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Research Article

ICT-Based Blended Learning in the Information Age: An Approach for Enhanced Learning Motivation

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Abstract: Blended Learning (BL) learning has emerged as a transformative approach in higher education, combining traditional face-to-face instruction with the advantages of online learning to enhance the educational process. BL has recently relied on Information and Communication Technology (ICT) to facilitate its implementation and usefulness. This study relies on Self-Determination Theory (SDT) to demonstrate the potential of ICT-based BL to support students' motivation and whether gender and academic level can influence that relationship particularly in the context of Jordanian universities. We applied a descriptive survey design and utilized a valid questionnaire to collect data samples randomly from undergraduate and graduate students in a private university in Jordan. Based on the data statistical analyses, it was revealed that ICT-based BL learning provides students with significant motivation in terms of flexibility, improved technological skills, and bridging theories to real-world applications in practice. The results also revealed that there were no statistically significant differences in motivation from the students' perspectives when considering gender or academic level, which suggests that ICT-based BL presents a universally engaging educational structure for diverse student demographics. The findings of this study suggest that ICT-based BL may facilitate varied learning preferences and reduce educational barriers. ICT-based BL, through the integration of interactive content and facilitation of self-regulated learning, provides a robust platform for academic achievement. More investment is needed to develop the ICT infrastructure in higher education in Jordan, as well as training to develop the capabilities to address some of the challenges with using ICT-based BL. This study provides evidential information about the motivating benefits of ICT-based BL and investigates its inclusive nature in multiple disciplines and educational contexts to maximize its potential and usage.

Keywords: Self-Determination Theory, Information and Communication Technology, Blended Learning, Learning Motivation, Higher Education, Jordanian Universities, Gender Differences, Academic Level

Introduction

Blended Learning (BL) has only recently, emerged to be the most used approach to deliver educational content in educational institutions, particularly in higher education (Porter *et al*., 2014).

Face-to-face teaching was prevalent before the COVID-19 pandemic, but it poses several challenges such as effective face-to-face engagement and individual differences between students.

However, when the pandemic struck, institutions had no choice but to shift the learning process online, which brought several issues i.e. technological infrastructure, and authentic evaluation methods (Alqahtani and Rajkhan, 2020; Rajab *et al*., 2020). As the pandemic goes down, educational institutes have begun adopting BL as a new teaching approach to transfer knowledge and skills to their students. BL enhances communication among learners and their teachers, and enhances students' self-regulation with greater responsibility for their academic

success (Eggers *et al*., 2021). Furthermore**,** BL can improve students' achievement compared to those taught through traditional methods (Porter *et al*., 2014). BL also can reduce dropout rates and an improvement in students' attitudes toward learning (Bervell and Umar, 2020).

BL relies heavily on Information and Communication Technology (ICT) to facilitate its implementation. Common ICT platforms, such as WhatsApp, Microsoft Teams, Google Classrooms, and learning management systems (LMS) use video conferencing and discussion forums, fostering student collaboration and supporting personalized learning by tailoring educational content and assessments to individual students' needs. Indeed, ICT enhances the flexibility of BL by providing efficient access to resources and bridging gaps in education during global challenges i.e. COVID-19 pandemic. This integration - referred to in this study as ICT-based blended learning - provides a far richer and much more interactive learning experience that aligns with contemporary educational needs (Graham, 2015; Means *et al*., 2010; Stefan, 2019). ICT-based blended learning is a learning model that combines innovative ICT and technological progress of online learning together with the interaction and participation of traditional learning, providing customized learning experiences mapped to individual learner needs (Throne, 2003). As ICT-based BL uses both conventional in-person teaching and online learning approaches, it provides the opportunity for the learner to use ICT technologies and modern computing environments, and in addition to their interaction with peers and teachers in face-to-face learning as well (Sulisworo, 2018).

However, challenges that impede BL's success are a lack of understanding of effective integration, attitudes of the students and teachers to innovations, and lack of technology infrastructure (Sareen and Mandal, 2024). Even though ICT-based BL approach may have the potential to provide a promising learning approach to modern educational environments which bridges the gap between traditional teaching and digital technological platforms and tools, there are extensive challenges which need to be carefully addressed to maximize the potential of this model of teaching. It will be necessary for higher education institutions to maintain a continuous investment in improving the digital infrastructure and providing continuous training sessions for educators in order to increase the use of BL in higher education (Lothridge *et al*., 2013; Alhindawi, 2023).

