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Methodological strategies for developing critical thinking in third-year upper secondary students

Estrategias metodológicas para el desarrollo del pensamiento crítico en los estudiantes de tercero de bachillerato

Carlos Omar Córdova-Aldas
carlomar788@gmail.com
Universidad Bolivariana del Ecuador. Durán, Guayas, Ecuador
https://orcid.org/0000-0002-2736-8652

Guillermo Ricardo Grunauer-Robalino
rgrunauer@ube.edu.ec
Universidad Bolivariana del Ecuador. Durán, Guayas, Ecuador
https://orcid.org/0000-0002-7662-8270

Ramón Guzmán-Hernández
rguzman@bolivariano.edu.ec
Universidad Bolivariana del Ecuador. Durán, Guayas, Ecuador
https://orcid.org/0009-0005-3190-4808

ABSTRACT

Critical thinking in technical upper secondary education depends on classroom strategies turning workshop practice into an opportunity for analysis. The study therefore set out to analyse the methodological strategies for developing critical thinking among third-year upper secondary students at the Juan Modesto Carbo Noboa school in Guayaquil. A descriptive quantitative approach was used, with a population of 50 students who answered a 14-item Likert questionnaire. The results showed that problem-based learning and case analysis gathered 88% agreement, while debates reached 52%, and analysing situations from several perspectives (72%) emerged as the least consolidated skill. The conclusions established that argumentative dialogue is the strategy most in need of strengthening.
Descriptors: critical thinking; teaching methods; active learning; technical education. (UNESCO Thesaurus).

RESUMEN

El pensamiento crítico en el bachillerato técnico depende de que las estrategias de aula conviertan la práctica de taller en ocasión de análisis. Es así que el estudio se planteó como objetivo central analizar las estrategias metodológicas para el desarrollo del pensamiento crítico en los estudiantes de tercero de bachillerato de la Unidad Educativa Juan Modesto Carbo Noboa de Guayaquil. En este sentido se empleó un enfoque cuantitativo descriptivo, teniéndose como población a 50 estudiantes que respondieron un cuestionario Likert de 14 ítems. Entre los resultados se obtuvo que el aprendizaje basado en problemas y el análisis de casos reunieron un 88 % de acuerdo, mientras que los debates alcanzaron un 52 %, identificándose el análisis desde varias perspectivas (72 %) como la habilidad menos consolidada. Entre las conclusiones se estableció que el diálogo argumentativo es la estrategia que requiere mayor fortalecimiento.
Descriptores: pensamiento crítico; método de enseñanza; aprendizaje activo; enseñanza técnica. (Tesauro UNESCO).

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Research Articles

INTRODUCTION

Technical training in upper secondary school has for decades rested on the repetition of procedures, given that the workshop rewards the correct execution of a sequence over an understanding of why a fault occurs and how it might be diagnosed differently. This legacy carries a visible cost in specialisms such as automotive electromechanics, where a student who only reproduces steps is left helpless before a problem that does not appear in the manual. López et al. (2023) address precisely this tension, noting that in technical and vocational education and training the development of critical thinking tends to be sidelined in favour of practical skills, and showing, with 149 first-year engineering students, that linking learning outcomes to the sub-skills of critical thinking and encouraging active participation produced better results than traditional teaching.

Understanding what is to be developed is the first step in choosing how to do it, and on this point Abrami et al. (2015) define critical thinking as purposeful, self-regulated judgement involving interpretation, analysis, evaluation, inference and explanation. Their meta-analysis, built on 341 effect sizes from quasi-experimental and experimental studies, obtained a mean effect of 0.30 and found that opportunities for dialogue, exposure to authentic problems and mentoring foster these skills across educational levels. Dwyer et al. (2014) complement this view by proposing an integrated critical thinking framework for the 21st century, while Bezanilla et al. (2018), after consulting 230 university teachers, found that most associate it with analysis and reasoning, some with questioning, evaluation and decision-making, and very few with action and commitment. This indicates that the way teachers conceive of critical thinking shapes the strategies they favour in the classroom.

