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Gender differences in absenteeism, engagement and academic performance in first-year blended learning teacher education: a learning analytics study

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Abstract

This study examines gender differences in absenteeism, academic performance and engagement of first-year teacher students, a group especially vulnerable to academic failure. Using learning analytics methods, including decision trees and robust statistical techniques, we analyzed multiple data sources from 327 students enrolled in a blended learning program at a Spanish university. Female students showed higher online engagement and attended classes more frequently than male students. In contrast, male students performed better when they autonomously accessed learning materials and quizzes, despite lower class attendance rates. The findings emphasize the need for gender-specific strategies to address disparities in engagement and performance. While female students benefited from structured feedback and regular class attendance, male students relied more on self-directed learning. These insights highlight the importance of tailored interventions in teacher education, offering valuable implications for designing inclusive, blended learning environments that support diverse student needs during the critical first year of higher education.

Key words

Learning analytics; gender differences; student engagement; academic performance.

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Diferencias de género en el absentismo, la implicación y el rendimiento en estudiantes de primer año de formación del profesorado: un estudio con analítica del aprendizaje

Resumen

Este estudio examina las diferencias de género en el absentismo, el rendimiento académico y la implicación del alumnado de primer curso en formación del profesorado, un grupo especialmente vulnerable al fracaso académico. Mediante métodos de analítica del aprendizaje, incluyendo árboles de decisión y técnicas estadísticas robustas, se analizaron múltiples fuentes de datos procedentes de 327 estudiantes matriculados en un programa de aprendizaje semipresencial de una universidad española. Las estudiantes mostraron una mayor implicación en línea y asistieron a clase con más frecuencia que los estudiantes varones. En cambio, los varones obtuvieron mejores resultados cuando accedían de manera autónoma a los materiales de aprendizaje y a los cuestionarios, a pesar de asistir menos a clase. Los resultados enfatizan la necesidad de estrategias específicas por género para abordar las disparidades en la implicación y el rendimiento. Mientras que las estudiantes se beneficiaron de la retroalimentación estructurada y de la asistencia regular, los estudiantes varones dependieron en mayor medida del aprendizaje autodirigido. Estas conclusiones ponen de relieve la importancia de diseñar intervenciones adaptadas en la formación del profesorado, ofreciendo valiosas implicaciones para el diseño de entornos de aprendizaje semipresenciales inclusivos que apoyen las diversas necesidades del alumnado durante el primer año crítico en la educación superior.

Palabras clave

Analítica del aprendizaje; diferencias de género; implicación del alumnado; rendimiento académico.

Introduction

Regular class attendance has traditionally been associated with improved academic performance in higher education (Serrano et al., 2024), with studies reporting an average decrease of up to 2.11% in final grades per absence (Ahmad et al., 2018). However, the physical classroom is no longer the only space for student activities, as the rise of digital resources has reshaped learning environments.

While meta-analyses and longitudinal studies have evidenced the positive impact of attending classes on academic success (Credé et al., 2010; Marburger, 2001), more recent research suggests that absenteeism does not always have a direct effect on student performance (Setapa et al., 2023). This shift indicates that academic outcomes may also depend on learning modalities facilitated by digital devices and online platforms, which have transformed student engagement and activities at the university level (Khafaga & Maneh Al-Johani, 2024; Fernández & Abellán, 2025; Zaldívar et al., 2024).

Although technological resources enhance educational experiences, they also pose challenges, as not all students possess the necessary skills to effectively utilize such resources, despite their increasing ubiquity at educational institutions. First-year students, in particular, are especially vulnerable to academic failure, due to the transition and adaptation process required for higher education. During this period, they often lack adequate

strategies to manage stress and anxiety (Amir Hamzah et al., 2019; Hassel & Ridout, 2018), they rarely employ effective study techniques (Perander et al., 2021; Ribeiro et al., 2019), and they exhibit various deficiencies in metacognitive skills, such as self-regulation, planning, and goal-setting, competencies that are crucial for online learning (Garcia-Garcia et al., 2022; Wang & Peck, 2013).

In digital learning contexts, deficiencies in metacognitive skills significantly reduce the effectiveness of pedagogical approaches such as flipped classrooms (Al-Samarraie et al., 2020; Sun et al., 2018) and asynchronous forum discussions (Hew & Cheung, 2008), thereby limiting students' ability to master curricular contents. Furthermore, social factors such as gender and different fields of study influence attendance, academic performance, and the use of digital educational resources (Palomares-Ruiz et al., 2021).