We usually combine the strengths of both traditional and online learning when deploying ICT-based BL. This educational approach has been adapted just recently by most of the Jordanian universities after the pandemic, and as a requirement by the government regulations. However, such double-environment learning has presented considerable significant challenges to maintain students' motivation to learn (Alkhawaja and Halim, 2019). This evident challenge has resulted in a growing interest in blended learning research for the purpose of developing more engaging and effective learning solutions (van der Rijst *et al*., 2023). For example, research suggests that blended learning can enhance student motivation more effectively compared to traditional approaches by correctly integrating multimedia, interactive content, and flexible learning opportunities (Junard, 2024; Singh, 2024). However, there is a need to investigate the specific impact of ICT-based BL within the context of Jordanian universities. While global studies indicate that BL can enhance students' motivation, there is a lack of focused research on how gender and academic level differences play a role in such interactive environments, specifically within Jordanian universities. It is vital to explore these distinctions to properly employ instructional strategies that can effectively accommodate learning experiences according to gender (i.e., male vs female) and academic levels (i.e., graduate vs undergraguate) (Gulnaz *et al*., 2020; Hagos and Andargie, 2022).

Furthermore, as Jordanian higher education institutions are embracing ICT technologies in their own educational systems, it is necessary for these institutions to investigate how these technologies have affected their students' motivation (Alassaf, 2014; Gasaymeh *et al*., 2017). Thus, our primary goal in this study is to close the existing gaps in the literature and provide educators and educational institutions with some insights that can improve their students' motivation and educational quality, through the meaningful incorporation and utilization of ICT-based BL.

Thus, this study aims to determine the role of ICT-based BL in enhancing students' learning motivation and to assess whether there are statistically significant differences in the impact of ICT-based BL learning on students' learning motivation based on gender and academic level i.e. graduate and undergraduate students (Al-Adwan and Smedley, 2012). To explore these aims, the study is guided by the following research questions:

1. What is the role of ICT-based BL in enhancing students' learning motivation?
2. Are there statistically significant differences in the impact of ICT-based BL on students' learning motivation based on gender and academic level?

This study provides significant contributions in the field of information and educational technology research and practice by exploring the role of ICT-based BL in enhancing the motivation of students within the context of Jordanian universities. By addressing gaps in the literature, especially the limited research on gender and academic level effects, this study provides valuable insights into how such an innovative approach impacts diverse student demographics. The findings contribute to the theoretical understanding of BL as an inclusive and

effective pedagogical model. Practically, the study highlights the importance of ICT-based BL in fostering student engagement, self-regulation, and academic success. It provides applicable recommendations for educators and administrators, emphasizing the need for strategic investments in technological infrastructure, teacher training, and resource development to maximize the benefits of BL. By advancing both theoretical and practical knowledge, this research serves as a foundation for future research aiming to optimize BL strategies and assess their impact across various educational disciplines.

Background and Literature

Self-Determination Theory

The theoretical framework adopted in this study is based on Self-Determination Theory (SDT) (Deci and Ryan, 2000). SDT suggests that human motivation is driven by the ability to achieve autonomy, competence, and relatedness, psychological needs for individuals. That is, autonomy represents human need for self-governance, competence addresses human need for effective feeling, and relatedness represents human need to be connected with others. According to SDT, intrinsic motivation arises when these needs are met, whereas extrinsic motivation is influenced by external rewards or pressures. There is evidence that when individuals experience autonomy in their learning, have opportunities to develop competence, and feel socially connected, they exhibit higher engagement and persistence (Deci *et al*., 1991). In educational settings, SDT has been widely applied to improve student motivation and learning outcomes by designing environments that support these psychological needs (Niemiec and Ryan, 2009). Additionally, several strategies have been explored and used to enhance motivation by incorporating technologies that satisfy SDT's core needs, ultimately fostering greater engagement and learning effectiveness (Chen *et al*., 2015). Indeed, leveraging SDT principles in the educational process design can lead to a more motivating learning experience.

SDT is adopted in the context of an ICT-based BL environment due to its flexibility and personalized learning nature which can enhance students' sense of autonomy and competence. We truly believe that the integration of multimedia elements along with emerging technology tools will probably help students in developing their essential skills, but allows for more autonomy in their learning process, which further increases their motivation. With this in mind, the development of the study's instrument was guided by SDT, and the survey items were aligned to students' perceptions of autonomy, competence, and relatedness, in order to develop a strong student learning motivation measurement.

