I.J. Modern Education and Computer Science, **2026, 1, 93-103**
Published Online on February 8, 2026 by MECS Press (http://www.mecs-press.org/)
DOI: 10.5815/ijmecs.2026.01.06

Challenges in Engineering Education: Addressing Student Motivation

Mirjana Kocaleva Vitanova*
Faculty of computer science, Goce Delcev University, Stip, Republic of North Macedonia
Email: mirjana.kocaleva@ugd.edu.mk
ORCID iD: https://orcid.org/0000-0002-2444-2917
*Corresponding Author

Elena Karamazova Gelova
Faculty of computer science, Goce Delcev University, Stip, Republic of North Macedonia
Email: elena.gelova@ugd.edu.mk
ORCID iD: https://orcid.org/0000-0001-5893-7435

Biljana Zlatanovska
Faculty of computer science, Goce Delcev University, Stip, Republic of North Macedonia
Email: biljana.zlatanovska@ugd.edu.mk
ORCID iD: https://orcid.org/0000-0003-4300-2877

Marija Miteva
Faculty of computer science, Goce Delcev University, Stip, Republic of North Macedonia
Email: marija.miteva@ugd.edu.mk
ORCID iD: https://orcid.org/0000-0001-5326-2301

Received: 12 March, 2025; Revised: 15 May, 2025; Accepted: 10 July, 2025; Published: 08 February, 2026

Abstract: Learning is a lifelong process. The saying 'You learn as long as you live' exists for a reason. Acquiring new and unfamiliar knowledge, preparing for exams, completing assignments, and writing research papers can be challenging and time-consuming. As educators, we always aim to give our best, simplifying complex concepts, providing clear visual aids, and even offering simulations where possible. Our main goal is to engage students effectively and maintain their attention throughout the learning journey. This is why the teaching materials provided by professors and the way they communicate to students are of great significance. In this paper, we will explore students' perspectives on teaching materials through a brief discussion, and we will draw conclusions to guide the future direction of the learning process.

Index Terms: Education Technology, Engineering Education, Hybrid Learning, Learning Styles, Student Motivation, Teaching Materials

1. Introduction

The progress and development of a society are rooted in the process of learning. Learning is a lifelong process, yet every society organizes education in several stages through which its members pass. Education and learning are dynamic processes that have changed throughout history, are changing today, and will continue to change in the future, depending on societal events.

Today, we are witnessing various economic, social, and health challenges that significantly impact learning and education. Consequently, higher education, confronted with societal challenges and new labor market demands, is seeking more efficient methods and approaches to advance the learning process. In this context, engineering education is also subject to constant changes and transformations. These challenges require a new kind of engineer, one who embodies interdisciplinarity, digitization, and the ability to adapt quickly to change [1]. Therefore, in today's conditions, the learning process in engineering education is even more complex and challenging. This process is far from simple for professors, and even more so for students, who are the primary participants [2, 3].

Professors today face the rapid development of computer technology, its application in everyday life, and the swift digitization of all societal segments. Therefore, they must find effective methods to motivate and guide students through the learning process. As key drivers of the learning process, professors should focus on several crucial steps:

- Selecting engaging and understandable learning materials that inspire students to learn, think critically, be creative, and develop ideas for their progress. The choice of such materials is the most crucial step in achieving successful learning. A student's motivation and contribution to the process depend largely on the quality of these materials. Therefore, professors must carefully seek out and choose the most suitable content.
- Ensuring the materials are easily accessible. In the digital age, it may seem simple to make selected materials available to students. However, this remains a challenge, as not all professors can independently control how their materials are shared with students. A unified institutional approach is necessary to ensure that learning materials are accessible to all professors and students in a manageable way. This approach must meet the needs of all participants while aligning with the learning goals and objectives.
- Providing access to necessary digital resources. Engineering education is inseparable from the use of computer technology and digital resources. During the learning process, each student should have access to these resources to effectively engage with the learning material.
- Choosing an appropriate learning style. Each student's learning style is individual and unique. While some students learn best through visualization, others may prefer reading, writing, auditory, or kinesthetic methods. For successful learning, it is essential that the professor selects a learning style suited to the specific group of students. Ideally, each student would choose their own learning style, but in larger groups, this is difficult and often impractical.
- Encouraging students to seek additional literature. Professors typically select core literature that they consider most suitable for the subject matter students need to master. However, students sometimes seek additional literature to clarify or deepen their understanding of a topic or to work on projects. Allowing and encouraging students to explore supplementary resources benefits both students and professors, as this process fosters deeper engagement and shared knowledge.

The most critical factor in all these steps is the student's motivation to learn. This is perhaps the biggest challenge in engineering education for professors. Therefore, this paper provides an overview of key questions and based on real data, draws conclusions on how to address the challenge of motivating students to learn. New methods and approaches, as mentioned in the literature, are being explored to enhance motivation in the learning process [4-8].

Engineering education faces numerous challenges, with student motivation being one of the most critical factors influencing learning outcomes. In an increasingly complex and fast-paced technological world, maintaining student engagement is essential for success in mastering demanding subjects. Engineering courses are often perceived as rigorous, requiring not only technical skills but also a high level of commitment and persistence. However, many students struggle with motivation due to the abstract nature of theoretical concepts, heavy workloads, and the fast-paced learning environment.

