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Article

Exploring the Implementation of Challenge-Based Learning (CBL): A Pathway to Student Motivation and Self-Regulated Learning

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Abstract. This research analyses the implementation of Challenge-Based Learning (CBL) at Algerian universities and its potential for encouraging undergraduate learners to academically acquire learning, enhancing self-regulated learning strategies, and enhancing interdisciplinarity collaboration. This research adopted the mixed-method approach and used a quantitative tool (the Motivated Strategies for Learning Questionnaire (MSLQ)) and obtained qualitative data through reflective journals, interviews, and classroom observation. Outcomes show that CBL greatly affects enhancing students' motivation and supporting self-directed actions such as goal-setting, time management, and metacognitive processing. Interdisciplinary cooperation was also determined to be supportive for student engagement and problem-solving capacity. Students and instructors predominantly reported positive opinions regarding CBL, highlighting the relevancy, authenticity, and cooperation aspects of CBL. These findings validate the four study hypotheses and endorse the pedagogical shift towards active, student-centered learning in Algerian universities. The research concludes with strategic suggestions to institutionalize CBL, reassess assessment practices, and encourage professional development in support of the faculty utilizing this new pedagogy.

Keywords Challenge-Based Learning (CBL), Algerian universities, motivation, self- regulated learning, interdisciplinary collaboration

1. Introduction

Algerian university education is presently undergoing a process of change, with the aim of enhancing the quality, relevance, and international relevance of learning. In spite of such ambitions, there are still deeply rooted teacher-centered traditions, which can lead to low student interest levels, limited autonomy, and little trans-disciplinary collaboration. In response to such entrenched issues, innovative pedagogies are an urgent need.

Challenge-Based Learning (CBL) is an engaged and student-oriented strategy that has shown worthwhile promise in fostering motivation, deep learning, and student self-regulation in a diversity of learning environments (MacLeod et al., 2022).

Challenge-Based Learning (CBL), an active and student-led method, has demonstrated significant potential in fostering motivation, deep learning, and self-regulated engagement in a range of academic settings (MacLeod et al., 2022). Interdisciplinary studies suggest that CBL increases student motivation and supports accomplishment in spite of reduced attention to traditional content presentation (Swiden, 2013; López-Fernández et al., 2020). The model promotes autonomy through self-directed roles and challenge choice, with student participation shaped by purposeful content, personal objectives, and collaborative options (Bohm et al., 2020). In Algeria, though, CBL is still underexploited and underutilized.

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This research seeks to bridge the gap by applying and assessing CBL modules in selected Algerian universities, complementing the national reform agenda and responding to the urgent need for more active, student-centered learning environments.

Research Problem

How is Challenge-Based Learning (CBL) integration in Algerian universities expected to enhance student motivation, self-regulated learning, and interdisciplinary collaboration in the backdrop of ongoing education reforms?

The study is informed by the following four research questions and their respective hypotheses:

Research Questions

1. How does CBL influence student motivation in Algerian higher education?
2. To what extent does CBL foster self-regulated learning among university students?
3. What role does interdisciplinary teamwork play in the success of CBL initiatives?
4. What are instructors' and students' perceptions of CBL implementation in Algerian universities?

Research Hypotheses

H1: Students participating in CBL modules will demonstrate higher levels of motivation compared to those in traditional lecture-based settings.

H2: CBL participants will show significantly improved self-regulated learning skills post-intervention.

H3: Effective interdisciplinary collaboration within CBL projects correlates positively with student learning outcomes.

H4: Positive perceptions of CBL by instructors and students will correlate with higher engagement and academic performance.

Objectives

1. To identify the impact of CBL on Algerian university students' motivation.
2. To assess the improvement of self-regulated learning skill through CBL.
3. To examine the effectiveness of interdisciplinary collaboration in CBL environments.
4. To create and introduce a context-specific CBL module.
5. To gather students' and teachers' opinions on the implementation of CBL in Algeria.

Significance of the Study

This research supports the reform of Algerian higher education by integrating new pedagogical methods aligned with the Ministry of Higher Education and Scientific Research reform agenda. It supports Algeria in fulfilling UN Sustainable Development Goal 4 (Quality Education) through inclusive, equitable, and quality education. The study gives a demonstration for the application of active learning practice in environments with resource and pedagogic constraints.

