing to complete the task (Jacob et al., 2022; Tran, 2019; Wright et al., 2017).

The second subcategory associated with grit was passion for long-term goals, also referred to as consistency of interest. Here, the coded responses referred to the unplugged experience in both classes as being enjoyable and a positive way of working, as well as being an interesting and fun experience (Looi et al., 2018; Merino-Armero et al., 2022).

The final subcategory for grit was adaptability to situations. This includes handling situations differently, viewing the process as being something new and different, as well as considering the change in pedagogical approach as being a positive (Datu et al., 2017; Datu et al., 2021). The coded responses within this subcategory also referenced preparation for the future, new learning, and being an easier and more practical way of working for the students (Tsortanidou et al., 2022; Kalogiannakis & Kanaki, 2022).

The third and final category to emerge from the students' responses was collaboration. Within this category, the first subcategory to emerge was student integration, with references made to spending time with peers, mutual support, and sharing different ideas and ways of thinking (Mensan et al., 2020; Chongo et al., 2021). The other subcategory within collaboration was collaborative learning, which included references to solving problems as a team, the feeling that collaborative work provided them with safety, and it encouraged peer learning (Andrian & Hikmawan, 2021; Cortina, 2015).

The thematic analysis from the student focus group underscores the value of computational thinking strategies such as using algorithms and decomposition. These techniques have been proven effective in helping students understand and tackle problems more efficiently (Lehman, 2023; Rao & Bhagat, 2024). In terms of grit, students reported that although tasks initially required considerable effort, they became more manageable over time, illustrating the importance of persistence (Puah et al., 2024). Students also expressed enjoyment and interest in the unplugged activities, recognizing these learning methods as enjoyable and beneficial, which aligns with the role of sustained interest in achieving long-term goals (Zhao et al., 2024). Additionally, students valued innovative teaching approaches, which they felt not only prepared them for future challenges but also simplified and enhanced their learning experience. On the collaboration front, the analysis highlighted that teamwork fostered a supportive learning environment through peer interaction and mutual support, enhancing safety and peer learning (Zhang, 2024; Trimble & Fan, 2023). Overall, the findings emphasize that integrating computational thinking, fostering grit, and encouraging collaboration are pivotal in enriching students' educational experiences and developing a supportive and effective learning environment.

The categories and subcategories from the teachers focus group are presented in Table 2 below:

Table 2
Teachers categories

Category	Subcategory	Coded response
Computational thinking	Phases of computational thinking	Step-based solution Methodical and orderly process Breaking the problem down makes it easier to solve
Grit	Perseverance of effort	Got progressively easier Developing persistence Meeting learning objectives
	Passion (Consistency of interest)	Novel system – different and interesting Satisfaction and happiness Very fun Good experience
	Adaptability to situations	Preparation for the future Change of setup within the classroom Change of pedagogical approach Change towards something more practical
Collaboration	Student integration	Encourages socializing Encourages communication Collaboration among peers
	Collaborative learning	Collaborative work as essential Helps develop collaboration in language arts Helps develop collaboration in mathematics

As was the case with the students, the first category to emerge from the teachers' responses was computational thinking, with the phases of computational thinking the only subcategory to emerge. In this case, the coded responses referred to solving problems by following a series of steps (i.e. algorithms), a methodical and orderly process (i.e. algorithms), and how breaking the problem down into steps makes it easier to solve (i.e. decomposition) (Andrian & Hikmawan, 2021).

The second category to emerge from the teachers' responses was grit. The first subcategory in this case was perseverance of effort, where they referenced that the students developed persistence, which made the task become progressively easier (Busuttil & Formosa, 2020; Threekunprapa & Yasri, 2020).

A second subcategory of grit to emerge from the teachers' responses was consistency of interest, or passion. In this case, the teachers referred to the unplugged activities as being very fun, very interesting, and a positive experience that brought the students satisfaction and happiness (Kite & Park, 2022; McGinnis et.al.,2020).