Furthermore, traditional teaching methods may not always resonate with modern learners, who often seek more interactive, hands-on, and relevant learning experiences. With the rise of new technologies and the shift towards hybrid learning environments, there is a need to re-evaluate educational strategies to ensure that students remain motivated and actively involved in their learning. Addressing this challenge involves understanding the diverse needs of students, implementing effective teaching methodologies, and creating a supportive learning atmosphere that fosters both intrinsic and extrinsic motivation.

This paper explores the key challenges in maintaining student motivation in engineering education and discusses strategies to enhance student engagement, ultimately aiming to improve learning outcomes in engineering programs.

2. Materials and Methods

In this study, we conducted a comprehensive discussion with a group of 37 second-year students enrolled in the Operating Systems (OS) course, 99 first-year students enrolled in the Object-oriented programming (OOP) course and 69 third-year students enrolled in the Numerical methods (NM) course. The 37 second-year students were volunteers from various academic backgrounds, consisting of 17 male and 20 female students, most of whom had little or no prior knowledge of the Operating Systems course. The course comprises twelve lectures and an equal number of lab sessions. The lectures are primarily theory-based, occasionally supplemented with videos and visual aids, while the lab sessions focus on coding exercises and provide links to simulations and relevant online examples. The course assessment includes two midterm exams and a final oral exam. For each lecture and lab session, the professor prepares a detailed presentation along with supplementary materials. In addition to regular classes, students have the opportunity for consultations by appointment, as well as time for questions and discussions during sessions.

The 99 first-year students (31 female, 68 male) were enrolled in the Object-Oriented Programming course during the second semester of their studies. These students came from diverse academic programs and had varying degrees of prior programming experience, with many object-oriented concepts for the first time. The course consists of twelve lectures and twelve accompanying lab sessions. The lectures cover the fundamental principles of object-oriented programming, including classes, objects, inheritance, and polymorphism, and are supported by visual presentations, code demonstrations, and practical examples. The lab sessions are dedicated to hands-on coding exercises, where students apply lecture concepts in real-time using programming environment such as C++. Course evaluation includes continuous assessment through assignments, two midterm exams, and a final written exam. The professor provides structured teaching materials for each session, including slides, sample codes, and additional reading resources. Students are encouraged to attend consultation hours and actively participate in discussions during and after lectures and lab sessions. The 69 third-year students were enrolled in the Numerical Methods course during the sixth semester of their academic program (25 female, 44 male). These students had already completed foundational mathematics and programming courses, providing them with the necessary background to engage with more advanced computational techniques. The course includes twelve theory-based lectures, and twelve lab sessions focused on practical application. The lectures cover key numerical methods topics such as solving systems of linear equations, numerical integration, interpolation, and numerical solutions of differential equations. Teaching is supported by visual aids, algorithmic explanations, and real-world engineering applications. The lab sessions allow students to implement numerical algorithms using programming tools such as MATLAB or Python, reinforcing their understanding through coding and problem-solving. Assessment is based on regular homework assignments, two midterm exams, and a final written exam. For each lecture and lab, the professor prepares comprehensive teaching materials, including slides, example problems, and digital simulations. Students are also provided with time for consultations and are encouraged to participate in class discussions to clarify complex concepts and deepen their understanding.

The discussion process involved posing questions on the board, with students responding by raising their hands. Their responses were systematically recorded by the teaching staff for further analysis. The discussion centered around six key questions related to the effectiveness of learning and exercise materials. This study ensured that all procedures adhered to the principles of reliability and credibility, crucial for qualitative research. A similar approach was adopted in the discussion outlined in [9] where the findings highlighted a trend among students favoring YouTube videos and free online courses over traditional written materials as their preferred learning resources.

To explore student motivation, we formulated six key questions related to the effectiveness of learning and exercise materials. These questions served as the basis for our discussions and included:

1. Are the teaching materials provided adequate for mastering the course content?
2. Are the exercise materials sufficient for mastering the course content?
3. How often do you engage with Moodle and the e-library for your studies?
4. What additional materials do you use, and to what extent?
5. What is your preferred learning style?
6. Is hybrid learning more effective than traditional learning?

In addition to structured discussion questions, students engaged in open-ended conversations that provided valuable, unfiltered insights into their motivation, learning experiences, and suggestions for improvement. Several students spontaneously emphasized the importance of emotional support and the classroom atmosphere. One student remarked, *"When the professor is enthusiastic, it really makes a difference—it makes me want to learn."* Others highlighted challenges related to balancing academic workload with personal responsibilities, noting that time pressure sometimes reduced their motivation. Many students expressed a preference for real-world applications of course content, with one stating, *"I understood better when we saw how the theory could be used in real programs."*

Students also offered constructive suggestions for enhancing engagement, including the integration of more interactive content and the provision of optional revision sessions. A recurring positive theme was the clarity and organization of the lectures. As one student shared, *"Having well-organized slides and examples made it easier to follow the material, even when it was complex."* The role of practical exercises was also highlighted: *"The lab sessions helped me understand the concepts better and kept me motivated to attend."*

However, students did not shy away from voicing critical feedback. In the Object-Oriented Programming course, several participants reported initial difficulties with programming tasks, with one noting, *"It was frustrating at first because we weren't sure how to start the assignments."* In the Numerical Methods course, workload was a concern, as one student commented, *"Sometimes it felt like too much was covered too quickly, which made it hard to keep up."*

Across all groups, peer collaboration consistently emerged as a strong motivational factor. One student noted, *"Working in groups made me feel less isolated and more confident to try solving problems."* These qualitative insights deepen our understanding of student motivation by illustrating how specific aspects of course design—such as pacing, structure, interactivity, and peer support—directly influence engagement.