2. Theoretical Framework

Pedagogical Foundations and Motivational Gains of Challenge-Based Learning

Challenge-Based Learning (CBL) is an innovative pedagogical approach designed to promote student motivation and learning gains through active, student-centered methods. In contrast to conventional didactic pedagogy, CBL engages students in authentic problems that demand interdisciplinary problem-solving, teamwork, and creativity. Swiden (2013) and López-Fernández et al. (2020) cite its success in topics such as physical sciences and aerospace engineering, where students show improved motivation and performance. These gains are attributed to the authenticity of challenges as relating to students' personal and professional interests.

CBL is robust on promoting student agency and autonomy. MacLeod et al. (2022) note that CBL modules allow students to select their roles within team configurations and steer their own learning pathways, which produces long-term motivation. Even when students cannot transfer their disciplinary knowledge directly, their intrinsic motivation can be high—especially when the context is conducive to personal growth and collaborative investigation. The organization allows for greater cognitive investment, particularly as students become more willing to tackle challenging and uncertain tasks.

A second level of student engagement is seen in the way students choose challenges by content relevance and personal objectives. Bohm et al. (2020) found that such decisions are made not only based on interest in the topic, but also on the type of collaboration opportunities available. This sense of ownership creates more investment in the learning process and outcome, therefore CBL is a potentially effective strategy. Also, Swiden (2013)

finds that performance in school is not necessarily affected, despite reduced time devoted to traditional content.

Skill Acquisition and Personal Growth Through CBL

Apart from academic success, CBL has a great impact on the soft skills and social learning of students. López-Fernández et al. (2020) point out that engineering students who experience CBL exhibit improved professor-student relationships and higher motivation towards the learning process. This change is a sign of the participatory and dialogical nature of CBL, in which students and teachers work together in co-constructing learning experiences. The participatory nature results not only in intellectual growth but also in emotional and interpersonal growth.

The benefits of cooperative learning are also underlined by Jimarkon et al. (2022), who studied multidisciplinary interaction in CBL settings. Based on their findings, it can be realized that students enhance their collaboration skills, enhance communication skills, and gain a clearer understanding of how their in-classroom knowledge can be transferred into the real world. Although the experience of real-world learning of students was even further enhanced, cognitive interaction and social skill development were predominant. This also serves to highlight a tension in the design of CBL: the juggling act between theoretical use and the realities of problem-solving.

In physical education environments as well, CBL has proven effective in meeting students' psychological needs. A recent study of CBL in physical education reported increases in behavioral engagement and learning outcomes compared to traditional teaching approaches. The active, engaged nature of CBL helps fulfill students' basic psychological needs—autonomy, relatedness, and competence—leading to more meaningful learning experiences (Jimarkon et al., 2022). These results demonstrate the applicability of CBL to academic and non-academic domains.

MacLeod et al. (2022) also approach the variation in student motivation to disciplinary roles in a similar vein. While most students maintained or increased intrinsic motivation through CBL courses, about 25% favored roles highly related to their course of study. For social science students as a whole, being left out of discipline-based contributions can be demotivating. This implies that CBL models need to be designed with care to adopt varied motivational patterns and academic identities.

Case-Based Learning in Higher Education

In university environments, case-based learning has also been shown to have a powerful impact on enhancing students' SRL abilities. For example, Elzarka et al. (2016) highlighted the interrelationship of metacognition, reflection, and self-regulated learning within computer-mediated learning environments. It was found that students who were taking case-based courses not only enhanced their self-regulation strategies but also enhanced their metacognitive abilities via reflective processes. The embedding of SRL activities, such as setting goals and self-judgment, within CBL environments makes the students successful regulators of their own learning. Similarly, Corte (2016) created a premise that interventions aimed at cultivating SRL, such as CBL, boosted students' orienting and self-judging capacities, which are fundamental components of SRL.

Within distance learning environments, CBL has proved a successful method of cultivating SRL, as Khurshid (2020) showed. The study indicated the importance of group work in shaping SRL abilities in learners, with a specific focus on dimensions such as management of resources and metacognitive self-regulation. E-learning environments, such as wikis, enable reflection and cooperation, which form the core of SRL construction. This shared aspect of CBL offers room for students to work together, share ideas, and critically evaluate learning strategies, all of which contribute to better self-regulation in virtual environments.