The third subcategory to emerge from the teachers' responses was adaptability to situations, which included how the students were able to adapt to the classroom structure, the change in pedagogical approach, and a shift towards something more practical (Datu et al., 2016; Houston et al., 2021). This supports the idea that adaptability to situations is related to perseverance of effort. Furthermore, the teachers also mentioned that the unplugged activities helped the students meet their learning objectives. The teachers therefore viewed these activities as a novel and interesting approach to teaching that is both fun and practical for the students (Sun et al., 2021; Grover & Pea, 2018).

The third and final category to emerge from the teachers' responses was collaboration. The first subcategory in this case was student integration, where the teachers referenced that the activities helped the students to socialize, while also encouraging communication and collaboration among peers (Lamagna, 2015; Curzon et al., 2014).

The final subcategory from the teachers' responses within collaboration was collaborative learning. In this case, the teachers' responses referred to collaborative work during the unplugged activities as being indispensable, while also helping develop collaboration within language arts (Jacob et al., 2022; Yeni et al.,2022) and mathematics (Perez, 2018; Kotsopoulos et al., 2017).

The thematic analysis of teacher responses highlighted significant educational benefits from incorporating computational thinking, grit, and collaboration into learning activities. Teachers observed that computational methods such as algorithms and decomposition improved students' problem-solving abilities, introducing a structured approach that made challenges more manageable (Aytekin & Topçu, 2024). Grit was evident in students' perseverance, which helped ease task difficulty over time, and their sustained interest made learning enjoyable and engaging (Karlen et al., 2019). Adaptability was also noted, with students successfully adjusting to new classroom structures and teaching methods, which supported their persistence. Furthermore, the importance of collaboration was underscored; activities enhanced social interactions and communication among students, fostering a supportive community that facilitated effective teamwork. This feedback suggests that integrating these elements creates a dynamic and supportive educational environment conducive to both personal and academic growth (Wang, et al., 2022).

In summary, the thematic analysis of the responses from both students (Table 1) and teachers (Table 2) revealed three main categories: computational thinking, grit, and collaboration. This analysis not only confirms the individual benefits of these elements but also demonstrates how they work together to create a dynamic, supportive, and effective learning environment (Lei, et al., 2024). This complementarity underscores the holistic approach to education that benefits all participants by enhancing both personal growth and academic achievement (Pears, et al., 2019).

CONCLUSIONS

Our first research question asked, "What are students' perspectives of the role of unplugged computational thinking activities in both STEM and non-STEM subjects?" In response to this question, we conclude that student perspectives were positive as the activities helped make challenging concepts easier to understand. In this sense, collaboration and grit can be seen as essential tools for developing computational thinking (Kotsopoulos, 2017; Lamagna, 2015; Curzon et al., 2014).

The students' positive perspective of unplugged computational thinking within STEM and non-STEM subjects, as well as the successful achievement of their learning objectives, suggest that such activities may be integrated into the teaching-learning process as a pedagogical tool, leveraging conative skills such as collaboration and grit (Kalogiannakis & Kanaki, 2022; Grover, 2021b; Huang & Looi, 2020).

Our second research question asked, "What are teachers' perspectives of the influence of unplugged computational thinking activities on their students' work in both STEM and non-STEM subjects?" In this case, our findings suggest that teachers of both language arts and mathematics had a positive perspective of such activities. By using the phases of computational thinking, students can make analogies with real-life problems and generalize their solutions (Kite & Park, 2022; Peel et.al., 2022). In this sense, grit and collaboration are both highly effective tools. Furthermore, with unplugged activities teachers can go much deeper than they normally would do in a conventional class. This therefore improves their students' understanding and knowledge of the subject (Grgurina & Yeni, 2021; Bell & Vahrenhold, 2018).

Finally, it is important to highlight that unplugged activities can be particularly effective in learning environments where the infrastructure and access to computers is limited (Polat & Yilmaz, 2022; Brackmann et al., 2019).

LIMITATIONS

The main limitation of this research is that it is a regional study in a Latin American context. In this sense, the school, students, and teachers have specific characteristics, and the results can therefore not be generalized to other international contexts. However, we recommend replicating and improving our study in other contexts in order to complement the results presented here. As future work, we therefore suggest carrying out studies involving the implementation of unplugged computational thinking activities as a pedagogical strategy in non-STEM subjects, which are relatively unexplored. Another question to answer would be "How might other higher-order thinking skills be related to computational thinking?" Finally, the lack of quantitative data restricts the ability to achieve a comprehensive understanding that benefits from the statistical breadth of quantitative analysis coupled with the detailed depth of qualitative insights. Future research should incorporate both methodologies to provide a more complete perspective.