Overall, these reflections reinforce and contextualize the quantitative survey findings. They highlight the importance of aligning instructional strategies with the three core components of Self-Determination Theory: autonomy, competence, and relatedness. Moreover, they underscore the need to consider emotional climate, instructor enthusiasm, real-life applicability, and manageable pacing when designing effective and motivating learning environments.

We systematically recorded the students' responses for further analysis. The study adhered to principles of reliability and credibility, crucial for qualitative research.

We are going to use Self-Determination Theory (SDT) in our study, which is directly related to learning motivation and the design of instructional materials, central themes of this research. According to SDT [10], people are motivated by three basic psychological needs:

- Autonomy: The need to feel in control of one's own behavior and goals. We surveyed students on how much control they feel they have over their learning, particularly in relation to how flexible the course materials are and their ability to make independent decisions. When students feel a sense of autonomy, they are more likely to engage deeply and persist in challenging tasks, which is critical for effective learning.
- Relatedness: The need to feel connected to others and belong to a group. We explored the level of interaction among students through group projects or discussions. Students who report higher interaction and connection tend to have greater motivation and participate more in class. Fostering a sense of belonging creates a supportive learning environment and increases engagement [10].
- Competence: The need to gain mastery and achieve outcomes. Students rated their perception of the difficulty of the course materials and how well they feel equipped to handle the tasks. Research shows that when students feel capable of mastering course content, they are more motivated to exert effort and take on new challenges [11].

To gain a comprehensive understanding of student motivation and perceptions of the learning process, this study employed a mixed-methods approach that combined Likert-scale surveys with group discussions. The Likert-scale surveys quantified students' levels of autonomy, competence, and relatedness based on Self-Determination Theory (SDT) (Table 1), providing structured and comparable data. These SDT principles informed both the course design and the evaluation instruments. Teaching materials were structured to support autonomy by allowing flexibility in assignments and problem-solving approaches; competence by offering gradually increasing challenges and feedback mechanisms; and relatedness through collaborative lab sessions and structured peer interaction. In parallel, group discussions offered a qualitative perspective, giving students the opportunity to elaborate on their experiences, preferences, and challenges in their own words. This combination enabled cross-validation of findings, identification of patterns, and interpretation of survey results within a richer educational context. By integrating both methods, we ensured that statistical insights were grounded in real student narratives, strengthening the validity and depth of our conclusions.

We will analyze SDT factors using descriptive statistics and correlation analysis to understand how they impact overall motivation and learning outcomes. It is expected that students who report higher levels of autonomy, competence, and relatedness will demonstrate stronger academic performance and engagement, which is supported by prior research.

Table 1. Likert-scale for SDT

subject	OS			OOP			NM		
Likert-scale	**Autonomy**	**Competence**	**Relatedness**	**Autonomy**	**Competence**	**Relatedness**	**Autonomy**	**Competence**	**Relatedness**
5	17	15	7	41	29	35	29	30	44
4	10	14	8	28	35	24	13	19	8
3	5	7	11	15	35	20	10	17	12
2	5	1	9	10	0	17	8	1	5
1	0	0	2	5	0	3	9	2	0

The data show that autonomy and competence are generally rated highly by students in the Operating Systems (OS) course, suggesting that they feel a positive sense of control over their learning and confidence in engaging with course materials. However, relatedness scores exhibit more variation, indicating that there may be opportunities to strengthen peer interaction and collaborative learning. Based on this, we hypothesize that students reporting higher levels of autonomy, competence, and relatedness will also demonstrate better academic outcomes, as reflected in their exam performance and active participation during class discussions.

The data for the Object-Oriented Programming (OOP) course show that autonomy and relatedness are rated relatively high by students, indicating that many feel they have control over their learning and experience a fair level of peer connection and support. However, the competence scores display greater variation, with a notable number of students rating their sense of competence as low. This suggests that while students may feel motivated and socially connected, some may struggle with mastering the course content. These findings emphasize the need to offer extra academic guidance and structured learning opportunities to help students strengthen their programming abilities and gain more confidence. As observed in the OS course, we anticipate that students who report higher levels of autonomy, perceived competence, and relatedness will exhibit improved academic performance and a higher degree of engagement throughout the course.

The data for the Numerical Methods (NM) course reveal that relatedness received the highest ratings overall, particularly among students who also reported strong levels of autonomy and competence. This shows that collaboration among peers and a supportive classroom environment are major advantages of the course. However, the wide range in autonomy and competence scores shows that some students may struggle to feel confident in their abilities or in control of their learning experience. The presence of students with low ratings across all three dimensions suggests that targeted support may be needed to boost motivation and engagement for a subset of the cohort. As in the other courses, we hypothesize that higher levels of autonomy, competence, and relatedness are associated with better academic performance and more active participation in problem-solving activities.

Spearman’s rank correlation to explore relationships among autonomy, competence, and relatedness was employed. This method is suitable for small sample sizes and ordinal data. Spearman’s Rho is a statistical measure that tells us how strongly two things are related, based on their rankings rather than their exact values. It indicates whether an increase in one variable is associated with an increase in the other (a positive correlation), a decrease (a negative correlation), or no consistent connection between the two (no correlation).