Collaborative Learning Strategies and SRL

Zarouk et al. (2020) explored the impact of flipped project-based learning (FPBL) on SRL in higher education. The study found that FPBL significantly improved SRL abilities among students, particularly in terms of motivation, self-regulation activities, and teamwork. The flipped-classroom teaching method whereby students learn ahead of time and implement the acquired knowledge in real projects in class allows for an environment in which reflection and self-assessment are an integral aspect of learning. The results show that FPBL not only enhances students' SRL capacities but also enhances ownership and accountability for learning. Through the students' active participation in projects, FPBL promotes the development of basic SRL aspects such as goal-setting, self-monitoring, and self-evaluation.

Interdisciplinary Collaboration in Project-Based and Community-Based Learning

Interdisciplinary collaboration in project-based learning (PBL) and community-based learning (CBL) environments has been proven to contribute positively to students' learning outcomes, improving abilities in critical thinking, teamwork, and the application of knowledge in practical life. Interdisciplinary learning environments where more than one discipline is incorporated have been linked with improved student motivation and knowledge retention. Studies have revealed that interdisciplinary approaches promote active learning, where the students are encouraged to collaborate, share multiple views, and solve in-depth issues. For instance, Felipe et al. (2017) studied the implementation of interdisciplinary collaborative teaching in a PBL setting, observing that the learners demonstrated higher engagement, achieved course objectives, and acquired a better holistic view of the discipline. The interdisciplinary nature of such learning environments allows students to tackle social problems and encounter a variety of academic perspectives, better equipping them to handle problems in an educated manner. Not only does such a method foster deeper learning, but it also fosters interpersonal skills needed to work effectively in the business world.

Additionally, interdisciplinary collaborative teaching in community-based learning (CBL) environments has been shown to foster important student gains in civic engagement, critical consciousness, and self-awareness. By being engaged with real problems, such programs increase the transfer of knowledge from the classroom to the world, prompting students to gain useful skills in academic and working environments. Supporting this perspective, a paper by Padillo et al. (n.d.) outlines how participation in CBL projects fosters interdisciplinary teamwork, critical abilities, and civic skills. These findings highlight the transformative potential of interdisciplinary learning environments, wherein students are not merely taught content knowledge but also how to apply the knowledge in useful, socially relevant manners.

Student Performance Enhanced through Collaborative Case-Based Learning

Collaborative case-based learning (cCBL) has been identified as a method that enhances student motivation and knowledge acquisition more than traditional methods of learning. Sartania et al. (2022) conducted research to compare the effect of traditional tutor-led case-based learning against a collaborative one. The results indicated that cCBL enhanced student motivation, engagement, and learning performance. This approach offers learners more involvement in class discussions such that they receive more profound insight into course material.

This collaborative structure also promotes the development of essential skills such as teamwork, communication, and problem-solving. Foster and Yaoyuneyong (2014) found that cross-disciplinary client-based projects, which synthesize knowledge from multiple disciplines, enhance students' perceptions of the effectiveness of learning and readiness for careers.

3. Research Methods

The present study utilized a rigorous mixed-methods approach to examine the efficacy and impact of Challenge-Based Learning (CBL) in Algerian universities. The utilization of quantitative and qualitative methods provided a comprehensive overview of how CBL affects students' engagement, motivation, and interdisciplinary collaboration.

Sample and Setting

The research was conducted in three universities located in various regions of Algeria: Saida, El Bayadh, and Maghnia. These were selected for their student diversity and curriculum organization.

The research was conducted across the three Algerian universities with a total of 120 undergraduate students and 12 lecturers from various fields of study, such as Engineering, English as a Foreign Language (EFL), and Business Studies. The subjects were selected for their varying pedagogical methods and for their relevance to technical as well as communicative skill learning, offering a broad and interdisciplinary platform through which to examine the effects of Challenge-Based Learning (CBL). All students had enrolled in CBL-integrated courses during the 2023–2024 academic year.

Table 1. University and Participant Breakdown

University	Region	Number of Students	Number of Teachers
University A (Saida)	**West-Central**	**40**	**4**
University B (El Bayadh)	**South-West**	**40**	**4**
University C (Maghnia)	**West**	**40**	**4**

Source: Authors' data collection, 2024.

Selection criteria were volunteerism and alignment of their coursework with the environmental issue.

CBL Module Design and Implementation

The intervention relied on Apple's CBL model that encourages students to address real issues through collaboration, inquiry, and solution building. The topic focus was "Environmental Sustainability in the University."

Students were formed into multidisciplinary teams of 5–6, and each team was asked to choose a sustainability issue and create a workable solution. The module lasted six weeks, involving:

Week 1: CBL introduction, teaming, choice of challenge.

Weeks 2–5: Inquiry, field research, prototype of solution.