ICT and Blended Learning

ICT-based BL has been widely adopted recently as the dominant learning model in educational institutions (Rashevska and Kiianovska, 2023; Ricardo-Barreto *et al*., 2020). ICT-based BL represents a transformation to learner-centered learning that can respond to any emerging need. Researchers have shown that ICT-based BL can also help students to gain higher-ordered thinking skills and develop understanding for their educational materials (Wainwright, 2011). Additionally, the implementation of AI tools has further personalized the learning process which helps to identify the weaknesses and strengths among learners so that they can address them accordingly (Huang *et al*., 2023). Furthermore, other researchers have also demonstrated that this learning model degrades infrastructure requirements while maintaining the quality of teaching (Lothridge *et al*., 2013). The reason ICT-based BL is popular is because it offers flexibility of time and place, high accessibility to educational materials, personalized fit with learning preferences and individual differences by meeting various learning styles (Min and Yu, 2023). Ultimately, through integrating emerging multimedia and ICT, blended learning can also enhance learners' engagement and attentional shift to the completion of learning requirements efficiently, as well as improve the quality of personalized learning outcomes significantly (Huang *et al*., 2023; Roopa and Rajesh Kanna, 2024).

The benefits of BL and its effect on both intrinsic and extrinsic motivation factors have been the subject of many researches (Ryan and Deci, 2000). Wong *et al*. (2020) conducted a quasi-experimental study for secondary students and found that the BL positively affected both the autonomy and student motivation of the students without significant differences in their academic achievements**.** Other Researchers have pointed out several contextual variables that were closely related to students' motivational behaviors, such as satisfaction, learning style preference, and instructional approaches. For example, (Oweis, 2018; Qindah, 2013) suggest that the integration of well-designed educational tasks in BL helps provide engaging and personalized learning which fosters motivation among students.

Furthermore, an analysis performed by Aladwan *et al*. (2018) demonstrated that BL positively impacts student attitudes and engagement across diverse educational and cultural contexts. Alamri (2022) found that personalized learning activities in online higher education supported students' psychological needs and enhanced their intrinsic motivation. Graduate students reported that online tasks] were engaging and effectively met their individual learning needs. Furthermore, (Sulisworo, 2018) concluded that BL helps enhance motivation and engagement among students due to the integration of technology into student teaching. Moreover, it is understood that students' motivational domain learning can be affected by the teacher, the arrangement of the classroom, the content taught, the educational resources

available, and the differences between the learners themselves (Bulic and Blazevic, 2020).

Gender differences in BL environments have gained additional attention in recent BL and motivation research (Hagos and Andargie, 2022; Zhao *et al*., 2023). The study of Ajlouni *et al*. (2022) pointed out there is a significant difference between female and male students regarding learning motivation toward online learning. The results suggest female students are more intrinsically motivated in online learning settings. Additionally, female students have demonstrated more acceptability for such type of learning compared to their male colleagues, suggesting that BL might be more accepted by female students (González-Gómez *et al*., 2012; Gulnaz *et al*., 2020). However, other studies, (Padilla-Meléndez *et al.,* 2013), argue that male students may exhibit enhanced motivation in the BL environment, especially when gamified elements have been employed, and other studies found no significant differences between male and female students' motivation in technology-integrated online learning (Hagos and Andargie, 2022). Consequently, academic level differences in BL environments have gained little attention in BL and motivation research. For example, (Artino and Stephens, 2009) compared undergraduate and graduate students' motivational beliefs and revealed higher levels of critical thinking by graduate students, compared to greater intentions to participate in online courses by undergraduate students. Coa (2012) suggested that graduate students were motivated more than others due to their advanced skills and educational abilities.

However, the ability of ICT-based BL to incorporate gamification elements, multimedia materials, and AI capabilities make this learning environment as interactive, personalized, and more engaging environment. For instance, animated presentations help simplify complex materials and better support visual learners (Putri and Apriza, 2024).

Instant feedback and recognition of achievement facilitated by employing gamification elements, like points and challenges, can help enhance students' motivation (Husain *et al*., 2023). AI tools can modify content in real time based on students' performance, thereby enhancing autonomy and perceived competence, which are both key motivations in SDT. These aspects can help improve student satisfaction and sustain their engagement in educational settings (Chiu *et al*., 2023).

In summary, blended learning has displayed vast possibilities for enhancing student motivation. Consequently, the combined aspects of content and process in learning make blended learning an exceptionally motivating learning-teaching method. The ability of ICT-based blended learning to adjust to the diverse students' preferences and deal with motivational disparities based on gender can offer a promising solution to tackle various educational challenges. However, understanding how it impacts motivation across academic levels and genders within specific contexts like Jordanian universities remains a gap in the literature that needs to be addressed. Addressing such gaps can provide valuable insights into optimizing the BL educational approach to increase students' motivation.