A Spearman’s rank-order correlation was conducted to examine the relationships between students’ perceived autonomy, competence, and relatedness across three different courses: Operating Systems (OS), Object-Oriented Programming (OOP), and Numerical Methods (NM). In the OS course, the analysis revealed a moderate to strong positive correlation between autonomy and competence ($r_s = 0.89865$), suggesting that students who felt a greater sense of control over their learning also perceived themselves as more capable of managing the course material. Weak positive correlations were observed between autonomy and relatedness ($r_s = 0.24763$) and between competence and relatedness ($r_s = 0.21010$), indicating weaker associations among these dimensions of motivation.

In the OOP course, there was a perfect positive and statistically significant correlation between autonomy and relatedness ($r_s = 1.000$, $p < 0.001$), suggesting that students who felt more autonomous also experienced a stronger sense of connection with their peers. Moreover, there were moderately strong positive relationships between autonomy and competence ($r_s = 0.632$) and between competence and relatedness ($r_s = 0.632$), but these correlations did not reach statistical significance.

In the NM course, a perfect and statistically significant correlation was found between autonomy and competence ($r_s = 1.000$, $p < 0.001$), highlighting a very strong association between students' perceived control over learning and their confidence in handling course material. Strong correlations were also observed between autonomy and relatedness ($r_s = 0.800$) and between competence and relatedness ($r_s = 0.800$), though these, too, did not reach statistical significance.

Overall, these findings emphasize the interrelated nature of the three motivational factors—autonomy, competence, and relatedness—with the most consistent and robust relationships appearing between autonomy and competence across all courses. Although no formal pre-assessment was conducted, some students reported feeling more confident and motivated as the course progressed, indicating perceived growth in autonomy and competence.

3. Results

The discussion will comprise a set of carefully formulated questions, accompanied by the corresponding responses from the students. These responses will undergo thorough statistical analysis, enabling us to derive insightful conclusions regarding the students' learning motivation and overall engagement. Through this analytical approach, we aim to gain a deeper understanding of the factors influencing their academic drive and performance [12, 13].

The initial question addressed in our discussion was, "Are the teaching materials provided adequate for mastering the course content?" To support the learning process, a comprehensive range of resources has been developed, including scripts, practical guides, presentations, videos, and simulations directly related to the lectures. All materials are readily accessible through the Moodle platform and the institution’s e-library system, ensuring students have seamless access to the necessary tools for effective learning.

The second question posed during our discussion was, "Are the exercise materials sufficient for mastering the course content?" In each session, a variety of problems are solved on the board, accompanied by the creation of tables and diagrams to enhance understanding. Additionally, computer-based tasks are performed, where scripts are written and executed to reinforce practical skills. After every three sessions, students are assigned individual homework tasks, which they complete independently and submit via Moodle. This structured approach ensures a balanced integration of theoretical and practical knowledge.

Table 2. Student Responses to Questions on Teaching Materials (Questions 1 and 2)

subject		Yes	No	Not sure
OS	The first question	21 (56.76%)	13 (35.14%)	3 (8.1%)
	The second question	26 (70.27%)	10 (27.03%)	1 (2.7%)
OOP	The first question	55 (55.56%)	36 (36.36%)	8 (8.08%)
	The second question	62 (62.63%)	32 (32.32%)	5 (5.05%)
NM	The first question	35 (50.72%)	19 (27.54%)	15 (21.74%)
	The second question	38 (55.07%)	18 (26.09%)	13 (18.84%)

When comparing the responses from students across the three courses, we can see that in all groups (Table 2), most students responded positively, indicating that the materials supported their learning effectively. The OOP course had the highest percentage of agreement, with 55.56% affirming the adequacy of materials for the first question and 62.63% for the second. Similarly, OS students also reported high levels of satisfaction, with 56.76% agreeing with the first question and 70.27% to the second, indicating strong alignment between materials and learning outcomes.

In contrast, students on the NM course showed slightly lower agreement rates, with 50.72% for the first question and 55.07% for the second. Additionally, NM responses revealed a notably higher proportion of undecided students, with over 20% expressing uncertainty in both questions. This could suggest either variability in how the materials were perceived or gaps in clarity or engagement.

Overall, while most students across all three courses viewed the materials as adequate, variations in uncertainty and disagreement rates, especially in the NM course—highlight the need for tailored improvements in how course content is delivered and supported across different subject areas.

The third question explored how frequently students use Moodle and the university's e-library as part of their study routines. While Moodle provides lesson-specific presentations and supplementary materials, the e-library offers a broader collection of academic resources such as textbooks, scripts, practicums, and curated collections prepared by faculty members. Across all three courses—Operating Systems, Object-Oriented Programming, and Numerical Methods—it was observed that the e-library is rarely used. This pattern appears to reflect a broader preference among students for more visually engaging learning resources. Many students reported favoring videos, interactive tutorials, and visual aids over traditional text-based materials, indicating that multimedia content may better align with their learning styles.

The fourth question was, 'What additional materials do you use, and to what extent?'.