Several studies have highlighted that reasons for absenteeism vary by gender. In general, male students tend to be absent more frequently due to factors such as class length or a lack of affinity with the teaching style of their professors (Armour et al., 2020; Odongo et al., 2023), whereas female students are more likely to miss classes for health-related reasons, including menstrual-related issues (Garg, 2023). Additionally, gender stereotypes may influence absenteeism patterns. For instance, independence, autonomy and even rebelliousness—traits traditionally associated with masculinity—can lead to male absences being less questionable. Such stereotypes might explain why male students tend to rely more on external resources and their own autonomy for learning, minimizing the need for class attendance (Gil-Galván et al., 2024).

Regarding fields of study, the relationship between absenteeism, online engagement and academic performance has been examined across disciplines such as Chemistry (Zaldívar et al., 2024), Medicine (Anderson & Fernandez-Branson, 2024; Mitra et al., 2022), Marketing (Peña et al., 2024), and Business (Setapa et al., 2023). Many of these fields have a predominantly male student population, raising the question of how these dynamics manifest in programs with a higher proportion of female students.

In the case of teacher education—a field where female enrollment is significantly higher—research on absenteeism and engagement is scarce, and the few existing studies in the literature report findings that differ from those observed in other disciplines. A notable aspect in this field is a widespread student disagreement with mandatory attendance policies (Larruzea-Urkixo et al., 2021), a perspective that is less frequently reported in studies regarding other academic disciplines.

To address absenteeism and academic performance issues, online engagement measurement technologies have been developed to monitor and enhance students' use of digital resources. These tools provide real-time data to both instructors and students when signs of disengagement are detected, enabling timely actions to be taken (Ha et al., 2024; Zhang et al., 2020). In this regard, learning analytics and educational data mining have been instrumental in analyzing university students' engagement, offering insights into their academic outcomes (Johar et al., 2023; Nizam Ismail et al., 2021) and promoting more effective use of online educational resources (Karaoglan Yilmaz & Yilmaz, 2022).

Despite these advancements, empirical evidence remains inconclusive on whether increased engagement in blended learning teacher education leads to improved academic performance and reduced absenteeism. This issue is particularly relevant for first-year students, whose vulnerability may be exacerbated by gender and field of study. Our study therefore aims to examine gender differences in first-year teacher education students enrolled in a blended learning program that incorporates embedded learning analytics to

support the monitoring of academic performance, attendance, and online engagement. In particular, we address the following research questions (RQs):

- RQ1: Are there gender differences in absenteeism, academic performance, and engagement?
- RQ2: How are these variables related in male and female students?

The findings of this study provide valuable insights into how students achieve academic outcomes in teacher education in blended learning environments with embedded learning analytics. This understanding will contribute to the development of more effective strategies to guide and support students at the beginning of their university careers.

Methods

Design and participants

We conducted a study involving 327 first-year teacher education students at a Spanish university. All participants were enrolled in a blended learning program and used a Moodle platform as their learning management system. The students were selected, using convenience sampling, from seven equivalent class groups, which were divided into two sections based on gender for data analysis: female students (n = 260, mean age = 24.39, SD = 3.72); and male students (n = 67, mean age = 24.46, SD = 4.07).

The smaller sample size of male students compared to female students reflects enrollment patterns in teacher education programs. According to the Spanish Ministry of Universities and the specific university's annual data report, over 80% of first-year enrollees in the past five years have been women. Similarly, in our study, 70.84% of the participants were female.

Learning environment

The authors of this study also served as instructors for the participants, overseeing their learning process in a first-year course on general and social pedagogy. In designing the course's virtual classroom, we incorporated Moodle quizzes to provide formative assessments of student progress, and generate study materials based on automated feedback (e.g., highlighting errors and correct answers after task completion). The quizzes were designed to promote active learning, and included case studies, problem-solving exercises, matching and dissociation tasks, and classification activities.

We integrated embedded data and visualizations to provide real-time information within Moodle's online environment. This approach offered an immediate, raw data view, in contrast with other widely studied learning analytics methods such as dashboards and summary reports (Matcha et al., 2020; Wang & Han, 2021). By integrating analytics directly into the learning platform, our goal was to enhance the immediacy and transparency of the information available to both students and instructors.