Materials and Methods

Research Design

A descriptive survey design was employed in this study, which is widely recognized for its suitability for studying relationships among educational variables and the influence of educational interventions. In this regard, a questionnaire was used for collecting data to examine the role of ICT-based BL, and its differentiated effects by gender and academic levels. An examination of whether there were statistically significant differences in students' motivation based on gender and academic standing was also conducted. The analysis was performed based on means and standard deviations to examine the role of BL in enhancing students' motivation, and a Two-way ANOVA assessed whether there were statistically significant differences in students' motivation, based on gender and academic levels.

Sample

The sample of this study is selected from a total population of 520 Jordanian graduate and undergraduate IT students using simple random sampling method, in order to have a representative sample and minimize selection bias. Among the total population, and to ensure accessibility and voluntary participation, 210 convenience sample were selected from graduate and undergraduate ICT students from a private University in Jordan during the 2022-2023 academic year. This selection was performed based on several factors, including accessibility, feasibility, and the institution's representativeness of similar universities in Jordan. The chosen university provides a diverse student body and academic environment that aligns with the objectives in this study, which make it appropriate for analysis. Moreover, logistical constraints, such as administrative approvals and data availability, influenced the selection decision to focus on one institution. Prior studies have also employed single-institution samples to explore educational and behavioral trends, demonstrating that such an approach can yield meaningful insights (Smith *et al*., 2022).

The selected students voluntarily filled out the research questionnaire that has been validated and sought to establish how ICT-based BL influenced their learning motivation. The questionnaire was validated by 10 expert lecturers in Information and Educational

Technology. Their feedback significantly contributes into enhancing the questionnaire's reliability, clarity, and validity. The Distribution of sample members in this study is presented in Table 1.

The demographic diversity is reflected by the gender and academic level distribution among the study sample to provide valuable insights into how ICT-based BL affects different environmental settings. Female participants in the gender distribution are dominant indicating that female enrollment is generally higher in the selected population. Several studies have also observed similar gender distributions in educational settings, particularly in fields where female participation is more prominent (Smith *et al*., 2022). This situation helps understand gender dynamics within this educational context.

Instrument

We designed a questionnaire tool to collect data samples for this study, which will quantitatively measure the impact of ICT-based BL on students' motivation. The questionnaire is developed based on widely known theory from the literature and based on the past research (Zhao, 2012; Keshavarz and Hulus, 2019; Zhafirah *et al*., 2020). We divided the quantitative instrument into two sections. Section one contained questions on gender and academic levels. The data collected by these items data will be used to assess and compare changes in motivation. Section two contained twenty items using a five-point Likert Scale (1: Strongly Disagree; 5: Strongly Agree). We used the collected samples from these items to compare students' impressions and declines in relation to the effects of ICT-based BL on students' motivation. In the design of the questionnaire, we ensured that there was equitable balance in the factors, both intrinsic and extrinsic motivation, to better address the research objectives.

The development of the study's instrument is guided by SDT in such a way that it maps the survey items to students' perceptions regarding autonomy (e.g., the degree of choice and flexibility in their learning activities), competence (e.g., feelings of effectiveness in completing tasks), and relatedness (e.g., the sense of connection with instructors and peers). This procedure help ensure that the student learning motivation can be measured firmly and grounded in a robust theoretical framework, moving beyond mere descriptive analysis.

Construct Validity

To establish the construct validity of the questionnaire, a pilot test was performed using 25 student sample from the same population. A correlation analysis was conducted to determine the coefficients that link each item to the total students' motivation score. The Cronbach's Alpha Coefficients showed that the correlation of the items was significant as it varied between 0.54 and 0.91 with the overall motivation as shown in Table 2.

Table 1: Distribution of sample members according to gender and academic level

Variable	Group	Frequency	Percent
Academic Level	Undergraduate	117	55.7
	Graduate	93	44.3
	Total	210	100.0
Gender	Male	34	16.2
	Female	176	83.8
	Total	210	100.0

Table 2: Correlation Coefficients between the Items and the Total Motivation Score

Item	correlation coefficients	Item	correlation coefficients
1	.90**	11	.81**
2	.84**	12	.75**
3	.70**	13	.80**
4	.91**	14	.83**
5	.72**	15	.54*
6	.90**	16	.90**
7	.92**	17	.80**
8	.91**	18	.74**
9	.83**	19	.84**
10	.82**	20	.77**

**Significant at 0.05 level.* **Significant at 0.01 level

That is to say, it can be noted that all the correlation coefficients were expected and significant, for that indeed none of the scale items have been deleted.