Table 3. Student Responses to Questions on additional Teaching Materials (Question 3 and Question 4)

subject	**OS**					**OOP**					**NM**				
frequency	Every day	Once a week	2-3 times a week	Once a month	Never	Every day	Once a week	2-3 times a week	Once a month	Never	Every day	Once a week	2-3 times a week	Once a month	Never
Moodle	5	15	8	6	3	7	67	15	7	3	11	27	15	11	5
e-library	0	3	11	16	7	13	10	15	56	5	0	14	19	20	16
Images	22	5	3	6	1	29	13	3	11	43	0	0	0	4	65
YouTube videos	25	6	3	1	2	75	14	10	0	0	12	20	7	16	14
E-materials in Macedonian	5	5	10	10	7	44	15	27	13	0	39	15	8	7	0
E-materials in English	3	4	11	9	10	60	19	7	5	8	45	12	8	4	0
Simulation	7	14	4	5	7	45	17	10	25	2	3	6	11	28	21
Presentations	11	11	7	5	3	30	29	13	24	3	35	14	15	5	0
Scientific papers	0	0	5	10	22	0	0	0	0	99	0	0	0	15	54
Tutorials	17	10	7	3	0	80	11	8	0	0	38	13	11	7	0
Free courses	7	9	6	10	5	89	5	5	0	0	0	0	0	0	69

Students across all three courses reported relying on various digital resources to support their learning, with noticeable differences in preference and usage patterns depending on the course content and availability of materials. In the Operating Systems (OS) group, students primarily used YouTube videos (25 students) and images (22 students) to reinforce their understanding of course topics. Tutorials were also utilized, though to a lesser extent (17 students). This suggests that OS students preferred visual and concise explanations to complement theoretical concepts. Students in the Object-Oriented Programming (OOP) group showed a much stronger reliance on online platforms, with 89 students using free courses, 80 using tutorials, and 75 turning into YouTube videos. These high numbers indicate that OOP students often sought external, self-paced, and structured resources, possibly due to the hands-on and technical nature of coding tasks, which benefit from guided practice and diverse problem-solving examples. For the Numerical Methods (NM) group, the preference shifted slightly toward text-based digital resources, with 45 students using e-materials in English and 39 using e-materials in Macedonian. Additionally, 38 students used tutorials, suggesting that while visual support is still valuable, written and formula-based content remains crucial for understanding numerical algorithms and mathematical procedures.

These findings highlight that while video and tutorial-based learning is common across all groups, the degree and type of digital resource usage vary by subject. Programming-oriented courses like OOP tend to drive students toward more interactive and comprehensive platforms, whereas courses like NM still benefit from language-specific and written resources. This underscores the need for course-specific digital support strategies in hybrid or self-directed learning environments.

While the course design primarily followed the principles of Self-Determination Theory (SDT), To better engage a diverse student population, the course design intentionally incorporated multiple learning styles based on the VARK model (Visual, Auditory, Reading/Writing, and Kinesthetic). Visual learners benefited from presentations with diagrams, charts, and code annotations, while auditory learners engaged with video explanations and recorded lectures. Reading/writing-preference students accessed detailed written instructions, textbooks, and slides, and kinesthetic learners were supported through hands-on lab sessions, practical assignments, and problem-based learning activities. By offering this variety, the instructional design aimed to provide multiple entry points for student engagement, allowing learners to choose the formats that best matched their preferences. Feedback from group discussions indicated that students appreciated the flexibility and felt more motivated when materials aligned with their preferred learning style. For example, several students noted that interactive coding tasks and step-by-step video tutorials helped them grasp complex concepts more effectively than traditional lectures alone.

The penultimate question was: “What is your preferred learning style?” [14].

- Visual: Learning through images, diagrams, and visual aids.
- Auditory: Learning through listening, such as lectures or discussions.
- Reading/Writing: Learning through reading texts and taking notes.
- Kinesthetic: Learning through hands-on activities and physical movement.

Table 4. Student Responses to Questions “What is your preferred learning style?”

subject	**OS**				**OOP**				**NM**			
The fifth question	Frequency	Percentage	Valid Percentage	Cumulative Percentage	Frequency	Percentage	Valid Percentage	Cumulative Percentage	Frequency	Percentage	Valid Percentage	Cumulative Percentage
Visual	17	45.94	45.94	45.94	39	39.40	39.40	39.40	11	15.94	15.94	15.94
Auditory	13	35.14	35.14	81.08	14	14.14	14.14	53.54	19	27.54	27.54	43.48
Reading/ Writing	7	18.92	18.92	100	46	46.46	46.46	100	39	56.52	56.52	100
Kinesthetic	0	0	0	100	0	0	0	100	0	0	0	100
in total	37	100	100		99	100	100		69	100	100	

Most OS students (45.94%) prefer a visual learning style, highlighting the importance of incorporating images and visual aids into the curriculum. A significant portion (35.14%) are auditory learners, suggesting that lectures and discussions also play a valuable role. A smaller group (18.92%) favors reading and writing, while none indicated a preference for kinesthetic learning. This distribution suggests a need for teaching strategies that prioritize visual and auditory methods to boost engagement and learning outcomes. In the OOP course, many students (46.46%) prefer reading and writing, indicating that well-structured texts, notes, and documentation are vital to their learning. Visual learners make up a substantial portion (39.40%), reinforcing the importance of diagrams, visual demonstrations, and annotated examples. A smaller group (14.14%) prefers auditory input, while again, no students selected kinesthetic learning. These findings suggest that a combined focus on text-based and visual strategies is most effective for OOP students. Similarly, NM students show a strong preference for reading and writing (56.52%), underlining the value of structured manuals, worked examples, and written explanations. Visual learners comprise 27.54% of the group, and 15.94% prefer auditory methods. No kinesthetic learners were identified. As with OOP, these results point to the effectiveness of combining text-based instruction with supportive visual materials. Overall, the consistent absence of kinesthetic preferences and the strong inclination toward visual and written learning across all three groups suggest that hybrid teaching strategies should prioritize clear texts, structured notes, and visual aids. Incorporating lectures and discussions as a supplement can further support auditory learners, ensuring inclusive and effective learning environments.