Among these strategies, problem-based learning holds a prominent place, as Liu and Pásztor (2022) show by synthesising 50 empirical studies published between 2000 and 2021, with 5,210 participants, and obtaining a standardised mean

difference of 0.640 in favour of this methodology on critical thinking, with better effects in groups of fewer than six members and no effect for short-term interventions. Loyens et al. (2023) add support by reporting positive effects of problem- and project-based learning on higher-order and critical thinking, although they warn of design problems in many studies, such as the lack of control groups, and Chen and Yang (2019) revisited the effects of project-based learning on academic achievement. In Latin America, Cardona-Posada et al. (2025) applied a collaborative problem-based learning methodology in 35 groups of 35 Programming Fundamentals students, with a marked increase in engagement and in the understanding of concepts.

Ecuadorian classrooms point in the same direction, albeit with nuances, as the work of Pazos-Yerovi and Aguilar-Gordón (2024) shows; they studied problem-based learning in the Entrepreneurship and Management subject of the Unified General Baccalaureate at a public school in Quito, with 302 students and four teachers, and found that teachers were only superficially familiar with the methodology, that its use was limited by planning time and traditional approaches, and that although 72.2% of students preferred collaborative work, lecture-based lessons predominated; teachers also tended to equate critical thinking with simply giving opinions. This poses an intrinsic challenge for technical upper secondary education, where pressure to cover practical content can shrink the space for argument even further.

Another aspect that needs to be examined is the resources used to organise and test information. Schroeder et al. (2018) meta-analysed the effects of studying and constructing concept maps, a common strategy for structuring complex technical content, while McGrew et al. (2018), assessing middle school, high school and college students in 12 US states, found that across all tasks and grade levels participants struggled to evaluate online claims, sources and evidence. Wineburg et al. (2022) took this concern into a field study of lateral reading in high

school government classes, which implies that judging the reliability of a source is not learned through exposure but through explicit practice.

But which strategies do the students of a technical upper secondary programme themselves perceive, and which critical skills do they recognise in themselves? Most of the evidence cited comes from higher education or general upper secondary education, so the technical programme in automotive electromechanics at the Juan Modesto Carbo Noboa school in Guayaquil is a little-documented context. In light of the above, the central objective of the research is to analyse the methodological strategies for developing critical thinking among third-year upper secondary students at the Juan Modesto Carbo Noboa school in Guayaquil.

METHOD

The methodology is quantitative, with a non-experimental, descriptive and cross-sectional design, in line with Hernández-Sampieri and Mendoza (2018), since the variables were observed as they occur in the classroom and at a single point in time, corresponding to the first semester of 2026. The population consisted of the 50 third-year students in the automotive electromechanics technical programme at the Juan Modesto Carbo Noboa school, all of whom took part, making this a census study.

The instrument was a structured questionnaire of 14 items, seven on methodological strategies (problem-based learning, debates, concept maps, case analysis, independent research, questions requiring argument and evaluation of source reliability) and seven on critical thinking (identifying arguments and fallacies, questioning sources, proposing solutions, distinguishing facts from opinions, analysing from several perspectives, self-assessing reasoning and making well-founded decisions). Each item was answered on a five-point Likert-type scale, strongly disagree (SD), disagree (D), neither agree nor disagree (N), agree (A) and strongly agree (SA).

The data were tabulated as absolute and percentage frequencies based on the 50 cases, grouping agree and strongly agree as an indicator of the presence of the strategy or skill, and the two disagreement options as an indicator of its absence, which made it possible to rank the items and compare them on a diverging scale centred on the neutral option (Figure 1). The proposal derived from the results was submitted by the authors to expert judgement, whose procedure is described in the corresponding section.

RESULTS

Students' perception of the methodological strategies used by their teachers is presented in Table 1, which shows that agreement exceeds 70% in six of the seven strategies surveyed.

Table 1. *Students' perception of methodological strategies (n = 50).*

No.	Item	SD f (%)	D f (%)	N f (%)	A f (%)	SA f (%)
1	Teachers often use problem-based learning (PBL) so that we apply our knowledge.	1 (2)	0 (0)	5 (10)	29 (58)	15 (30)
2	Lessons include debates or group discussions on controversial or current topics.	6 (12)	8 (16)	10 (20)	18 (36)	8 (16)
3	The use of concept maps or diagrams to organise and analyse complex information is actively promoted.	5 (10)	4 (8)	5 (10)	20 (40)	16 (32)
4	The teacher regularly asks us to analyse cases or real situations to find solutions.	2 (4)	3 (6)	1 (2)	26 (52)	18 (36)
5	Learning activities require independent research and the use of a range of information sources.	3 (6)	2 (4)	3 (6)	22 (44)	20 (40)
6	The teacher asks questions that require us to justify, argue or defend our opinions.	1 (2)	2 (4)	12 (24)	22 (44)	13 (26)
7	We are taught and required to assess the reliability and validity of information found online or in books.	1 (2)	4 (8)	2 (4)	29 (58)	14 (28)

Source: Own elaboration (2026).