Instrument Reliability

The reliability of the questionnaires was established using a test-retest approach with the same validation sample (25 students) over two weeks. The results of the two tests were hence compared through the use of Pearson's correlation which had a value of 0.88. Also, a reliability test was conducted using Cronbach Alpha on the entire questionnaire to determine internal consistency and the test yielded a 0.85 alpha. These reliabilities suggest that the present questionnaire is valid for the research aims and objectives of the present study as stated. Such steps were performed to ensure that the research instrument effectively examined the role of ICT-based BL and its differentiated effects across gender and academic levels.

Results

To address the role of ICT-based BL in enhancing students' learning motivation, a quantitative analysis of the means and standard deviations of the students' responses was conducted. The results obtained were interpreted through the lens of SDT as presented in Table 3. That is, it can be inferred that the respondents in the study attain a significant level of agreement about the

role of ICT-based BL in enhancing their learning motivation. Out of all the items investigated the one with the highest mean response was item 6, where the response was: "I take BL courses because it is relevant to my real-life situation". The overall mean for this item was M = 4.26 (with SD 0.92). The overall mean for the role of BL in enhancing students' learning motivation is M = 3.99 (with SD = 0.87) which indicates that students were highly motivated to learn due to the use of ICT-based BL.

Table 3: Means (M) and Standard Deviations (SD) of the role of ICT-based BL in enhancing students' learning motivation, ranked in descending order

Rank	N	Item	M	SD	Degree
1	6	I engage in the BL courses because it is relevant to my real-life situations	4.26	.92	high
2	1	I am enthused to take BL courses	4.24	1.00	high
2	3	I believe that BL could improve my technological skills	4.24	.97	high
4	4	I enjoy learning new concepts throughout the BL strategy	4.21	.94	high
5	2	I do recommend my friends to take the blended course	4.20	1.00	high
6	8	I plan to take more blended courses in the future	4.18	.96	high
7	5	I involved in the BL assignments	4.14	1.02	high
7	7	I prefer to submit my assignments through the ICT tools used within the BL	4.14	1.06	high
9	12	Accessibility in BL is considered a source of pleasure	4.13	1.05	high
10	9	Feedback through BL reinforced me	4.12	1.02	high
11	10	Multimedia and other ICT elements in BL arouse my curiosity	4.10	.97	high
12	11	Flexibility in BL satisfied me	4.08	.97	high
12	16	I enjoy the way that content delivery by BL	4.08	.96	high
14	18	I am certain that the BL will qualify me for my future career	4.07	1.00	high
15	13	I believe that BL meets my preferences	3.65	1.04	moderate
16	14	I enjoy BL courses because it is available at any time and in any place	3.64	1.07	moderate
17	17	I am confident BL will improve my academic achievement	3.62	1.05	moderate
18	15	I think BL tasks, content, and experience challenge me	3.61	1.07	moderate
19	20	I concentrate on BL lectures due to instant feedback	3.59	1.07	moderate
20	19	I pay more attention to the BL content because it has several ICT elements i.e. multimedia	3.57	1.07	moderate
		QLL	3.99	.87	high

The findings revealed that ICT-based BL plays a significant role in boosting students' motivation for learning by leveraging personalized and interactive content with flexible scheduling**.** These features align with SDT, particularly by satisfying autonomy and competence psychological needs of the students. The integration of ICT tools not only captures students' interest but also enhances their sense of control and relevance**,** key drivers to foster intrinsic motivation. Additionally, the integration of multimedia and ICT elements makes the teaching and learning process exciting, bridging the gap between theory and practice and promoting informal learning contexts.

The high levels of student motivation observed in the ICT-based BL environment can be attributed to enhanced student perceptions about their autonomy and competence. This finding is consistent with SDT, which indicates that satisfying autonomy and competence psychological needs of individuals can increase their intrinsic motivation.

Consequently, to address the role of gender and academic level differences in the impact of ICT-based BL learning on students' learning motivation, a Two-way ANOVA analysis was conducted and the results are presented in Table 4.