We deliberately avoided using recommendation systems, notifications or similar features to guide online learning, as these can cause cognitive overload and be counterproductive (Sachdeva & Gilbert, 2020). Likewise, we did not encourage extensive coursework production or impose pressure for early submissions, as prior research suggests these practices do not improve academic performance and may even be detrimental (López-Francés et al., 2022). Instead, we established reasonable deadlines for assignments and provided clear guidelines for their completion and submission.

The course structure was uniform across all groups, with a grading system in which 40% of the final grade was based on individual assignments, 20% on group activities, and 40% on a

comprehensive final exam. To ensure consistency, instructors used automated quiz-based assessments, conducted in-person classes lasting 2 to 2.5 hours, and maintained a standardized structure for both the final exam and the learning environment configuration. This ensured that all students experienced a consistent learning process.

Data gathering and management

Multiple types of data were collected continuously, 24 hours a day, throughout the course. Data collection spanned from September 13, 2021, through to June 3, 2024. The procedure adhered to fundamental ethical principles, guaranteeing the participants' right to be informed and data privacy protection, as well as confidentiality and non-discrimination. Students provided consent for their data to be used, and received no compensation for participating in the study.

The student records were downloaded in .xlsx format from the Moodle platform, and underwent manual preprocessing. This included transforming the grouping variable "gender" into a factor and converting the dependent variables into numerical vectors using identical Excel macros and R functions to ensure consistency across the seven class groups.

We used grades as a measure of academic performance and attendance records as an indicator of absenteeism, calculated as 100 minus the percentage of class attendance. To measure online engagement, we considered course interface logins, access to specific content and quizzes, and individual grade report views.

Data exploration and analysis

To address the research questions, we conducted a gender differences analysis (RQ1) and a correlational analysis (RQ2). The correlational analysis focused on identifying associations between dependent variables and on exploring complex relationships using decision trees, in order to understand their influence on academic performance.

Since the data exhibited non-normal residuals and heteroscedasticity, we employed the *Mann-Whitney U test* to assess gender differences. Additionally, we applied *Yuen's robust independent samples t-test* on trimmed means, calculating effect sizes with 95% confidence intervals around the estimates. This statistical approach is considered one of the most robust methods for comparing independent samples with non-normal distributions, and providing greater reliability than conventional non-parametric tests (Wilcox, 2013). Effect size values of ξ = .1, .3, and .5 were interpreted as small, medium, and large, respectively. Table 1 presents the results of the assumption tests for the between-group analysis.

We used *Spearman's rho* and *Kendall's tau-b coefficients* to evaluate monotonic correlations and pairwise concordance based on gender. Subsequently, we employed decision trees separately for each gender in order to capture non-linear and complex relationships among the variables. In this analysis, academic performance was the variable of interest, while gender, absenteeism rate, and online engagement served as independent variables. A decision tree model was applied using the rpart classification algorithm, implemented in R's rpart package.

This method allows for the exploration of complex relationships between categorical and continuous variables, making it particularly useful for identifying significant predictor interactions. The model was fitted using a Poisson distribution, suitable for count data, and was formulated as follows:

Academic perf. ~ Absenteeism + Course logins + Content accesses + Quiz accesses + Grade accesses

Table 1.

Assumption checks for absenteeism, academic performance, and course activities.

Variable	Descriptive Statistics		Shapiro-Wilk Test		Levene's Test			
	Median*	IQR*	W*	p-value*	F	df1	df2	p-value
Absenteeism	16.00, 20.80	20.03, 39.30	.860, .852	1.332e-14, 1.212e-6	10.913	1	325	.001
Academic Perf.	7.19, 6.88	2.12, 3.27	.766, .846	6.111e-19, 7.609e-7	11.055	1	325	9.854e-4
Course Login	125.00, 100.00	82.25, 24.50	.892, .960	1.111e-12, .030	2.359	1	325	.126
Content Access	167.00, 127.00	134.50, 105.00	.972, .957	6.182e-5, .020	.994	1	325	.320
Quizzes Access	71.00, 60.00	35.00, 46.50	.966, .920	8.699e-6, 3.663e-4	7.382	1	325	.007
Grade Access	7.00, 4.00	11.25, 5.00	.595, .912	2.865e-24, 1.617e-4	18.145	1	325	2.683e-5

*Data is reported as: Female, Male.

