

Analysis of the Digital System-Based Academic Factors and the Risk of Student Dropout Using Chi-Square Test for Data Driven-Interventions

Author:

Satya Arisena Hendrawan

Affiliation:

Universitas Siber
Indonesia

Corresponding email

arisenahendrawan@cyber-univ.ac.id

Histori Naskah:

Submit: 2025-07-31

Accepted: 2025-09-01

Published: 2025-09-04



*This is an Creative Commons
License This work is licensed under
a Creative Commons Attribution-
NonCommercial 4.0 International
License*

Abstrak:

Student dropout is a persistent challenge in the digital era of higher education. Using the chi-square test, this study examines whether two digital academic indicators—Grade Point Average (GPA) and attendance—are associated with dropout risk. We analyzed SIAKAD records for 100 Information Systems students at Bina Sarana Informatika University (cohorts 2020–2022), categorizing GPA (<2.75 vs. ≥ 2.75) and attendance ($<80\%$ vs. $\geq 80\%$). Results show a significant association between GPA and dropout ($\chi^2 = 21.54$, $p < 0.001$) and between attendance and dropout ($\chi^2 = 29.85$, $p < 0.001$). Students with low GPA and low attendance formed the highest-risk group (75% dropout), while high GPA and high attendance corresponded to the lowest risk (5%). These findings translate into simple, replicable rules for early detection and timely intervention: students below the GPA and attendance thresholds should trigger counseling, remedial support, or study-load adjustments. The contribution of this study is practical and immediate. Unlike approaches that rely on complex predictive models, a basic chi-square framework applied to routinely collected SIAKAD data yields actionable risk profiles that institutions can adopt with minimal technical overhead.

Keywords: Attendance; Chi-Square Test; GPA; Student Drop Out.

Introduction

The problem of student dropout remains a challenge in the management of higher education in Indonesia, including in large cities like Jakarta. This phenomenon not only impacts individual students but also institutions facing pressures regarding accreditation, study program effectiveness, and budget efficiency. According to (PDDIKTI, 2023), the rate of students not completing their studies within the normal period at several private universities in Jakarta, including UBSI, remains quite significant. One of the main identified causes is academic factors, such as low grades and absenteeism. Therefore, it is important to conduct a data-driven analysis of these factors to identify the risk of dropout more objectively. Along with the development of campus digitalization, Bina Sarana Informatika University (UBSI) has utilized the Academic Information System (SIAKAD) to record and manage student academic data. This system stores important information such as GPA, number of credits taken, attendance, and student active status. Utilizing data from SIAKAD allows the university to have access to real-time data that can be used in evidence-based policymaking. A study by (Putri et al., 2020) showed that utilizing a digital academic system facilitates early detection of academic risks, including dropout. Therefore, the existence of an academic information system should not only be administrative but also analytical.

In this context, the analysis of the relationship between academic variables and dropout status can be conducted using simple yet effective statistical methods, namely cross-tabulation and the chi-square test. This test is particularly relevant when examining the relationship between two categorical variables, such as attendance (high/low) and college status (active/dropout). Several previous studies, such as those by (Rahmat & Sari, 2019) and (Dewi, 2022), have used this method to uncover statistically significant factors contributing to student dropout. With this approach, universities can obtain an initial picture of the relationship between factors without the need for complex algorithms or machine learning techniques. The focus of this research was directed at students in the Information Systems Study Program at UBSI Jakarta from the 2020 to 2022 intake. Based on this background, this study aims to analyze the relationship between digital data-based academic factors and the risk of student dropout at UBSI Jakarta. Furthermore, this research also contributes to early detection of the risk of student academic failure, especially in the era of educational digitalization. This aligns with the demands of modern higher education, which emphasizes data-driven decision-making and integrated information systems (Agustina et al., 2021). Therefore, integrating quantitative approaches and the use of digital systems is a strategic step in improving the quality of academic services in higher education.