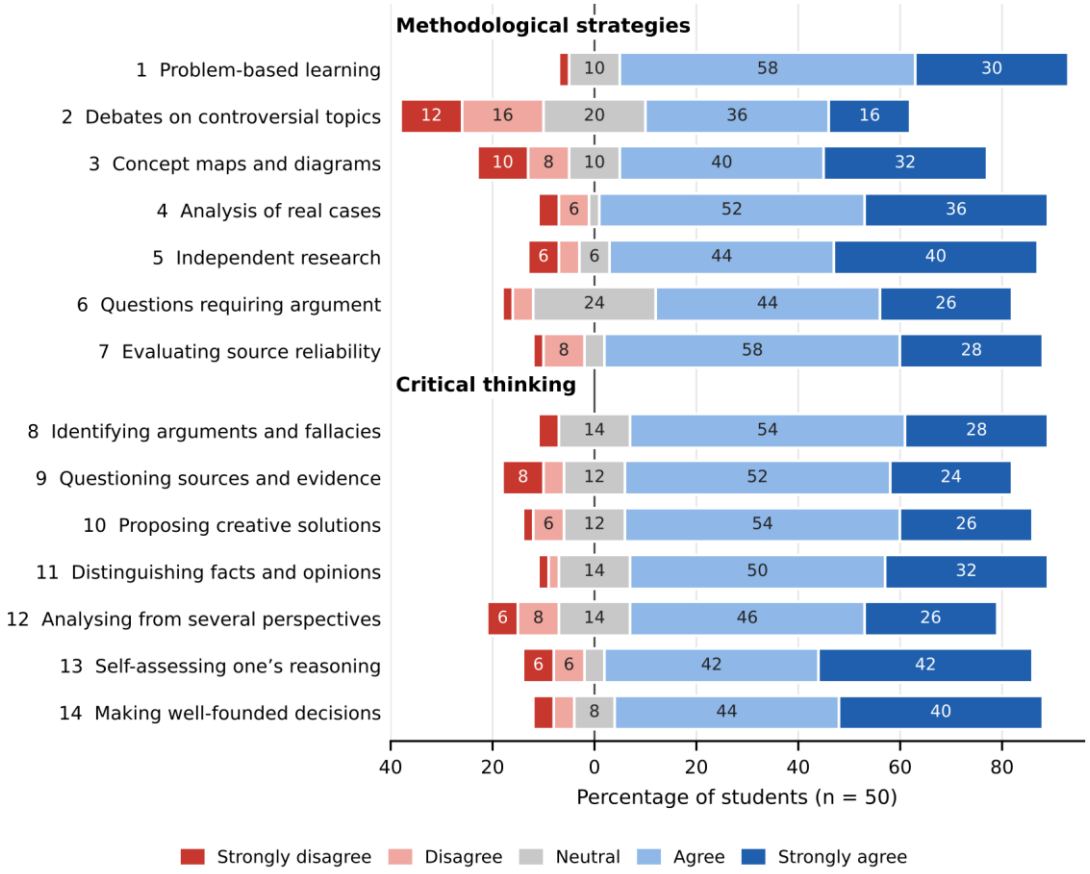
As Table 1 shows, problem-based learning and the analysis of cases or real situations are the most present strategies, since both gather 88% agreement

when agree and strongly agree are combined, although with a difference in intensity, given that case analysis obtains 36% for strongly agree compared with 30% for problem-based learning. They are followed by the evaluation of source reliability with 86% and independent research with 84%, the latter with the highest share of strongly agree responses in the table (40%), so that the strategies linked to practical situations and to the search for information are those students recognise most clearly.

At the opposite end, debates or group discussions on controversial topics reach only 52% agreement, with 28% of students disagreeing and 20% neutral, making them the least perceived strategy. Questions that require students to justify or defend their opinions obtain 70% agreement but concentrate the highest share of neutral responses in the questionnaire (24%), while concept maps, with 72% agreement, show 18% disagreement, which suggests that their use is not consistent across teachers.

Figure 1 brings the 14 items together on a diverging scale centred on the neutral option, which shows that disagreement only carries visible weight for debates, concept maps and, among the skills, analysing from several perspectives.