To facilitate the interpretation of results, we generated a graphical representation of the decision tree using the rpart.plot function, which visually displays the model's decision-making process. Specific parameters were configured in the function to enhance clarity, including the visualization of terminal nodes and additional information at each split.

Results

RQ1: Gender differences in absenteeism, academic performance, and engagement

The results presented in Table 2 indicate that female students exhibited higher online engagement, particularly in their concern for grades ($\hat{r}_{biserial}^{rank}$ = .36 [.22, .49]; δ_R^{AKP} = .44 [.30, .56]). They also attended class more frequently, and achieved slightly higher academic performance than male students.

Although both non-parametric and robust statistical tests generally yielded consistent results for each variable, a discrepancy was observed when analyzing academic performance. This suggests that the non-normal distributions of the data may have influenced statistical significance in some cases. Nevertheless, Figure 1 provides violin plots displaying the distribution of data by gender, allowing for the visualization of individual positions across all study variables.

Figure 1.

Distribution of data by gender across study variables (absenteeism, academic performance, and online engagement)

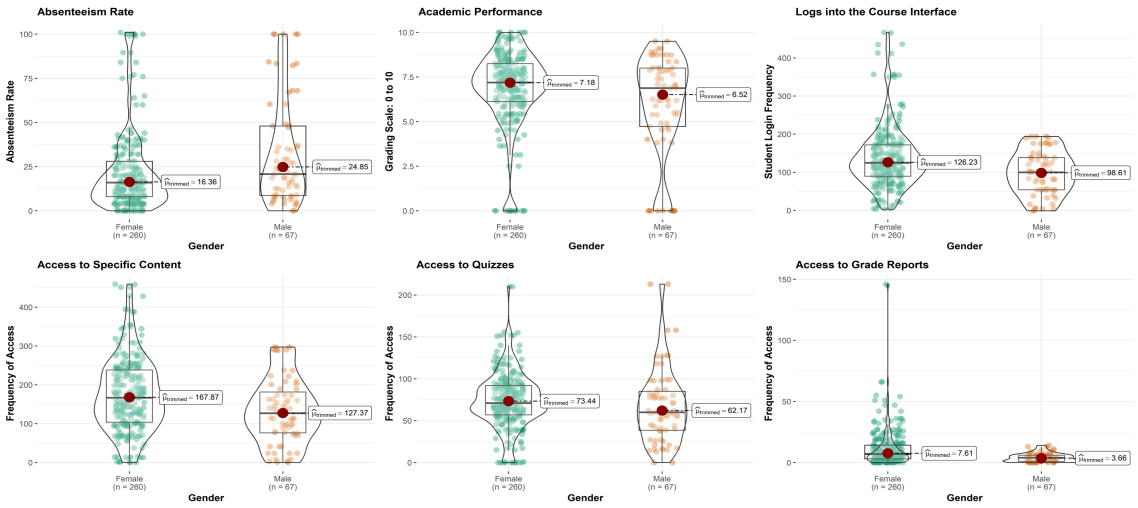

Table 2.

Effects of gender on absenteeism, academic performance, and online engagement

Variables	U_{MW}	*p-value*	$\hat{r}_{biserial}^{rank}$	$CI_{95\%}$	t_{Yuen}	*p-value*	δ_R^{AKP}	$CI_{95\%}$
Absenteeism	6907.500	.009	-.21	[-.35, -.06]	2.029	.048	.51	[-1.09, -.17]
Academic Perf.	1014.000	.038	.16	[.01, .31]	1.889	.065	.42	[5.93e-03, .84]
Course Login	10928.500	.001	.26	[.11, .39]	3.151	2.47e-03	.45	[.12, .72]
Content Access	1090.000	.002	.25	[.10, .39]	3.396	1.13e-03	.45	[.16, .73]
Quiz Access	10175.500	.034	.17	[.02, .31]	2.002	.051	.43	[.10, .79]
Grade Access	11841.000	5.439e-6	.36	[.22, .49]	5.149	7.69e-07	.44	[.30, .56]

RQ2: Correlations between variables and their influence on academic performance

As shown in Table 3, female students who missed more classes tended to use quizzes and learning materials less frequently, which negatively impacted their academic performance, particularly when they did not review the quiz feedback (Z_{Fisher} of ρ = .527 [.400, .654]; Z_{Fisher} of τ-*B* = .364 [.285, .409]). Moreover, frequent logins to the virtual classroom had a strong impact on their engagement, leading to increased consultation of course-specific contents (Z_{Fisher} of ρ = 1.039 [.908, 1.170]; Z_{Fisher} of τ-*B* = .701 [.652, .750]), underscoring the critical role of online engagement in academic success.