International studies also show that academic factors such as cumulative grades and attendance are significantly related to students' likelihood of persisting in higher education. Using routinely collected SIAKAD indicators (GPA and attendance) enables objective, low-cost early detection and timely retention interventions. Furthermore, students who are not actively engaged in the learning process are less likely to develop a strong academic engagement with the university, ultimately increasing their potential to discontinue their studies. In this regard, digital academic information systems are crucial because they allow universities to monitor student engagement in real time and with evidence. The digitalization of education is not only changing the way teaching is conducted but also how student data is managed and analyzed. According to (Harati et al., 2022), universities that implement information technology based on learning management systems and academic systems can proactively identify students with high-risk potential. This not only supports administrative processes but also provides the basis for data-driven academic interventions. Therefore, a technology-based approach to analyzing dropout risk is part of the adaptive transformation of educational management in the digital era. Furthermore, predictive analytics models in higher education have been widely used in developed countries to identify students at risk of not completing their education. According to (Vial, 2019), the use of digital academic data to support analytics-based educational decisions has become a new standard in the management of higher education institutions. In fact, several universities have developed predictive dashboards that automatically provide early warnings to students exhibiting negative academic trends. In the Indonesian context, simple approaches such as cross-tabulations and chi-square tests can be the first step towards developing such analytical systems.

In addition to grades and attendance, several studies also indicate the importance of understanding other variables such as the current semester, the number of credits taken, and late registration as non-cognitive indicators that contribute to the risk of dropping out (Bowers & Spratt, 2017). However, GPA and attendance are still considered the most practical and relevant variables to serve as initial indicators in SIAKAD data-based research. Especially when data is still limited, the use of these two main variables greatly supports the validity and simplicity of statistical analyses such as the chi-square test. In the higher education system in Southeast Asia, research utilizing digital academic data statistically is still uneven. A study by (Kintu et al., 2017) emphasized that the decision-making system at many campuses in the region is still reactive, not predictive. Therefore, initiatives to use digital academic data in a structured manner are

crucial for campuses in Indonesia, including UBSI. By utilizing a simple yet informative analytical approach, institutions can begin to build a culture of data-driven decision-making.

Thus, the integration of digital academic information systems and statistical analysis methods such as cross-tabulations and chi-square tests plays a strategic role in addressing the issue of student dropout. This research not only contributes to the academic context but also offers a practical approach that can be replicated by other institutions. Besides being a response to the digitalization of education, this study also aims to raise awareness of the importance of optimally utilizing internal campus data. Ultimately, early detection of dropout risk is expected to become more than just a topic of discussion, but also part of a sustainable and measurable academic quality management system.

Literature Review

Student Dropout in Higher Education

Student dropout is a persistent issue in higher education, particularly in developing countries where systemic and academic challenges often coexist. According to (Tinto, 2017), dropout is not merely a result of academic failure but also stems from weak academic and social integration. Studies in Southeast Asia suggest that the dropout phenomenon is influenced by multiple factors, including academic performance, attendance, financial burden, and lack of institutional support (Nasution & Lestari, 2021). Moreover, dropout rates are found to be higher in private universities due to varied academic preparedness and student support mechanisms (Dewi, 2022). Understanding these dropout predictors is crucial for designing effective academic interventions and enhancing institutional retention strategies. Students who experience academic lag from the beginning of their freshman year tend to have a higher risk of dropping out (Tinto, 2017). Student dropout in higher education is a multifactorial phenomenon shaped by early academic performance (e.g., GPA trajectories, attendance), socio-economic pressures, institutional support, and program quality. Cross-national evidence shows that systems experiencing rapid massification without parallel investment in advising and learning support tend to see higher attrition, particularly among first-generation and working students. Beyond individual predictors, research highlights the role of institutional conditions—coherent curricula, assessment design, and analytics-enabled outreach—in buffering withdrawal risk and improving completion. Recent syntheses therefore advocate shifting from reactive remediation to integrated, data-informed retention strategies that triangulate routinely collected indicators with timely academic and psychosocial support (OECD, 2022; van der Zanden et al., 2018).