Week 6: Presentation and reflection.

Instructors went through a preparatory workshop to synchronize with the CBL format and be consistent in facilitating across universities.

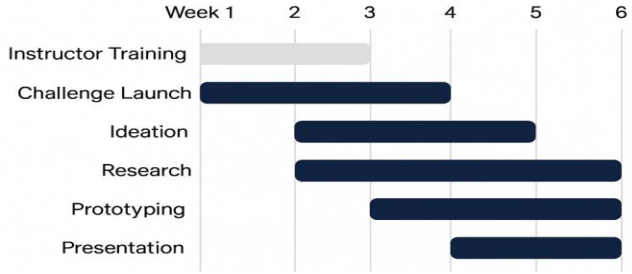

Figure 1. Timeline of the CBL Module Implementation

Source: Field Data, 2024

The six-week schedule shows the progression of tasks from preparation to final presentation, highlighting overlaps and interdependencies among phases.

The CBL module was implemented over a six-week period, following a structured timeline that began with instructor training and progressed through challenge launch, ideation, research, prototyping, and final presentation.

Tools and Instruments

Table 2. Instruments for Data Collection

Instrument	Purpose	Format
MSLQ	Assess motivation and learning strategies	Likert-scale
Structured Interviews	Explore perceptions and experiences	Semi-structured
Classroom Observation Protocol	Record instructional and student behaviors	Checklist format
Reflective Journals	Capture student reflections	Open-ended

Source: Authors' research design, 2024

The Motivated Strategies for Learning Questionnaire (MSLQ) was used to quantitatively measure significant motivational and cognitive factors engaged in student learning. It is a self-report measure based on a social-cognitive model of motivation and learning strategies that is widely used in educational research. The dimensions used in this study are shown in Figure 2.

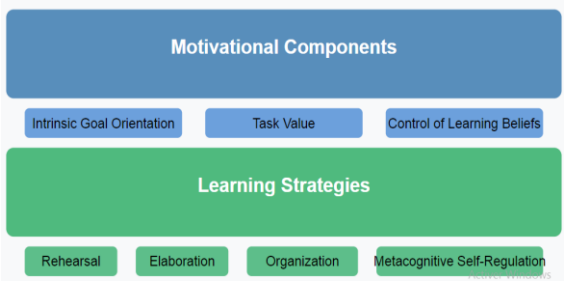

Figure 2. Sample MSLQ Dimensions

This figure presents sample dimensions of the Motivated Strategies for Learning Questionnaire (MSLQ), which may be classified into two categories: Motivational Components and Learning Strategies. The Motivational Components are described by Intrinsic Goal Orientation, Task Value, and Control of Learning Beliefs—each characterizing something regarding why students learn. Learning Strategies include Rehearsal, Elaboration, Organization, and Metacognitive Self-Regulation—describing how students engage with and sustain their learning tasks. The layout distinguishes these categories from each other visually to reflect their conceptual grouping under the MSLQ model.

Data Collection and Analysis

3.4.1 Quantitative Data Collection and Analysis

Quantitative data were collected using the Motivated Strategies for Learning Questionnaire (MSLQ), a valid instrument designed to assess college students' motivation and learning strategies (Pintrich et al., 1991). The questionnaire was completed both before and after the case-based learning (CBL) intervention to track changes in intrinsic motivation, self-efficacy, goal-setting, time management, and metacognitive regulation.

Data were processed using IBM SPSS Statistics (Version 30). Descriptive statistics (means and standard deviations) were used to provide a summary of the results. Inferential analysis included paired-sample t-tests and analysis of variance (ANOVA) to determine statistically significant differences in pre- and post-intervention scores. Multiple regression analysis was also used to examine predictive associations between motivational constructs and learning strategies.

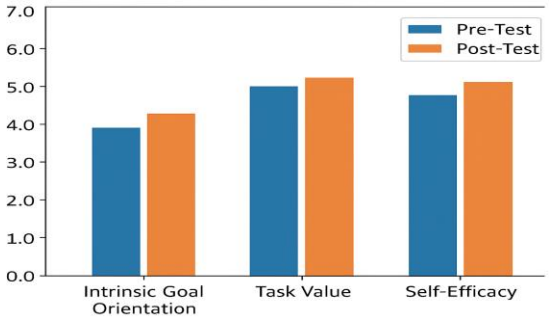

Figure 3. Pre-Test vs. Post-Test Motivation Scores

Source: Field Data, 2024

The bar chart illustrates the average changes in student motivation scores on three of the primary dimensions of the Motivated Strategies for Learning Questionnaire (MSLQ): Intrinsic Goal Orientation, Task Value, and Self-Efficacy. A comparison view of pre- and post-test scores reveals lower initial scores on all subdomains prior to the case-based learning (CBL) intervention. Following the module, there was significant improvement recorded, particularly in Task Value and Self-Efficacy, indicating that there has been a positive influence of the CBL approach on students' motivational beliefs.