The obtained Two-way ANOVA results revealed that there are no statistically significant differences in the role of BL in enhancing students' learning motivation based on the gender variable ($F = 1.336$, $p = .249$). This indicates that both female and male students obtained equivalent benefits from BL courses suggesting that the digital divide between genders in terms of educational technology usage has diminished recently. A potential reason might be the familiarity of BL and ICT to both female and male

students, and they exhibited comparable levels of excitement and interest in this model of learning. Furthermore, both genders share similar social and economic cultural backgrounds. It can also be inferred that the integration of BL is becoming increasingly standardized across various courses, prompting equal participation from both genders.

Table 4: Two-way ANOVA results of the effect of gender and academic level variables on the role of BL in enhancing students' learning motivation

Source	Sum of Squares	DF	Mean Square	F	Sig.
Academic level	.300	1	.300	.395	.530
Gender	1.015	1	1.015	1.336	.249
Error	157.162	207	.759		
Corrected Total	159.618	209			

Similarly, the obtained result revealed that there are no statistically significant differences at ($\alpha \geq 0.05$) in the role of ICT-based BL in enhancing students' learning motivation based on their academic level ($F = .395$, $p \geq .05$). This outcome indicates that graduate and undergraduate students exhibit a similar level of motivation when engaging with BL activities. This inclusivity extends to both undergraduate and graduate students, who share common instructors, learning environments, educational resources, and technological infrastructure. Moreover, all students are equally required to interact with course materials, assignments, and tasks through the BL platform.

Discussion

To provide a focused and coherent interpretation of the obtained results, this section is organized into two main folds according to the research questions. Firstly, the findings in this study revealed a significant role for ICT-based BL in enhancing students' motivation by offering flexibility, interactivity, and a student-centered approach. BL supports autonomy and competence through multimedia integration and varied activities, aligned with SDT. It also improves communication and relatedness by enhancing interaction with peers and instructors. Importantly, students were most motivated when learning felt relevant to real life. Moreover, BL helped improve their digital skills, autonomy, and enjoyment, with multimedia making learning more engaging.

One of the key advantages of ICT-based BL lies in its ability to make the learning experience more engaging and responsive to students' needs. That is, ICT-based BL that combines online and face-to-face learning with proper integration of multimedia and ICT elements, makes the learning process more exciting and satisfying autonomy and competence which is required by SDT. This suggests that the design and implementation of BL should prioritize these elements to foster a more engaging and effective learning experience. Another critical factor that influences student motivation in ICT-based BL is the increased level of communication and interaction in the learning process, resulting in a more interactive and responsive environment. Instructors help students feel connected and supported when clarifying learning objectives and facilitating the instructional process (Baran *et al*., 2011). This is compatible with SDT, i.e. the need for relatedness. When students feel related and guided by capable instructors, their engagement improves (Chiu, 2023). Therefore, combining ICT-based BL with intentional, responsive instructor presence maximizes its effectiveness.

Accordingly, one of the strongest motivational factors identified in this study is the perceived relevance of ICT-based BL to students' real-life situations. The statement, "I engage in BL courses because it is relevant to my real-life situations" received the highest mean ($M = 4.26$), indicating that students believe that there is a direct connection between their learning experiences and future applications. This aligns with the findings of Wong *et al*. (2020) who highlighted the role real-world applicability in motivating students by increasing their engagement and autonomy. Similarly, (Zhafirah *et al*., 2020) revealed that students were highly motivated when they perceived the practical benefits of their learning in technology-enhanced environments. The consistency across these studies addresses the importance of real-life relevance as a driver of motivation in BL contexts.

Another motivational aspect revealed by the result is the role of ICT-based BL in improving students' technological skills, interactive experiences, and autonomy in learning. Students conveyed strong agreement with statements about the helpfulness of BL in developing essential digital competencies. The integration of multimedia tools and ICT elements was particularly motivating, as it encouraged learners to explore, interact, and take responsibility for their own learning process. Statements such as "Multimedia and other ICT elements in BL arouse my curiosity" and "I enjoy learning new concepts throughout the BL strategy" received high mean scores indicating that the use of multimedia creates a more enjoyable and stimulating learning environment. The results also support learning autonomy when helping students manage their own learning progress and search for information independently. This finding is supported by Budiarto and Jazuli (2021), who asserted that that multimedia tools in learning settings can increase motivation by offering interactive learning tasks. Agustiani *et al*. (2021) also found that the BL environment fosters students' motivation and support their autonomy by allowing access to diverse online resources. Overall, the findings clearly demonstrate that ICT-based BL plays a significant role in

enhancing students' motivation by fostering interactive, relevant, and personalized learning experiences.