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APPENDIX A: Script used in the focus group

General research questions

1. What is the students' perspective of the role unplugged computational thinking activities in both language arts and mathematics classes?

2. What are the language arts and mathematics teachers' perspective of the influence of unplugged computational thinking activities on their students' work in class?

Focus groups

Presentation and Introduction

First of all, we would like to thank you for choosing to participate in this activity. We would like to remind you that this study is carried out as part of a research project. It should also be noted that everything we discuss is confidential and that the session will be recorded.

To begin with, we are going to introduce ourselves, if you can please state your name and age.

Interview guide for students:

i) Regarding Unplugged computational thinking

Based on your experience in class, do you feel that the activities helped you meet the learning objectives? Why?

What positive or negative experiences did you have when doing the activities? Why?

Do you feel that you learned anything in addition to the learning objectives for the class? What?

What would you like to see maintained from these activities? Why?

ii) Regarding Collaboration

Did the group work make it easier to do the activities? Why? Did you feel comfortable? Why?

What positive or negative experiences did you have when working in groups during the activities? Why?

Did your group have any problems working as a team? Why?

iii) Regarding Grit

Adaptability to situations.

How did you feel when tackling the problems that had to be solved during class? Why?

Did you need to adapt or change the suggested solution in order to complete the activity? How?

Did you find these activities to be useful? Why?

Perseverance of effort.

Do you feel that you had to make an effort to complete the activities? How did this make you feel?

What made it easier or more difficult to do the activities? Why? How did you manage to overcome any difficulties?

Consistency of interest.

Did you manage to do the activities in the way you wanted? Why?

Do you feel that you managed to stay focused on the activities during the allotted time? Why?

Did you find the activities relevant, interesting, and/or motivating? Why?

Interview guide for teachers:

i) Regarding Unplugged computational thinking

Based on your experience in class, do you feel that the activities helped the students meet the learning objectives? Why?

Do you feel that your students learned anything in addition to the learning objectives for the class? What?

Would you like to use these activities in your classes? Why? Do you think it would be easy or complicated to do it? Why?

ii) Regarding Collaboration

Do you think it was a positive or negative that the activities required the students to work in groups? Why?

Do you think working in groups made the activities easier to do? Why?

Do you think the activities helped develop collaboration within your subject? Why?

iii) Regarding Grit

Do you think the activities helped the students develop persistence? Why?

Adaptability to situations.

Do you think your students needed to adapt or change the suggested solution in order to complete the activity? How?

Do you think these new activities were useful for your students? Why?

Perseverance of effort.

Do you think your students had to make an effort to complete activities? How did this make you feel?

What made it easier or more difficult to do the activities? Why? How did your students manage to overcome any difficulties?

Consistency of interest.

Did your students manage to do the activities in the way they wanted? Why?

Do you think your students managed to stay focused on the activities during the allotted time? Why?

Do you think the activities were relevant, interesting, and/or motivating for your students? Why?

Closing

Of everything we have discussed [summarize], is there anything else you would like to add or comment on?

Thank you very much, everything you have shared with us is extremely useful.

APPENDIX B: Lesson design using the phases of computational thinking

Guiding questions for students to solve the problem presented in class (language arts or mathematics) associated with the phases of computational thinking

1.(Abstraction) Which elements should be analyzed in order to solve the problem? Suggest more than one.

2. (Decomposition) What are the constituent elements of the problem? Suggest more than one.

3. (Algorithms) Propose a series of steps to solve the problem. Suggest more than one.

4. (Evaluation) Based on the previous answer, the students must evaluate whether the solution is effective and relevant.

5. (Generalization) Apply the solution proposed for this problem to another real-world problem. First define this new problem and then apply the solution.

Developing collaboration among the students

In groups of 3, each student must play one of the following roles:

Instigator: Propose and support ideas for solving the problem.

Challenger: Complement, refute, and argue against the ideas proposed by the instigator.