The final question was “Whether hybrid learning is more effective than traditional learning.”.

Hybrid learning is often considered better because it combines the flexibility of online learning with the structure of in-person classes. This allows students to access materials at their own pace while still benefiting from face-to-face interactions. Additionally, hybrid learning can accommodate different learning styles, offering a mix of visual, auditory, and hands-on activities. It also provides greater accessibility and convenience, making it easier for students to balance their studies with other responsibilities. Certain students who expressed interest were given material to study on their own and presented in the following classes. Many students did not agree to study on their own and showed a certain level of reluctance toward this type of learning.

Table 5. Student Responses to Questions "Whether hybrid learning is more effective than traditional learning."

subject	OS				OOP				NM			
The sixth question	Frequency	Percentage	Valid Percentage	Cumulative Percentage	Frequency	Percentage	Valid Percentage	Cumulative Percentage	Frequency	Percentage	Valid Percentage	Cumulative Percentage
Yes	21	56.76	56.76	56.76	50	50.5	50.5	50.5	20	28.99	28.99	28.99
No	13	35.14	35.14	91.9	35	35.36	35.36	85.86	30	43.48	43.48	72.47
Not sure	3	8.1	8.1	100	14	14.14	14.14	100	19	27.53	27.53	100
in total	37	100	100		99	100	100		69	100	100	

Across the three courses—Operating Systems (OS), Object-Oriented Programming (OOP), and Numerical Methods (NM)—student preferences for hybrid and traditional learning models varied, yet several common patterns emerged. In both the OS and OOP courses, over half of the students (56.76% and 50.5%, respectively) expressed a preference for hybrid learning, indicating a broadly positive perception of the flexibility and accessibility offered by blended formats. This suggests that for courses where materials can be effectively supplemented with digital resources, hybrid models are well-received. At the same time, around one-third of students in both OS (35.14%) and OOP (35.36%) favored traditional face-to-face instruction, highlighting the ongoing importance of structured classroom environments, instructor presence, and in-person interaction. A small percentage of students—8.1% in OS and 14.14% in OOP—remained undecided, which points to mixed experiences and suggests that more individualized support or clearer expectations in hybrid setups might be needed.

In contrast, students in the NM course demonstrated a stronger inclination toward traditional learning, with 43.48% favoring it over hybrid formats. Only 28.99% favored hybrid learning, and a notably larger share, 27.53%—remained uncertain. This trend may reflect the technical complexity of the course content, which students may feel is better addressed through consistent in-person instruction and immediate support. Overall, while hybrid learning was favored in OS and OOP, NM students showed more hesitation, emphasizing that subject matter complexity and learning style compatibility play a critical role in students' preferences. These findings suggest that hybrid learning should not be implemented as a one-size-fits-all solution; rather, it should be adapted to the specific pedagogical needs of each course and the characteristics of its students.

Table 6. Male/female learning method preferences

	OS		OOP		NM	
Learning method preferences	Male	Female	Male	Female	Male	Female
Visual	9	8	29	10	6	5
Auditory	6	7	11	3	14	5
Reading/Writing	2	5	28	18	24	15
Kinesthetic	0	0	0	0	0	0

Because the data doesn't appear to show a symmetric distribution, and the sample size is relatively small, the Mann-Whitney U test, a non-parametric alternative to the t-test, is appropriate for this analysis. The hypotheses are as follows:

- Null Hypothesis (H_0): There is no difference in learning method preferences between male and female students ($\mu_0 = \mu_1$).
- Alternative Hypothesis (H_1): There is a difference in learning method preferences between male and female students ($\mu_0 \neq \mu_1$).

The result of the Mann-Whitney U test for OS is as follows:

- U-statistic: 140
- p-value: 0.36812

The U-statistics of 140 represents the test statistic generated by the Mann-Whitney U test, comparing the ranks of learning method preferences between the two groups students. Since the p-value 0.36812 is greater than the significance level of 0.05, meaning we fail to reject the null hypothesis. This suggests that there is no statistically significant difference in learning method preferences between male and female students.

The result of the Mann-Whitney U test for OOP is as follows:

- U-statistic: 887.5
- p-value: 0.2113

For the Object-Oriented Programming (OOP) course, the Mann-Whitney U test produced a U-statistic of 887.5 and a p-value of 0.2113. Again, since the p-value exceeds 0.05, we fail to reject the null hypothesis. This indicates that there is no statistically significant difference in learning method preferences between male and female students in the OOP course. The result suggests that gender does not significantly affect learning preferences for this course either.

The result of the Mann-Whitney U test for NM is as follows:

- U-statistic: 540
- p-value: 0.90448

In the case of the Numerical Methods (NM) course, the Mann-Whitney U test results show a U-statistic of 540 and a p-value of 0.90448. Since the p-value is much greater than 0.05, we fail to reject the null hypothesis. This means there is no statistically significant difference in the learning method preferences between male and female students in the NM course. The result reinforces the idea that gender does not influence the preferred learning methods for this subject.

4. Discussion

The literature on student motivation in higher education has identified several key factors that influence engagement, including intrinsic and extrinsic motivators, the relevance of learning materials, and teaching methodologies that cater to diverse learning styles. Recent studies have emphasized the positive impact of digital resources and multimedia on student engagement. Furthermore, the integration of technology in education, such as hybrid learning environments, has shown promising effects on motivation and learning outcomes [15]. These findings provide a theoretical foundation for examining how various factors, including digital resource use and learning preferences, impact student motivation in engineering education.