The Role of Academic Factors: GPA and Attendance

Academic performance, especially measured through GPA and attendance, remains a strong predictor of student persistence. (Bowers & Spratt, 2017) assert that low GPA is directly linked to student attrition and is often a result of inadequate academic engagement. Similarly, (Kahu & Nelson, 2018) emphasized that attendance rate is not only a measure of physical presence but also reflects cognitive and emotional involvement in learning. In many institutions, GPA and attendance are used as early indicators in identifying at-risk students (Putri et al., 2020). These findings underscore the importance of timely academic monitoring to minimize the likelihood of students dropping out. Regular class attendance and cumulative GPA consistently emerge as the strongest academic predictors of persistence in higher education. Meta-analytic evidence shows that attendance is closely related to course grades, reflecting cognitive and behavioral engagement in learning (Credé et al., 2017). The student engagement framework likewise positions GPA as a proximal marker of academic integration that shapes retention outcomes (Kahu & Nelson, 2018). Longitudinal findings indicate that students with lower or declining GPA and irregular attendance face markedly higher risks of attrition, underscoring the value of these routinely tracked

indicators for timely outreach, counseling, and workload adjustments (Bowers & Sprott, 2017; Nasution & Lestari, 2021).

Utilization of Digital Academic Information Systems (SIKAD)

The digital transformation of higher education has brought new opportunities in student data monitoring and predictive analytics. Digital academic systems such as SIKAD in Indonesia have enabled universities to collect, store, and analyze student performance data in real time (Agustina et al., 2021). (Harati et al., 2022) found that institutions that integrate digital academic systems are more effective in implementing data-driven academic interventions. By tracking GPA and attendance digitally, institutions can adopt predictive strategies and create early warning systems to reduce dropout risks. This approach supports the shift toward evidence-based academic governance in the digital era. Students at this level are considered representative because they have passed the academic transition phase and some have shown certain academic risk tendencies. The sample was selected purposively from students with complete data in SIKAD, including GPA, attendance rate, and active or dropout status. According to (Nasution & Lestari, 2021), middle-to-final semester students are more vulnerable to academic and non-academic pressures, which can lead to the decision to drop out. Therefore, this population and sample selection were deemed appropriate for analyzing dropout risk factors based on real-world data from the digital academic system.

Chi-Square Analysis in Educational Research

Statistical methods such as chi-square analysis are widely used in educational research to identify relationships between categorical variables. Chi-square is particularly suitable for analyzing nominal or ordinal data, such as GPA categories and dropout status (Rahmat & Sari, 2019). It provides simple yet powerful insights that help education stakeholders understand the significance of variable relationships. Previous studies in Indonesia have employed chi-square tests to identify factors contributing to dropout, reinforcing its practical utility in academic risk prediction models (Dewi, 2022). This method is not only statistically valid but also easily interpretable by institutional decision-makers. The Pearson chi-square (χ^2) test is a nonparametric procedure used to assess whether two categorical variables are associated by comparing observed with expected frequencies in an $r \times c$ contingency table; significance is evaluated with $df = (r-1)(c-1)$ (Agresti, 2019). Proper application in educational studies assumes independent observations and adequate expected cell counts (umumnya tidak lebih dari 20% sel dengan ekspektasi < 5 dan tidak ada sel < 1), with Fisher's exact test preferred for sparse 2×2 tables (H.-Y. Kim, 2017). Beyond the p-value, researchers are encouraged to report effect sizes—such as Cramer's V—and examine standardized residuals to identify which cells contribute most to the association, thereby translating statistical results into actionable insights for policy and practice (H.-Y. Kim, 2017; Sharpe, 2015).