For male students, performance improved when they accessed learning materials and quizzes more frequently. However, as their class attendance increased, they also tended to rely less on virtual classroom resources, particularly quiz feedback (Z_{Fisher} of ρ = -.543 [-.796, -.290]; Z_{Fisher} of τ-*B* = -.389 [-.528, -.250]) and grade reports (Z_{Fisher} of ρ = -.660 [-.915, -.405]; Z_{Fisher} of τ-*B* = -.435 [-.570, -.300]). Similar to female students, frequent logins to the course website had a strong effect on their access to study materials (Z_{Fisher} of ρ = .852 [.593, 1.111]; Z_{Fisher} of τ-*B* = .617 [.505, .729]), highlighting the importance of online engagement for their academic performance. Male student results are detailed in Table 4.

The decision tree analysis revealed that, for female students, a class absenteeism rate above 87% was associated with lower access to digital resources and lower grades (terminal nodes with scores of 4.6 and 4). In contrast, those with lower absenteeism rates and greater interaction with quizzes and learning materials achieved higher grades (ranging from 7.8 to 7.3). This reinforces the idea that online engagement was directly related to academic performance, but unlike for male students, absenteeism was a determining factor in female students' academic success.

For male students, academic performance was primarily determined by access to learning materials and grade consultations. Those who accessed learning resources fewer than 33 times and checked their grades fewer than twice obtained the lowest scores (ranging from 1.3 to 5.4). However, students with higher online interactions and more consistent class attendance (absenteeism rate <28%) achieved significantly higher grades (ranging from 7.9 to 8). Figure 2 illustrates these behavioral patterns.

Figure 2.

Decision tree models of academic performance by gender, absenteeism, and online engagement

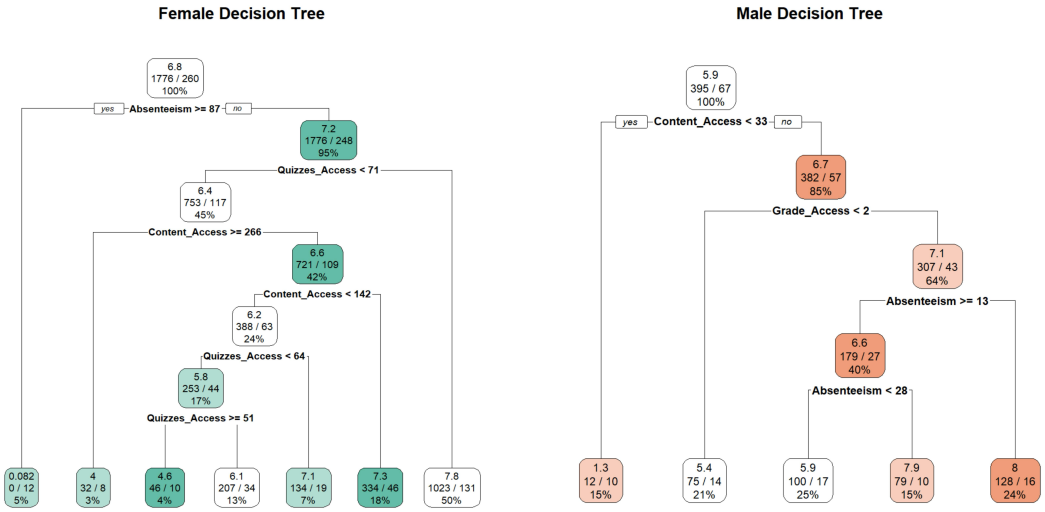

Table 3.