Our study shows a clear preference among students for audiovisual content, particularly YouTube videos and tutorials, with a majority accessing these materials daily or weekly. Images and presentations are also popular but used less consistently. Simulations and free online courses have moderate engagement levels, while scientific papers are the least utilized, indicating a preference for resources that may be perceived as more accessible or engaging. This trend aligns with the concept of competence in SDT, as audiovisual content could enhance students' confidence in understanding complex topics.

Additionally, in all three courses (OS, OOP, and NM), the Mann-Whitney U test results indicate that there is no statistically significant difference in the learning method preferences between male and female students. The p-values for each course (OS: 0.36812, OOP: 0.2113, NM: 0.90448) are all greater than the typical significance threshold of 0.05, suggesting that gender does not play a significant role in determining preferences in any of these courses for hybrid versus traditional learning approaches. While educational psychology often explores potential gender-based differences in learning styles, the results of this study indicate that both groups may have similar preferences. This insight can help educators focus on more universal strategies for enhancing student engagement and motivation, rather than tailoring instructional materials based on gender differences.

In summary, our findings support the use of hybrid and multimedia resources to foster motivation in engineering education. By prioritizing accessible and varied content that aligns with students' autonomy and competence needs, instructors can help create a more inclusive and effective learning environment.

4.1. Limitations and Researcher Bias

As the study is based primarily on self-reported data through surveys and discussions, there is a risk of bias due to students' personal perceptions or the tendency to respond in socially acceptable ways. Although a formal control group was not included, the addition of student groups from different courses with varied instructional designs allowed for a broader comparison of student motivation and engagement.

This study is subject to several limitations. First, discussion-based data collection was conducted in the presence of the professor, which may have influenced students' responses due to social desirability bias—some students might have been reluctant to express negative opinions about the teaching materials or methods. Additionally, the study did not include a pre-assessment of student motivation or academic performance before the teaching interventions were implemented. This makes it difficult to definitively attribute the observed outcomes to the instructional strategies used. Another limitation is the involvement of the course professor as both the instructor and a researcher, which introduces the potential for confirmation bias in interpreting student feedback. Furthermore, students' motivation levels may have been influenced by the professor's individual teaching style, which was not systematically compared to other instructors or courses. To address these issues, future research should include multiple courses and instructors, use independent evaluators, and implement anonymous data collection methods. Pre- and post-assessments should also be incorporated to more accurately measure changes in motivation and learning outcomes over time.

4.2. Challenges in Hybrid Learning Environments

While students generally expressed a preference for hybrid learning due to its flexibility and access to diverse resources, several challenges emerged from group discussions and open-ended comments. Several students reported difficulties related to technology access, such as unreliable internet connections or outdated devices, which sometimes hindered their ability to participate fully in online components. Others mentioned struggling with self-paced learning, citing issues like procrastination, lack of structure, and difficulty staying motivated without real-time instructor interaction. For some students, navigating multiple platforms (e.g., Moodle, e-library, and external tools) was confusing or overwhelming. These findings suggest that while hybrid learning has clear advantages, effective implementation requires additional support mechanisms—such as digital literacy training, consistent platform use, and structured timelines—to ensure that all students can benefit equally.

5. Conclusion

The research was conducted in response to the observation that new generations of students often arrive at university underprepared, with limited prior knowledge and declining motivation. Through student discussions and surveys, this study sought to identify strategies to make the learning process more accessible and motivating. While some students show little interest in academic commitment and resort to dishonest behaviors, others remain eager to learn and invest time in their studies, ultimately aiming for personal growth and a better future.

Findings suggest that traditional written materials may no longer effectively engage today's learners. Instead, students increasingly favor interactive and visually engaging resources, such as videos, diagrams, and online tutorials. This shift underscores the need for educational strategies that reflect evolving learning preferences. Hybrid learning, which combines online flexibility with the structure of in-person instruction, emerges as a promising model.

To enhance hybrid learning, future instructional design should consider the following concrete recommendations:

- **Incorporate multimedia resources** (videos, simulations, interactive exercises) into core content delivery to appeal to visual and auditory learners.
- **Structure online modules with self-paced activities** and immediate feedback to build a sense of autonomy and competence.
- **Use in-person sessions for collaborative activities**, peer discussions, and guided problem-solving to foster relatedness and engagement.
- **Implement regular low-stakes assessments**, both online and in-person, to help students track their progress and reduce anxiety associated with high-stakes exams.
- **Provide optional revision sessions and targeted support**, especially for students who need additional help with foundational concepts.

To meet student needs through traditional methods, educators should maintain clarity in course structure, ensure access to well-organized materials (e.g., slides and notes), and reinforce core theoretical knowledge through consistent classroom instruction. Blending these with modern approaches can cater to a wider range of learning styles.

Finally, the use of Self-Determination Theory in this study highlights the importance of promoting student autonomy, competence, and relatedness in course design. Future research should employ more robust methods—such as pre- and post-assessments, classroom observations, and independent evaluations—to provide a clearer picture of how instructional strategies affect motivation and performance over time.