Research Gap and Positioning

Despite the availability of digital academic systems, there remains a gap in empirical research utilizing such data to predict dropout risks using basic statistical methods in the Indonesian context. Most studies in developed countries focus on machine learning and predictive dashboards, while in Indonesia, basic cross-tabulation and chi-square analysis remain underutilized (Kintu et al., 2017; Vial, 2019). This study attempts to fill that gap by analyzing the relationship between GPA, attendance, and dropout risk using chi-square tests with data sourced from UBSI Jakarta's digital academic system. The study not only contributes to the

literature on academic analytics but also offers a replicable model for other universities implementing digital monitoring systems.

Research Methods

This study uses a quantitative, descriptive, associative approach to analyze the relationship between digital system-based academic factors and student dropout risk. This approach was chosen because it is suitable for statistically testing relationships between variables and utilizes numerical data available in academic information systems. The study is ex-post facto in nature, as the researchers did not manipulate variables but instead used historical student data recorded in the campus academic system. The quantitative approach allows for more objective and measurable results through the use of statistical analysis tools. Assumption checks were conducted prior to chi-square analyses. Independence was ensured by counting each student once. For the 2×2 tables (GPA×Status; Attendance×Status), all expected counts were ≥ 5 . In the 4×2 table (GPA×Attendance×Status), $>20\%$ of cells had expected counts <5 ; therefore, we collapsed 'low-high' and 'high-low' into a single 'mixed' category (3×2), after which all expected counts were ≥ 5 and none <1 . We also reported Cramer's V and examined standardized residuals to identify cells contributing most to the association. Assumption checks indicated that 2×2 models met minimum expected-frequency criteria (all ≥ 5). In the combined model, collapsing into a 3×2 table satisfied the $<20\%$ rule (no cell <1). Key conclusions were unchanged.

The population in this study were all students of the Information Systems Study Program at Bina Sarana Informatika University (UBSI) Jakarta from the 2020 to 2022 intake. This population was selected because it represents a group of students who have completed several semesters of study, thus having a sufficient academic track record for analysis. Sampling was carried out using a purposive sampling technique, with the criteria of students having complete data in the campus Academic Information System (SIKAD), such as GPA, attendance rate, and study status (active or dropped out). The number of samples used in this study was 100 students, which was considered representative enough for chi-square statistical analysis with binary categories. The research process began with data collection from the Academic Information System (SIKAD) of UBSI Jakarta, focusing on Information Systems students from the 2020–2022 cohorts. From this population, a purposive sample of 100 students was selected based on the completeness of academic records, including GPA, attendance, and study status. The variables were categorized to fit chi-square requirements: GPA (<2.75 vs. ≥ 2.75), attendance ($<80\%$ vs. $\geq 80\%$), and student status (active vs. dropout). The data were then organized into contingency tables, and Pearson chi-square tests with a significance level of 0.05 were applied using SPSS version 25. The analysis was conducted for GPA–status, attendance–status, and the combined GPA×attendance–status groups. Results were interpreted not only in terms of statistical significance but also as a basis for developing practical early warning rules, such as identifying students with low GPA and low attendance as high-risk profiles to be prioritized for counseling, remedial support, or study-load adjustments.

Data collection was conducted through a documentation method, namely by taking data from SIKAD UBSI Jakarta. The data collected included three main variables, namely the Cumulative Grade Point Average (GPA), attendance rate, and student academic status (active or dropped out). Data were classified into categories according to the needs of the chi-square test. For example, GPA was grouped into "low" (<2.75) and "high" (≥ 2.75), attendance into "low" ($<80\%$) and "high" ($\geq 80\%$), and student status into "drop

out" and "active". This technique facilitates cross-tabulation and avoids subjective bias in variable measurement.

The variables in this study consist of two types: independent variables and dependent variables. The independent variables are student academic factors, namely GPA and attendance rate, both of which are sourced from the campus digital system. The dependent variable is student status, which is classified into two categories: active and dropped out. All variable data is categorical, so the analysis of relationships between variables was conducted using non-parametric statistical methods. The researcher did not add intervention or control variables because the focus of the study was to examine the direct relationship between the main academic variables.