Correlations between absenteeism, academic performance, and engagement for female students

Contrast	ρ	*p-value*	Z_{Fisher}	$CI_{95\%}$	τ-B	*p-value*	Z_{Fisher}	$CI_{95\%}$
Absenteeism - Academic Perf.	-.239***	9.911e-5	-.244	[-.367, -.121]	-.166***	9.229e-5	-.168	[-.242, -.089]
Absenteeism - Course Login	-.244***	7.189e-5	-.249	[-.372, -.126]	-.167***	7.231e-5	-.169	[-.242, -.090]
Absenteeism - Content Access	-.326***	7.676e-8	-.338	[-.463, -.213]	-.233***	3.471e-8	-.237	[-.304, -.159]
Absenteeism - Quiz Access	-.266***	1.379e-5	-.273	[-.398, -.148]	-.187***	1.052e-5	-.189	[-.261, -.110]
Absenteeism - Grade Access	-.053	.393	-.053	[-.176, .070]	-.035	.416	-.035	[-.117, .047]
Academic Perf. - Course Login	.336***	2.718e-8	.350	[.225, .475]	.24***	1.142e-8	.245	[.167, .311]
Academic Perf. - Content Access	.376***	3.725e-10	.395	[.270, .520]	.273***	9.856e-11	.280	[.203, .340]
Academic Perf. - Quiz Access	.483***	1.260e-16	.527	[.400, .654]	.349***	1.536e-16	.364	[.285, .409]
Academic Perf. - Grade Access	.296***	1.175e-6	.305	[.180, .430]	.213***	6.785e-7	.217	[.138, .287]
Course Login - Content Access	.778***	6.373e-54	1.039	[.908, 1.170]	.605***	2.019e-47	.701	[.652, .750]
Course Login - Quiz Access	.425***	7.631e-13	.454	[.327, .581]	.293***	2.704e-12	.302	[.224, .360]
Course Login - Grade Access	.605***	2.369e-27	.701	[.572, .830]	.444***	2.401e-25	.477	[.390, .494]
Content Access - Quiz Access	.430***	4.103e-13	.460	[.333, .587]	.307***	2.789e-13	.317	[.240, .371]
Quiz Access - Grade Access	.520***	2.108e-19	.576	[.449, .703]	.378***	7.108e-19	.398	[.318, .435]

* p < .05, ** p < .01, *** p < .001

Table 4.

Correlations between absenteeism, academic performance, and engagement for male students

Contrast	rho	*p-value*	Z_{Fisher}	$CI_{95\%}$	tau B	*p-value*	Z_{Fisher}	$CI_{95\%}$
Absenteeism - Academic Perf.	-.283*	.020	-.291	[-.540, -.042]	-.194*	.024	-.196	[-.353, -.039]
Absenteeism - Course Login	-.401***	7.667e-4	-.425	[-.676, -.174]	-.292***	5.798e-4	-.301	[-.450, -.152]
Absenteeism - Content Access	-.326**	.007	-.339	[-.588, -.090]	-.202*	.017	-.204	[-.361, -.047]
Absenteeism - Quiz Access	-.495***	2.034e-5	-.543	[-.796, -.290]	-.371***	1.257e-5	-.389	[-.528, -.250]

Absenteeism - Grade Access	-.578***	3.015e-7	-.66	[-.915, -.405]	-.410***	3.146e-6	-.435	[-.570, -.300]
Academic Perf. - Course Login	.222	.071	.226	[-.021, .473]	.159	.064	.160	[.001, .319]
Academic Perf. - Content Access	.290*	.017	.298	[.049, .547]	.197*	.021	.200	[.043, .357]
Academic Perf. - Quiz Access	.335**	.006	.348	[.099, .597]	.232**	.007	.236	[.081, .391]
Academic Perf. - Grade Access	.341**	.005	.355	[.106, .604]	.231**	.009	.235	[.080, .390]
Course Login - Content Access	.692***	8.728e-11	.852	[.593, 1.111]	.549***	9.225e-11	.617	[.505, .729]
Course Login - Quiz Access	.678***	2.841e-10	.826	[.567, 1.085]	.533***	3.394e-10	.594	[.480, .708]
Course Login - Grade Access	.42***	4.060e-4	.447	[.196, .698]	.334***	1.457e-4	.347	[.202, .492]
Content Access - Quiz Access	.623***	1.851e-8	.729	[.472, .986]	.436***	2.655e-7	.467	[.336, .598]
Quiz Access - Grade Access	.414***	4.959e-4	.440	[.189, .691]	.342***	9.780e-5	.356	[.213, .499]

* p < .05, ** p < .01, *** p < .001

Discussion and conclusions

Previous research has presented conflicting findings regarding the effect of absenteeism on academic performance. It is well established that the reasons for attending class vary by gender, and that first-year university students, in particular, are more vulnerable to academic failure. However, in teacher education—where female enrollment is significantly higher—studies examining the impact of absenteeism and engagement on academic performance remain scarce.