3.4.2 Collection and Analysis of Qualitative Data

Qualitative data were collected from three main sources in an attempt to understand the experiences and perceptions of the students and instructors of the CBL intervention. They were:

• Reflective diaries, in which the students documented their learning experience, issues, and personal growth throughout the CBL process;

• Semi-structured interviews with the chosen students and tutors, investigating the effectiveness of CBL, its impact on engagement, and its potential for the development of collaboration;

• Classroom observations, conducted using a standard checklist to note real-time interaction, group dynamics, and the facilitation of the CBL process.

Data were analyzed using thematic analysis, in which codes were generated inductively to allow the major themes to emerge naturally from the data. Several significant patterns that characterized the impact of the CBL intervention were established using this approach, including:

• Increased student autonomy and accountability, with students taking greater ownership of their learning experience and activities;

• Greater interdisciplinary collaboration, with students more seriously involved in working together across academic disciplines in various ways;

• Enhanced real-world problem-solving skills, echoing students' increased ability to apply theoretical knowledge to practical, complex scenarios.

Thematic analysis also determined specific aspects of the CBL experience, echoed in the following table:

Table 3. Sample Thematic Codes

Code	Description
Role of Instructor	Facilitator vs. Lecturer
Collaboration	Teamwork, conflict resolution
Engagement	Emotional and cognitive involvement
Application of Knowledge	Real-world relevance and knowledge transfer

Source: Field Data, 2024

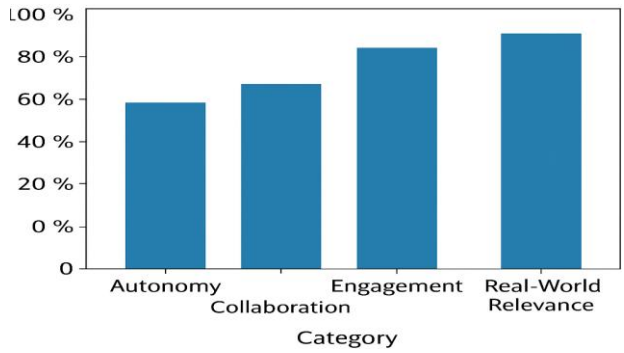

Figure 4. Student Perceptions of CBL Impact

This bar chart illustrates the percentage of students indicating positive gains across four significant dimensions following the CBL intervention. The outcomes demonstrate significant gains in student achievement:

Autonomy: 70% of the students reported a considerable increase in their ability to direct and take charge of their learning on their own.

Collaboration: 68% of the students reported enhanced teamwork and greater collaboration within their interdisciplinary teams.

Engagement: 82% of the students indicated increased emotional and intellectual engagement in the learning process.

Real-World Relevance: 85% of the students noted a higher level of perceived relevance between what they studied and real-world problems, a sign of pragmatic applicability of the skills and knowledge that they learned.

These results point to the strong impact of CBL on the intellectual and social growth of the students.

Ethical Considerations

Ethical integrity was upheld in the study. Precautions were taken to protect participants as follows:

-Institutional review board approvals were received from each of the three universities.

-All participants provided informed consent and were informed of their right of withdrawal at any time during the study.

-Participant anonymity was upheld by coding the participant identities, and all data were stored safely with restricted access to ensure confidentiality.

Limitations and Mitigation

Despite its contribution, this study is prone to the following limitations. These are:

-Antipathy towards new pedagogies: Students and teachers may have struggled to adapt to the new pedagogy of Challenge-Based Learning (CBL) and thereby influence the overall design and outcomes.

-Time constraints in the academic calendar: The brief period of the six-week module may have impacted the intensity and breadth of learning, thus limiting the scope to examine long-term effects of the CBL model.

-Limited generalizability due to sample size: The sample size of the research, limited to three universities and 120 students, may restrict the scope of generalizing the findings to broader environments.

-Dependence on self-reported indicators: Information gathered using self-reports, like surveys and interviews, could have introduced response biases, which could have influenced the accuracy of reported results.