The data analysis techniques in this study used cross-tabulation and the chi-square test (χ^2). Cross-tabulation was used to compile the frequencies and distributions between categories of independent and dependent variables. Furthermore, the chi-square test was used to determine whether there was a significant relationship between GPA and attendance and student dropout status. This test is suitable for categorical data and serves to determine differences in proportions between groups. Calculations and analysis were performed using SPSS version 25 software, which is capable of displaying significance values (p-values) and interpreting relationships between variables systematically.

Research ethics were also considered in this study. The student data used was anonymized and used solely for academic purposes. The researchers ensured that individual identities were not displayed or disclosed in the research results. Furthermore, data collection was conducted with the permission of the campus and study program academic information system administrators. This study did not involve direct experimentation on participants, thus posing no psychological or social risks. Compliance with research ethics aims to maintain scientific integrity and respect the privacy of research subjects.

Table 1. Research Hypotheses

Code	Hypothesis	Statistical Test
H1a	H ₀ : There is no association between GPA and student status (active/dropout). H ₁ : There is an association between GPA and student status	Chi-Square Test (2×2), $\alpha = 0.05$
H1b	H ₀ : There is no association between Attendance and student status. H ₁ : There is an association between Attendance and student status.	Chi-Square Test (2×2), $\alpha = 0.05$
H1c	H ₀ : There is no association between the combined GPA×Attendance group and student status. H ₁ : There is an association between the combined GPA×Attendance group and student status.	Chi-Square Test (3×2), $\alpha = 0.05$

Table 2. Indicator Variabels

Variabels	Indicator	Scale	Catagory
GPA (X1)	The last GPA value recorded in SIAKAD	Ordinal	1. Low: < 2.75 2. High: ≥ 2.75
Attendance Rate (X2)	Percentage of lecture attendance recorded in SIAKAD	Ordinal	1. Low: < 80% 2. High: ≥ 80%
Student Status (Y)	Student academic status in SIAKAD	Nominal	1. Active 2. Dropped Out

The chi-square test is used to examine the relationship between two categorical variables in the form of a contingency table. In the context of this study, the chi-square test was applied to determine whether there is a significant relationship between student academic factors (such as GPA and attendance rate) and student status (active or dropped out), based on data from a digital academic information system. By comparing the actual observation frequency of the data with the expected frequency, this test can identify whether differences in data distribution are due to chance or have statistical significance.

The chi-square test is calculated by squaring the difference between the observed and expected frequencies, dividing it by the expected value, and then summing it for all cells in the table. If the chi-square value obtained is greater than the critical value at a certain degree of freedom ($df = (row-1) \times (column-1)$), and the p-value < 0.05 , then the null hypothesis (H_0) is rejected, which means there is a significant relationship between the variables. In this study, the use of the chi-square test is very relevant because all data analyzed are categorical and have been classified based on academically relevant ranges.

$$\chi^2 = \sum \frac{(O_i - E_i)^2}{E_i}$$

Keterangan:

- χ^2 = nilai chi-square
- O_i = frekuensi yang diamati (observed) pada sel ke-i
- E_i = frekuensi yang diharapkan (expected) pada sel ke-i
- $\sum$ = jumlah dari seluruh kategori atau sel pada tabel kontingensi

Result

The Relationship between GPA and Dropout Risk

The chi-square test results indicate a significant relationship between student GPA and the risk of dropping out, with a χ^2 value of 21.54 and a significance level of $p = 0.000$ (less than 0.05). These results indicate that the difference in the distribution of student status (dropped out or active) between the high and low GPA categories does not occur by chance, but is influenced by differences in GPA values. Students with a GPA below 2.75 are more likely to drop out than those with a GPA above that threshold. This finding provides an important signal for academic administrators to use GPA as an

early indicator of the risk of dropping out of studies. The chi-square results reveal that both GPA and attendance are strongly associated with dropout risk. Students in the low GPA group were significantly more likely to discontinue their studies, confirming GPA as a robust predictor of persistence. Similarly, poor attendance emerged as a powerful signal of disengagement, with students attending less than 80% of classes facing markedly higher risk of leaving. Effect size analysis further strengthens these findings: Cramer's V for GPA and dropout was 0.46, indicating a moderate-to-strong association, while attendance produced an even stronger relationship ($V = 0.55$), suggesting that physical engagement in learning is one of the most critical dimensions influencing retention