Our study provides one of the first pieces of evidence of using learning analytics to understand online activity patterns by gender and their influence on academic outcomes. To achieve this, we integrated multiple data sources and conducted complex analyses, uncovering results that conventional methods may overlook (Mo et al., 2022). These kinds of findings contribute to more effective decision-making for interventions in higher education settings (Ha et al., 2024; Zhang et al., 2020).

The gender differences we identified align, to some extent, with gender stereotypes documented in the literature. Previous studies have consistently shown that female students tend to achieve better academic results regardless of discipline, demonstrating higher levels of organization and preparation (Larruzea-Urkixo et al., 2021; Oberleiter et al., 2023; Sicard et al., 2022;). They also tend to exhibit a high degree of self-imposed academic pressure and frequently seek instructor approval to meet course objectives. This tendency may be linked to societal expectations regarding responsibility, discipline, and academic excellence (Aguilar-Durán & Arias-Odón, 2023).

As a result, female students often require more supervision throughout their learning process, in order to maintain a sense of control and reduce anxiety and uncertainty about their performance (Apridayani et al., 2023; Ramírez Morera & Díaz Jiménez, 2022). This could explain why the women in our study showed higher online engagement than men, such as frequently consulting quizzes for self-assessment.

In contrast, male students tend to approach learning in a more strategic and pragmatic manner (Gil-Galván, 2019). They generally perceive themselves as more self-sufficient (Allan & McKenna, 2022), and place greater trust in their own judgments rather than in feedback from instructors or peers (Sicard, 2021). This mindset may reduce their perceived need to attend class or to regularly consult continuous assessment tools such as quizzes. In fact, for the male students in our study, accessing grade reports was a key predictor of academic performance, whereas for female students, absenteeism was the strongest predictor.

Moreover, high-achieving female students tend to seek support from peers and instructors to navigate both online and in-person learning environments (Apridayani et al., 2023). Attending class and engaging online has been shown to be essential for forming social connections within the academic setting (Amir Hamzah et al., 2019; Bittmann, 2021; Koh et al., 2023), which was also observed among the women in our study.

Limitations and emerging research

Our findings highlight gender differences in academic performance during the first year of a blended learning teacher education program. Future research should explore factors influencing these differences, such as access to and use of digital resources (Borhani & Wong, 2023; Lofgren, 2023), metacognitive skills (Wang & Peck, 2013), and biometric aspects, for example, sleep quality (Sanders, 2023), and the impact of menstruation on absenteeism (Odongo et al., 2023). Additionally, qualitative analyses could provide deeper insights into these dynamics and their effects on learning.

Our study relied on a binary gender classification (female/male), which prevented the analysis of other gender identities. This is a common limitation in research, as many individuals do not identify themselves within this binary framework. For instance, in a global survey of 22,514 adults across 30 countries, only 9% identified as non-binary or gender-diverse (Ipsos, 2023). Low representation in such studies may stem from concerns about stigma and discrimination (Simons et al., 2021). Thus, future research should examine academic differences across a broader spectrum of gender identities.

Implications for educational practice

The results underscore the importance of adapting learning environments to gender differences, in order to promote inclusion and equity. Male students' autonomy in using Moodle seems to support their academic performance. However, absenteeism may cause them to miss critical information in blended settings. Conversely, female students appear to rely more on class attendance in order to receive instructor approval, reinforcing their tendency toward perfectionism (Aguilar-Durán & Arias-Odón, 2023). Therefore, personalized and real-time online feedback could provide valuable guidance for achieving learning objectives (Makhambetova et al., 2021).

To enhance personalized learning and improve academic outcomes, learning analytics based on quizzes and assignments should be promoted (Zheng et al., 2022), rather than less meaningful metrics such as assignment length or submission timing (López-Francés et al., 2022). This approach could increase student engagement, reduce absenteeism, and help prevent dropout rates, particularly among female students like those in our study, who often benefit from direct feedback from instructors and peers (Figure 2).

Our findings highlight the value of embedded learning analytics as an instructional tool. This approach allows educators to identify learning patterns by gender and tailor course contents and activities to meet the needs of different student groups. Also, it facilitates personalized feedback, engagement monitoring, and the evaluation of teaching strategy effectiveness. By leveraging evidence, educators can make informed decisions about instructional design, ultimately improving student learning experiences and outcomes.

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