Figure 1. *Distribution of students' responses across the 14 questionnaire items.*



Source: Own elaboration (2026).

Figure 1 shows that the agreement segments predominate in every item, although their length varies between the most and least present strategies. Table 2 details students' self-perception of their critical thinking skills.

Table 2. *Students' self-perception of critical thinking (n = 50).*

No.	Item	SD f (%)	D f (%)	N f (%)	A f (%)	SA f (%)
8	I am able to identify the main arguments and fallacies in a text or speech.	2 (4)	0 (0)	7 (14)	27 (54)	14 (28)
9	Before accepting information, I tend to question its source and the evidence supporting it.	4 (8)	2 (4)	6 (12)	26 (52)	12 (24)
10	I find it easy to propose creative and innovative solutions to complex problems.	1 (2)	3 (6)	6 (12)	27 (54)	13 (26)
11	I can distinguish between facts, opinions and value judgements in the information I consume.	1 (2)	1 (2)	7 (14)	25 (50)	16 (32)
12	I manage to analyse a situation from different perspectives before making a judgement.	3 (6)	4 (8)	7 (14)	23 (46)	13 (26)
13	I am able to self-assess my own reasoning and recognise when I have made a mistake.	3 (6)	3 (6)	2 (4)	21 (42)	21 (42)
14	Lessons have helped me make well-founded and logical decisions in my academic life.	2 (4)	2 (4)	4 (8)	22 (44)	20 (40)

Source: Own elaboration (2026).

Table 2 shows that self-assessment of one's own reasoning and well-founded decision-making are the skills with the highest agreement, at 84% each, with the former reaching the highest strongly agree value in the whole questionnaire (42%), followed by the latter with 40%. Identifying arguments and fallacies and distinguishing between facts, opinions and value judgements gather 82%, while proposing creative solutions to complex problems stands at 80%, values that describe a favourable perception of analytical and interpretive skills.

The two skills with the lowest agreement are questioning sources and evidence before accepting information, with 76% agreement and 12% disagreement, and analysing a situation from different perspectives before making a judgement, with 72% and 14% disagreement. The latter result corresponds to the low presence of debates in Table 1, since both dimensions involve contrasting points of view, just as the gap between the 86% who acknowledge being required to assess source reliability and the 76% who say they question sources on their own

initiative indicates that the teaching of this practice does not fully translate into a habit.

PROPOSED METHODOLOGICAL STRATEGIES

Based on the diagnosis above, a workshop for sharing and strengthening methodological strategies for developing critical thinking is put forward, aimed at the school leaders and teachers of the technical area and, through them, at third-year students in automotive electromechanics. Its purpose is for fault-finding in the workshop to stop being a mechanical procedure and become a reasoned diagnosis, in which students formulate hypotheses, compare explanations and justify their decisions.

The design responds to the items with the lowest agreement, so that argumentative debate and analysis from several perspectives lie at the centre of the proposal, in keeping with Abrami et al. (2015), who identify dialogue as one of the conditions most conducive to critical thinking, and with Rivas et al. (2022), whose problem-based programme uses reflective questions, decision diagrams and individual and group dialogues and debates to strengthen metacognition. It also takes up the recommendation of Liu and Pásztor (2022) to work with small groups and avoid short-term interventions. Table 3 organises the proposal into five stages.

Table 3. *Stages of the methodological strategies workshop for critical thinking.*

Stage	Actions	Responsible parties and resources	Expected outcome
I. Sharing	Present the diagnostic results to school leaders and technical teachers; identify the strategies already in use and those needing reinforcement.	Leadership team and teachers; results report.	Shared diagnosis and institutional commitment.
II. Teacher development	Train teachers in problem-based learning, argumentative debate, Socratic questioning and source evaluation, with model lessons and joint planning.	Technical teachers and facilitators; teaching guides and real fault cases.	Lesson plans that build critical thinking into the workshop.

Stage	Actions	Responsible parties and resources	Expected outcome
III. Classroom application	Use fault-diagnosis cases in groups of fewer than six students, debates on alternative solutions, lateral reading of technical sources and open days.	Students, teachers and school community; workshop, simulators and manuals.	Technical argumentation and analysis from several perspectives.
IV. Follow-up	Support lessons through peer observation and regular feedback; record students' participation and reasoning.	Area coordination and teachers; observation sheets.	Timely adjustments to teaching practice.
V. Evaluation	Re-administer the questionnaire and complement it with performance tasks and a validated scale; review the results and propose improvements.	Technical-pedagogical committee; assessment instruments.	Evidence of change and continuous improvement.