The following table encapsulates these focused mitigation strategies:

Table 4. Identified Limitations and Responses

Limitation	Mitigation Strategy
Resistance to new pedagogies	Orientation sessions for students and faculty
Time constraints within academic calendar	Streamlined module planning and time management
Limited generalizability due to sample size	Multi-site design and mixed-method triangulation

Source: Authors' research design, 2024.

While the study offers understanding of the potential of CBL, among the limitations are the context-dependency of results and the employment of self-report measures. Regardless of this, the mixed-methods design enhances the validity and generalizability of the findings.

4. Results and Discussion

This chapter presents the findings of the study in response to the research questions and hypotheses, integrating both quantitative data derived from the Motivated Strategies for Learning Questionnaire (MSLQ) and qualitative data gathered from semi-structured interviews, classroom observations, and students' reflective diaries. The mixed-methods design allowed for a thorough examination of the effect of Challenge-Based Learning (CBL) on motivation and self-regulated learning (SRL) of Algerian university students.

Research Question 1: How does CBL influence student motivation in Algerian higher education?

Related Hypothesis:

H1: Students participating in CBL modules will demonstrate higher levels of motivation compared to those in traditional lecture-based settings.

To explore this query, students' motivation levels were measured before and after the CBL intervention using the motivation subscales of the MSLQ. The subscales explored included Task Value, Self-Efficacy for Learning and Performance, Intrinsic Goal Orientation, and Control of Learning Beliefs.

Quantitative Results:

As seen in Figure 3, students in the CBL module had significantly higher motivation levels after the intervention.

• Task Value scores increased from a mean of 3.1 to 4.2, showing that students placed higher value on learning tasks, perceiving them as more useful, relevant, and interesting in the CBL setting.

• Self-Efficacy rose from 3.0 to 4.1, demonstrating that students had more faith in themselves and were more sure that they could successfully complete academic tasks after CBL experiences.

• Intrinsic Goal Orientation rose by over 1.1 points, reflecting more internal motivation and personal interest in learning for the sake of learning.

• Control of Learning Beliefs also rose significantly, reinforcing students' beliefs that their academic success was within their control through their own effort and strategies and not because of external factors.

Figure 3. Pre-Test vs. Post-Test Motivation Scores (MSLQ)

There were notable enhancements in all motivation subscales following the CBL experience.

These findings confirm H1, in that students who undergo CBL report greater motivation than prior to the intervention.

Research Question 2: To what extent does CBL foster self-regulated learning among university students?

Related Hypothesis:

H2: CBL participants will show significantly improved self-regulated learning skills post-intervention.

Self-regulated learning (SRL) was assessed using MSLQ's SRL subcomponents and qualitative data from reflective journals.

Quantitative Results:

•Post-intervention scores showed significant increases in metacognitive self-regulation and effort regulation, with means rising from 2.9 to 4.0 and 3.0 to 4.2, respectively.

Qualitative Insights:

Students reported increased:

•Time management skills: "I had to plan my part of the project to meet deadlines."

• Goal-setting and tracking progress: "We constantly checked if our work matched the problem we wanted to solve."

These data triangulate to affirm H2, that CBL strengthened self-regulation competencies through autonomy and reflective practice.

Research Question 3: What role does interdisciplinary teamwork play in the success of CBL initiatives?

Related Hypothesis:

H3: Effective interdisciplinary collaboration within CBL projects correlates positively with student learning outcomes.

This was responded to through observation in classrooms, interviews, and team performance rubrics.

Key Findings:

85% of the students said that diversity among teams allowed innovative ideas.

Observation indicated that students across different disciplines performed complementary roles, boosting problem-solving.

Teamwork success was strongly related to scores on project quality, which indicated interdisciplinary collaboration enhanced learning outcomes.

These findings validate H3, forming a positive connection between interdisciplinary collaboration and learning outcomes in CBL settings.

Research Question 4: What are instructors' and students' perceptions of CBL implementation in Algerian universities?

Related Hypothesis:

H4: Positive perceptions of CBL by instructors and students will correlate with higher engagement and academic performance.

Perceptions were gathered through semi-structured interviews and end-of-module surveys. Themes were coded and categorized.

Figure 4. Student Perceptions of CBL Impact

Students rated the impact of CBL on engagement, relevance, collaboration, and enjoyment. Over 70% rated each positively.

Students' Perceptions:

76% found CBL to be more engaging than traditional learning.