Secondly, in examining potential differences in the motivational impact of ICT-based BL, the results showed that ICT-based BL helped bridge gender differences, with male and female students reporting similar motivation, enjoyment, and autonomy. Also, no differences were found between graduate and undergraduate students, suggesting that the structured ICT-based BL design offered equal motivational benefits across levels.

The obtained results revealed similar levels of engagement, enjoyment, and self-directed learning among male and female Students. A potential explanation for this equivalence is the balance between online tools and face-to-face interaction within BL, which may reduce disparities in comfort levels or access to multimedia and digital resources. The universal effect can also be attributed to the structured integration of ICT in the learning process, ensuring that all students, regardless of demographic variations, benefit from the accessibility and engagement enhancements provided by ICT. Additionally, the study's context within Jordanian universities, where ICT-based BL is relatively new, might result in a novelty effect, leading to widespread excitement among various student demographics. However, prior studies have shown mixed results. while the current finding is in line with Hagos and Andargie (2022); Ajlouni *et al*. (2022) revealed that female students are more intrinsically motivated in online learning in contrast. Padilla-Meléndez *et al*. (2013); Zhao *et al*. (2023) indicated that male students demonstrated higher levels of cognitive and emotional engagement in blended environments. The current findings, however, diverge from these results, pointing instead to the possibility that the combination of ICT tools and in-person elements neutralizes gender-related motivational differences.

Consequently, the result revealed an absence of differences among graduate and undergraduate students' motivation toward ICT-based BL, indicating that students from both academic levels experienced comparable motivational benefits. This suggests that the design and structure of the BL environment provided equal opportunities for engagement, autonomy, and satisfaction across different academic levels. Both levels had access to the same technological resources, collaborative tools, and instructional strategies, which may have contributed to the uniformity in motivational responses. This finding contrasts with previous research such as (ElSayad, 2024; Coa, 2012), who argued that graduate students demonstrate higher motivation due to their advanced skills and educational maturity. Similarly, (Artino and Stephens, 2009) found that graduate students tend to exhibit stronger critical thinking abilities, while undergraduate students show greater intentions to engage in online learning. Despite these findings, the present study supports the idea that well-structured ICT-based BL can equalize the motivational experience across academic levels. These results suggest that the motivational benefits of ICT-based BL are perceived consistently among students, regardless of their gender or academic level, pointing toward the inclusive and adaptable nature of this learning approach.

In conclusion, the discussion confirms the effectiveness of ICT-based blended learning in enhancing students' motivation and highlights its universal applicability across diverse learner profiles, thus providing strong support for its broader implementation in higher education settings.

Implications

We can identify some important implications from the analysis results. First, the strong motivation of students in a BL environment suggests that educational institutions should consider expanding on their BL models. Additionally, the BL models can enhance motivation to learn and academic success through an engaging and flexible learning environment that provides real connections with educators and learners. Also, the lack of differences between the BL learners with respect to gender or academic level highlights its inclusive nature. Universities and institutions should benefit from this result and implement BL across various student demographic levels without assuming that one level will benefit more. It also indicates that BL properties help bridge any technological divides among genders, making technology use more equitable. Finally, the findings obtained in this study suggest that BL should focus not only on the flexibility of educational content and its accessibility but also on learners' engagement through appropriate and extensive use of ICT multimedia and interactive educational tasks.

One significant contribution is that this study underscores the value of ICT-based BL in motivating students at various demographic levels. However, given the nature of BL which depends on dynamically changing and evolving ICT and other technologies, continuous investigation is required. Further research might help refine and develop learning models and strategies, making BL an effective learning approach in Jordanian universities. Future research could benefit from longer period studies that capture any changes in the student's motivation over that period to observe the long-term effect of BL. Understanding how BL affects motivation across periods would provide more valuable insights for decision-makers and curriculum developers. Furthermore, performing comparative studies across various educational contexts and different environmental variables also would provide a deeper understanding of BL efficiency. Research that examines how BL impacts motivation in various disciplines and fields might help

highlight the unique and diverse requirements of various student populations. Additionally, investigating more specific challenges and benefits that exist in BL environments, in diverse cultural and institutional contexts can offer specific and targeted recommendations for improving their communities.

Also, further studies that could explore how different demographic factors influence students' motivation in BL are required. Studies that investigate the effect of specific BL models are more effective for certain genders or academic levels, which may lead to more efficient personalized educational approaches. Such investigations are helpful for educational institutes and universities to better meet their diverse students' needs. Future research with a focus on the role of newly emerged technologies, i.e. artificial intelligence in BL, is recommended. Examining how these technologies influence student engagement, motivation, and achievement could provide valuable insights for educators seeking to integrate innovative approaches into their teaching.