Source: Own elaboration (2026).

The proposal was submitted to the judgement of four specialists with postgraduate training and experience in technical upper secondary education, who rated its clarity, relevance and coherence on a five-point scale, with agree and strongly agree responses predominating; the experts also suggested constant monitoring of the strategies and ongoing training spaces with the school community. As the design has not yet been applied, its outcomes are to be understood as expected and will need to be tested in a later implementation.

DISCUSSION

The first finding of the study is that strategies linked to problems and real cases are those most recognised by students, with 88% agreement for both items, a result consistent with the evidence of Liu and Pásztor (2022) on the effect of problem-based learning on critical thinking and with that of Loyens et al. (2023) on its positive effects on higher-order thinking. In view of the above, automotive electromechanics appears to offer fertile ground for these methodologies, since fault diagnosis is itself an authentic problem; however, Loyens et al. warn that many studies overlook essential components of these methodologies, so the frequency with which problem-based learning is mentioned does not guarantee that it is applied with all its phases.

Secondly, debates were the least perceived strategy (52%) and analysis from different perspectives the least consolidated skill (72%). This invites reflection on the relationship between the two figures, since Abrami et al. (2015) place dialogue among the conditions that best foster critical thinking and Rivas et al. (2022) include individual and group debates as part of their intervention. Pazos-Yerovi and Aguilar-Gordón (2024) describe a similar scenario in Quito, where students' preference for collaborative work coexisted with predominantly lecture-based lessons, and Cáceres et al. (2020) examined, from the teacher's perspective, the conditions for integrating critical thinking into the classroom. Both works agree that the decision to open spaces for discussion depends largely on the teacher, which explains why the proposal prioritises teacher development.

The third finding concerns the evaluation of information, since although 86% of students say they are required to assess the reliability of sources, only 76% report questioning them on their own initiative, and this gap gains relevance in light of McGrew et al. (2018), who found that students at different levels struggle to evaluate online claims, sources and evidence, and of Wineburg et al. (2022), whose field study on lateral reading shows that this competence requires deliberate teaching. This indicates that source evaluation should be addressed through explicit tasks, particularly with the manuals, forums and technical videos that mechanics students consult every day.

Another aspect that needs to be examined is self-assessment of reasoning, which reached 84% agreement and the highest share of strongly agree responses (42%). Perry et al. (2019), after reviewing more than 50 studies, report strong evidence that effective teaching of metacognition improves student outcomes, and Rivas et al. (2022) explicitly link metacognitive strategies to the development of critical thinking; nevertheless, such a high perception of one's own ability to recognise mistakes may be influenced by social desirability, one of the method biases that Podsakoff et al. (2003) identify in self-report measures. It is naive to

think, then, that the questionnaire captures the actual level of critical thinking; what it describes is students' perception of their own performance.

The study has limitations that should be borne in mind when interpreting its results, beginning with the fact that the descriptive design, the single point of application and the population of 50 students from one institution do not allow causal relationships between the strategies and critical thinking to be established or the findings to be generalised. Likewise, the questionnaire does not report reliability coefficients and relies on self-report, so future research could combine it with performance tests and validated scales, such as the short form of the Critical Thinking Self-Assessment Scale developed by Payan-Carreira et al. (2022), which showed an internal consistency of 0.969 in 531 higher education students, as well as longitudinal designs that make it possible to observe how these skills evolve.

CONCLUSION

The methodological strategies that third-year technical upper secondary students recognise most clearly are problem-based learning and the analysis of real cases, which confirms that the automotive electromechanics workshop offers authentic situations for exercising critical thinking, provided these methodologies are applied with all their phases and are not reduced to the guided solving of exercises.

Debate and analysis from several perspectives are the weakest points of the process, both in the strategies perceived and in the skills reported, so argumentative dialogue is the component most in need of strengthening, together with the independent evaluation of technical information sources.

The proposed workshop, organised in five stages and rated favourably by specialists, offers the institution a route for integrating these strategies into teaching practice; its application and evaluation with validated instruments and performance tests will make it possible to test in later studies the favourable perception that students report here.

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CONFLICT OF INTEREST

The authors declare that there are no conflicts of interest of any kind in relation to this research.

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