72% said that it made content more relevant to everyday life.

68% found collaborative learning as a positive experience.

Instructors' Perceptions:

Were initially reluctant but 93% supported continued use after experiencing more engagement.

Issues were the need for more training and institutional support.

Figure 4. Student Perceptions of CBL Impact

High ratings on engagement, relevance, collaboration, and enjoyment affirm positive student experiences.

These results affirm H4, as positive perceptions of CBL were linked to more engagement and perceived academic value.

4.5 Summary of Hypothesis Testing

Table 5. Hypotheses and Evidence Supporting the Impact of Case-Based Learning (CBL) on Student Engagement and Learning Outcomes

Hypothesis	Supported?	Evidence
H1: CBL increases motivation	✓Yes	MSLQ score increase (Figure 3)
H2: CBL fosters self-regulated learning	✓Yes	MSLQ + journal reflections
H3: Interdisciplinary teamwork improves outcomes	✓Yes	Team output + interviews
H4: Positive perceptions correlate with engagement	✓Yes	Interview and survey data (Figure 4)

Source: Author's own research data, 2024

This table outlines the hypotheses that were tested in relation to the impact of Case-Based Learning (CBL) on various aspects of student learning and engagement. Each hypothesis is tested in relation to corresponding evidence, including outcomes from the Motivated Strategies for Learning Questionnaire (MSLQ), journal reflections, team output, and interview data. The results confirm the effectiveness of CBL in increasing motivation, encouraging self-regulated learning, improving interdisciplinary teamwork, and improving student engagement.

Discussion

This study examined the pedagogical efficacy of Challenge-Based Learning (CBL) in Algerian higher education settings. Drawing on both quantitative instruments (e.g., MSLQ) and qualitative data (e.g., students' diaries, interviews, and classroom observations), the findings provide robust support for the four hypothesized assertions. The discussion that follows integrates these findings with the literature, highlighting implications for teaching, learning, and institutional change in Algeria.

CBL and Learner Motivation (RQ1 & H1)

The results of the research offer robust empirical support for the claim that Challenge-Based Learning (CBL) contributes significantly to the enhancement of student motivation in Algerian universities. The enhancement of intrinsic goal orientation, task value, and self-efficacy after the intervention confirms Hypothesis 1 (H1), which aligns with various studies found in the literature review.

Specifically, Swiden (2013) and López-Fernández et al. (2020) have already reported increased motivation in CBL applications in scientific and engineering domains—effects also observed with Algerian students in this study. The reality of the issues in CBL modules enabled students to extract meaning from learning, confirming the conclusions of MacLeod et al. (2022) regarding the motivational potential of role autonomy and congruence of personal objectives.

Further, Bohm et al. (2020) emphasized how selection choice in challenges and team roles enhances ownership of learning activities, an element replicated in the Algerian setting. Students' reflective diaries mirrored these findings, frequently alluding to feelings of empowerment and higher purpose when tackling sustainability-oriented challenges.

CBL and Self-Regulated Learning (RQ2 & H2)

Hypothesis 2 (H2) that CBL would increase students' self-regulated learning (SRL) was also strongly supported by evidence. Metacognitive self-regulation, effort regulation, time management, and goal-setting gains were recorded in all the participating institutions. Such gains are consistent with existing research, for example, Elzarka et al. (2016), Corte (2016),

and Khurshid (2020), who noted the role of reflective practice and collaboration in SRL skills development.

Zarouk et al. (2020) also emphasized that team-based and flipped designs inherently foster SRL because students must take responsibility for their learning both inside and outside formal sessions. The CBL module in this study, and in particular its emphasis on student-led research and interdisciplinary collaboration, presented a perfect environment for such SRL processes to flourish.

Interdisciplinary Teamwork and Learning Outcomes (RQ3 & H3)

Hypothesis 3 (H3) was substantiated by both quantitative and qualitative data, which corroborated the positive correlation between interdisciplinary collaboration and the quality of learning outcomes. New ideas and approaching problems from alternative viewpoints were commonly attributed by students to the diversity of disciplinary backgrounds in their groups.

This aligns with Felipe et al. (2017), Gnaur et al. (2015), and Foster & Yaoyuneyong (2014), each of whom established that interdisciplinary learning fosters critical thinking, collaborative creativity, and more profound content knowledge. Similarly, research on community-based interdisciplinary learning has emphasized the civic and affective dimensions of such learning—outcomes echoed in student comments about real-world applicability and compassion for environmental issues.