Limitations and Future Research

One significant contribution is that this study underscores the value of ICT-based BL in motivating students at various demographic levels. However, given the nature of BL which depends on dynamically changing and evolving ICT and other technologies, continuous investigation is required. This study relies on cross-sectional data, which provides only a snapshot of students' motivation at that point in time, which limit capturing changes in motivational levels over time. Future research could benefit from longer period studies to address a longitudinal design that tracks changes in student motivation over one semester or academic year. This might help capture stronger evidence about the motivation within ICT-based BL environment and observe the long-term effect of BL. Understanding how BL affects motivation across periods would provide more valuable insights for decision-makers and curriculum developers.

Furthermore, performing comparative studies across various educational contexts and different environmental variables also would provide a deeper understanding of BL efficiency. Research that examines how BL impacts motivation in various disciplines and fields might help highlight the unique and diverse requirements of various student populations. Additionally, investigating more specific challenges and benefits that exist in BL environments, in diverse cultural and institutional contexts can offer specific and targeted recommendations for improving their communities. Future research could extend the scope by incorporating multiple institutions to enhance external validity and overcome the limitation of selecting one university which may affect the generalizability of the findings. Despite this limitation, this study contributing to the existing body of knowledge on ICT and BL by offering valuable insights into the examined phenomenon within the context of private higher education in Jordan.

Additionally, further studies that could explore how different demographic factors influence students' motivation in BL are required. Studies that investigate the effect of specific BL models are more effective for certain genders or academic levels, which may lead to more efficient personalized educational approaches. Such investigations are helpful for educational institutes and universities to better meet their diverse students' needs. Future research with a focus on the role of newly emerged technologies, i.e. artificial intelligence in BL, is recommended. Examining how these technologies influence student engagement, motivation, and achievement could provide valuable insights for educators seeking to integrate innovative approaches into their teaching. Further studies should go beyond identifying statistical differences and investigate the qualitative nature of motivation across academic levels. Measuring self-regulation, intrinsic goal orientation, and engagement strategies could provide a more nuanced understanding of how graduate and undergraduate students interact with ICT-based BL.

Moreover, the absence of data triangulation (i.e. focus groups or qualitative interviews) might limits deeper insight into students' motivational capabilities. While a self-administrated questionnaire was employed due to logistical and contextual constraints during data collection, we recognize that including a control group of students enrolled in either fully face-to-face or online courses might be useful in strengthen the validity and robustness of the findings (Robinson, 2007). Thus, integrating qualitative validation and comparative groups is strongly encouraged to examine additional relationships and extend the understanding of motivational differences across various learning models.

Conclusion

This study addresses the key role of ICT-based BL in newly emerged educational environments, underlining its ability to enhance students' motivation. By integrating ICT and multimedia technologies, ICT-based BL significantly motivated students to learn regardless of gender and academic level. Indeed, ICT-based BL helps address diverse students' requirements and promotes their personalized learning experience, which makes it a transformative force that bridges theoretical understanding with real-world practical situations. The obtained results revealed that students became highly motivated when studied in flexible, interactive, and more relevant to real-life contexts BL environment. Additionally, the inclusive nature of the BL environment

was evident, as no significant differences in motivational impact among gender or academic levels. This highlights the potential of BL as an equitable learning approach that is adaptable to diverse learners' characteristics and demographics.

However, an effective deployment that consider challenges of BL requires strategic investments in ICT infrastructure and human development training. For example, a limited internet access for low-income students can disrupt continuity and reduce. Additionally, learners might struggle to adapt to digital ICT tools and online platforms, especially when they lack prior experience with technology-enhanced learning (Devisakti *et al*., 2024). For instructors, managing BL courses increases workload such as designing dual-format materials and monitor multiple platforms. These barriers underscore the importance of institutional investment in training, infrastructure, and support systems to ensure BL is equitable and effective for all learners.

In sum, BL with appropriate and extensive use of ICT and interactive technologies presents an essential tool for enhancing motivation and preparing students for the dynamically changing educational environments. With thoughtful ICT integration and continuous improvement, BL has the potential to redesign the educational landscape, fostering lifelong learning and academic excellence.

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Authors Contributions

All authors equally contributed in this work.

Ethics

We, the authors of this research paper, confirm that this research study is original and has not been published before. I, the corresponding author, also state that all authors have read and approved the manuscript and adhered to the ethical guidelines.

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