Summarizer: Record, write down, and present the ideas agreed upon by the instigator and challenger.

Developing grit among the students

The real-life problem in each session for both subjects should meet the conditions needed for the students to develop grit: practical, energizing, and relatable activities connected to their everyday lives.

Example of a Language arts class

TOPIC: The writing process and using discourse markers

REAL-LIFE PROBLEM: Before passing away, your grandfather left a letter with strict instructions for you for when you turned 15. However, over time the letter has been damaged and is now in pieces that you must arrange so that the letter is coherent and understandable.

The remaining pieces are the following:

go to the Bank of Mexico with your mother and withdraw the money.

that's why I've left a savings account

Affectionately yours, Grandpa

By the time you read this letter, a number of years will have passed.

in your name that will help you continue your studies

IMPLEMENTATION:

1. Abstraction (15 minutes)

a) In response to question 1, the instigator identifies the main elements of the problem and discusses these with the challenger.

b) The challenger provides counterarguments and complements the ideas proposed by the instigator.

c) The summarizer records the main elements of the problem in a table.

2. Decomposition (15 minutes)

a) In response to question 2, the instigator breaks the problem down into its main parts and discusses these with the challenger.

b) The challenger provides counterarguments and complements the ideas proposed by the instigator.

c) The summarizer records the main parts of the problem in a table.

3. Algorithms (15 minutes)

a) In response to question 3, the instigator proposes a series of steps for solving the problem.

b) The challenger provides counterarguments and complements the instigator's proposal. Together, they identify the steps that should be followed to solve the problem.

c) The summarizer writes down the steps that were followed in order to solve the problem and presents them to the teacher and the rest of the class.

4. Evaluation (15 minutes)

a) Considering question 4, the instigator and challenger solve the problem using the steps from the previous phase and evaluate their effectiveness when being applied.

b) The summarizer writes down the solution to the problem, taking into account the instigator and challenger's ideas.

5. Generalization (20 minutes)

a) Considering question 5, the instigator proposes a similar problem to the one they solved, as well as a solution.

b) The challenger provides counterarguments and complements the proposal made by the instigator.

c) The summarizer writes down the problem and proposed solution and presents it to the teacher and the rest of the class.

Evidence that each group must present at the end of the session

1. Steps for solving the problem

2. Similar problem and solution

Example of a Mathematics class

TOPIC: Linear equations

REAL-LIFE PROBLEM: You've got a part-time job at a pizza restaurant as a delivery driver. The restaurant will pay you every week at a day-rate of $250 for your deliveries, with Monday being a day off. Before accepting the job, and to see whether it's in your best interests, you work out how much you'd receive per week and month.

IMPLEMENTATION:

1. Abstraction (15 minutes)

a) In response to question 1, the instigator identifies the main elements of the problem and discusses these with the challenger.

b) The challenger provides counterarguments and complements the ideas proposed by the instigator.

c) The summarizer records the main elements of the problem in a table.

2. Decomposition (15 minutes)

a) In response to question 2, the instigator breaks the problem down into its main parts and discusses these with the challenger.

b) The challenger provides counterarguments and complements the ideas proposed by the instigator.

c) The summarizer records the main parts of the problem in a table.

3. Algorithms (15 minutes)

a) In response to question 3, the instigator proposes a series of steps for solving the problem.

b) The challenger provides counterarguments and complements the instigator's proposal. Together, they identify the steps that should be followed to solve the problem.

c) The summarizer writes down the steps that were followed in order to solve the problem and presents them to the teacher and the rest of the class.

4. Evaluation (15 minutes)

a) Considering question 4, the instigator and challenger solve the problem using the steps from the previous phase and evaluate their effectiveness when being applied.

b) The summarizer writes down the solution to the problem, taking into account the instigator and challenger's ideas.

5. Generalization (20 minutes)

a) Considering question 5, the instigator proposes a similar problem to the one they solved, as well as a solution.

b) The challenger provides counterarguments and complements the proposal made by the instigator.

c) The summarizer writes down the problem and proposed solution and presents it to the teacher and the rest of the class.

Evidence that each group must present at the end of the session

1. Steps for solving the problem
2. Similar problem and solution