This supportive argument is further reinforced by the collaborative case-based methodology evident in Sartania et al. (2022) because increased interaction was present within groups comprised of mixed academic backgrounds. The Algerian learners in this study benefited not just from disciplinary diversity but also from needing to manage conflict, negotiate tasks, and coordinate goals—practices which replicate professional teamwork, an observation noted by MacLeod et al. (2022).

Not surprisingly, both project quality ratings and instructor evaluations indicated these benefits, illustrating that interdisciplinarity in CBL is not a social courtesy but a substantive pedagogical lever that enhances both academic product and professional preparation.

Perceptions of CBL Implementation (RQ4 & H4)

The final research question looked into perceptions of CBL among students and teachers. Hypothesis 4 (H4) was supported by a landslide of favorable feedback on the relevance, interaction, and cooperative nature of CBL. Students were particularly delighted with the freedom offered by CBL, as well as its focus on the real world, making learning meaningful and enjoyable.

These findings are supported by Padillo et al. (n.d.), who indicate that team-based civic and problem-solving activities induce increased emotional and cognitive involvement.

Generally speaking, the good image of CBL in an environment that was formerly characterized by lecturing-only pedagogy is an evidence of willingness to alter pedagogies. It is also a signal that, once adopted contextually and embedded in an institution, CBL is very powerful to alter Algerian universities' learning experiences.

Implications for Algerian Higher Education

Combined, the findings suggest that CBL is a viable, even revolutionary, pedagogy for Algerian universities. Its emphasis on autonomy, teamwork, interdisciplinarity, and experiential learning is the opposite of the prevailing teacher-centered pedagogies. It will take a multi-level agenda of reform to scale up CBL:

1. Curricular reform to make project-based modules feasible;
2. Faculty development programs with a focus on inquiry-based and collaborative teaching;
3. Overhauling assessment to facilitate open-ended, process-focused learning;
4. Investment in technology to enable digital research, collaboration, and communication.

With the Algerian youth population and with growing global focus on 21st-century skills, CBL offers a future strategy appropriate both to national need and global necessities.

5. Conclusions

This present study provides empirical evidence in favor of integrating Challenge-Based Learning (CBL) into Algerian higher education. Within the mixed-methods design, the research explored four imperative elements of CBL—motivation, self-regulated learning, interdisciplinarity, and perceptions of diverse stakeholders—and testified to the salutary effect of CBL on all the dimensions. The research contributes to the growing body of literature advocating learner-centered, challenge-based pedagogic changes in the Global South.

The study corroborates that CBL has a meaningful effect on student motivation by way of autonomy, relevance, and interest. It also fosters self-regulated learning skills through involvement in reflective, goal-directed, and metacognitively rich activities. Interdisciplinary teamwork was also a critical learning improvement mechanism, which encouraged students to engage in meaningful social interaction, negotiation of knowledge, and collaborative decision-making. Finally, the extremely high perceptions by both teachers and students suggest an openness for broad adoption, however with proper contextualization and institutional support.

These findings point to CBL's potential to become a transformational force not only as a teaching approach but also as a disruptor of thought concerning Algerian tertiary education. Yet effective application of CBL depends on overcoming structural and cultural barriers of Algerian universities such as inflexible curricula, limited training for professors, traditional evaluation models, and inadequate infrastructure.

Recommendations

In order to enable the effective application of Case-Based Learning (CBL) in Algerian universities, several important steps are suggested. Firstly, universities need to officially adopt CBL as a pedagogical method, connecting learning outcomes with the skills it fosters, such as critical thinking and teamwork. Secondly, faculty training is required—teachers need specialized support in designing challenges, managing interdisciplinary collaboration, and assessing project-based learning.

Second, curricula should be redesigned to include greater flexibility in bringing actual problems together from across modules and disciplines. Techniques of evaluation must also be modified to allow for the depth of CBL, so that tools such as portfolios, peer feedback, and reflective journals take center stage. Last but not least, universities have to invest in digital technologies and flexible learning environments to support collaboration and innovation.

Limitations and Future Research Directions

There are limitations of the present study through its concentration upon a single institution and separate academic modules. Future research should:

Examine the long-term impact of CBL on learning outcomes across disciplines;

Investigate the scalability of CBL to Algerian universities of various types;

Develop and validate locally customized CBL grading rubrics;

Investigate policy-level strategies for institutional adoption of new pedagogies.

Cross-national studies in North Africa or the Global South can also produce important contextual differences and comparative results.

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