References

[1] Van den Beemt, A., MacLeod, M., Van der Veen, J., Van de Ven, A., Van Baalen, S., Klaassen, R., & Boon, M. (2020). Interdisciplinary engineering education: A review of vision, teaching, and support. Journal of Engineering Education, 109(3), 508-555. https://doi.org/10.1002/jee.20347

[2] Askin, A. (2002). Pre-service Teachers' Use of Technology to Create Instructional Materials: a school-college partnership. Journal of Information Technology for Teacher Education, 11(2), 217-232. https://doi.org/10.1080/14759390200200133

[3] Hamroev, A. R. (2019). Modeling activities of teachers when designing creative activities of students. European Journal of Research and Reflection in Educational Sciences.

[4] Litzinger, T., Lattuca, L. R., Hadgraft, R., & Newstetter, W. (2011). Engineering education and the development of expertise. Journal of Engineering Education, 100(1), 123-150. https://doi.org/10.1002/j.2168-9830.2011.tb00006.x

[5] Litzinger, T. A., Wise, J. C., & Lee, S. H. (2011). Effects of a web-based learning environment on student motivation in engineering. Journal of Engineering Education, 100(3), 501-515. https://doi.org/10.1002/j.2168-9830.2011.tb00058.x

[6] Mentzer, N., & Becker, K. (2009). Motivation while designing in engineering and technology education impacted by academic preparation. Journal of STEM Teacher Education, 46(3), 7.

[7] Terrón-López, M. J., García-García, M. J., Velasco-Quintana, P. J., Ocampo, J., Vigil Montaño, M. R., & Gaya-López, M. C. (2017). Implementation of a project-based engineering school: increasing student motivation and relevant learning. European Journal of Engineering Education, 42(6), 618-631. https://doi.org/10.1080/03043797.2016.1209462

[8] Terrón-López, M., Gutiérrez-Castillo, J. J., & Bermejo-Toro, L. (2017). Self-regulated learning in higher education: Its influence on academic performance. Journal of Educational Psychology, 109(5), 731-745. https://doi.org/10.1037/edu0000133
[9] Kocaleva, M., Karamazova Gelova, E., & Sofijanova, E. (2024). The importance of students' meaning in the process of creating teaching materials. Southeast European Journal of Sustainable Development, 8(3), 47-51.
[10] Ryan, R. M., & Deci, E. L. (2000). Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. American Psychologist, 55(1), 68. https://doi.org/10.1037/0003-066X.55.1.68
[11] Schunk, D. H., Pintrich, P. R., & Meece, J. L. (2014). Motivation in education: Theory, research, and applications.
[12] Karamazova Gelova, E., Kocaleva, M., & Milanova, B. (2023). The role of ICT tools in teaching mathematics. Southeast European Journal of Sustainable Development, 7(1), 1-7.
[13] Kocaleva, M., Karamazova Gelova, E., Zlatev, Z., & Zlatanovska, B. (2024). Students' Attitude Towards Learning of Fundamentals of Electrical Engineering and Their Professors. TEM Journal, 13(3), 2046-2053. https://doi.org/10.18421/tem133-32
[14] Stojanova, A., Stojkovikj, N., Kocaleva, M., Zlatanovska, B., & Martinovska-Bande, C. (2017, April). Application of VARK learning model on "Data Structures and Algorithms" course. In 2017 IEEE Global Engineering Education Conference (EDUCON) (pp. 613-620). IEEE. https://doi.org/10.1109/educon.2017.7942909
[15] Garrison, D. R., & Kanuka, H. (2004). Blended learning: Uncovering its transformative potential in higher education. The Internet and Higher Education, 7(2), 95-105. https://doi.org/10.1016/j.iheduc.2004.02.001

Authors' Profiles

Mirjana Kocaleva Vitanova is an Assistant Professor at Faculty of Computer Science, Goce Delcev University, Stip. She received her Ph.D. in technical sciences in the field of computer science at Faculty of Computer Science, Goce Delcev University, Stip in 2021. Her research interests include applied mathematics, computer science and mathematical education, information systems and technologies and data structure and algorithms. She has been participating in several local and COST projects and she is author or coauthor on over 100 papers in domestic regional and international journals and conferences.

Elena Karamazova Gelova is an Associate Professor at Faculty of Computer Science at Goce Delcev University, Stip. Elena received her PhD in field mathematics, area Complex analysis - Theory of univalent (multivalent) function at Faculty of Natural Sciences and Mathematics, Ss. Cyril and Methodius University, Skopje in 2017. Her research work includes complex analysis, applied mathematics and education. She is an author of many papers published in international journals and conference proceedings.

Biljana Zlatanovska is a Full Professor at Faculty of Computer Science, Goce Delcev University, Stip. She received her Ph.D. in Mathematical Sciences of Natural Sciences and Mathematics, Ss. Cyril and Methodius University, Skopje in 2014. Her research interests include pure and applied mathematics, mathematical modelling, and mathematical education. She is an author of many papers published in international journals and conference proceedings.

Marija Miteva is an Associate Professor at Faculty of Computer Science, Goce Delcev University, Stip. She received her Ph.D. in Mathematical Sciences and Applications at Faculty of Natural Sciences and Mathematics, Ss. Cyril and Methodius University, Skopje in 2017. Her research interests include pure and applied mathematics, mathematical modelling, and mathematical education. She is an author of many papers published in international journals and conference proceedings.

How to cite this paper: Mirjana Kocaleva Vitanova, Elena Karamazova Gelova, Biljana Zlatanovska, Marija Miteva, "Challenges in Engineering Education: Addressing Student Motivation", International Journal of Modern Education and Computer Science(IJMECS), Vol.18, No.1, pp. 93-103, 2026. DOI:10.5815/ijmecs.2026.01.06