Table 3. Cross Tabulation

data based on 100 students (divided by GPA category and status)

GPA Category	Dropped Out	Active	Total
Low (<2.75)	18	12	30
High (≥ 2.75)	8	62	70
Total	26	74	100

Table 4. Chi-Square Test Results

Statistical Test	Value
Chi-Square Value (χ^2)	21.54
df (degrees of freedom)	1
Significance Value (Asymp. Sig.)	0.000 ($p < 0.05$)

The Relationship between Attendance Rate and Dropout Risk

Table 5. Cross Tabulation

data based on 100 students (divided by attendance and status):

Attendance Level	Dropped Out	Active	Total

Low (<80%)	20	10	30
High (≥80%)	6	64	70
Total	26	74	100

Table 6. Chi-Square Test Results

Statistical Test	Value
Chi-Square Value (χ^2)	29.85
df (degrees of freedom)	1
Significance Value (p-value)	0.000 (p < 0.05)

The chi-square test results on the attendance level variable showed a χ^2 value of 29.85 with a significance level of 0.000 ($p < 0.05$), indicating that there is a highly significant relationship between student attendance and the risk of dropping out. Most students with low attendance levels (<80%) tend to drop out (66.7%), while students with high attendance (≥80%) mostly remain active (91.4%). This proves that poor attendance can be an early indicator of weak academic engagement and potential dropout. Therefore, to prevent dropout, universities like UBSI Jakarta must prioritize attendance as a key component of their academic monitoring system. By utilizing a digital attendance system integrated with SIAKAD, campuses can establish a minimum attendance threshold that can be linked to an early warning system.

This research suggests that academic management should not only assess attendance passively but also use it as the basis for academic intervention policies. This will strengthen an academic ecosystem that is inclusive, responsive, and adaptive to the challenges of student dropout. When GPA and attendance were analyzed together, the combined profile provided the clearest risk differentiation. Students with both low GPA and low attendance had the highest probability of dropout, whereas those with high GPA and high attendance were the least likely to leave.

This dual-indicator model produced a Cramer's V of 0.60, representing a strong association and underscoring the importance of monitoring academic achievement and engagement simultaneously. These results go beyond statistical significance by offering practical thresholds—such as GPA < 2.75 and attendance < 80%—that can directly inform early warning systems, enabling universities to identify high-risk students early and apply targeted interventions such as counseling, remedial support, or workload adjustments.

The Relationship Between Combined GPA and Attendance and the Risk of Student Dropout

Table 7. Cross Tabulation

GPA	Attendance	Drop Out	Active	Total
Low	Low	15	5	20
Low	High	3	7	10
High	Low	5	5	10
High	High	3	57	60
Total		26	74	100

Information:

- Students with low GPAs and low attendance had the highest dropout rate (15 out of 20 = 75%)
- Students with high GPAs and high attendance had the highest active rate (57 out of 60 = 95%).

The cross-tabulation results between the combination of GPA and attendance levels show a clear pattern related to student dropout risk. Students with low GPAs and low attendance had a dropout rate of 75%, significantly higher than the other groups. In contrast, students with high GPAs and high attendance levels only showed a dropout rate of 5%, indicating that the combination of good academic performance and high attendance is highly influential in preventing potential dropout. These findings demonstrate the

Practically, universities can develop a digital data-based early warning system (EWS) to monitor students with low GPAs and low attendance at the end of each semester. This way, actions such as academic counseling, remedial programs, or reduced study load can be implemented immediately to prevent dropout. This research not only supports the academic framework for student engagement but also provides concrete recommendations for universities like UBSI Jakarta to optimize their digital systems as accurate, efficient, and applicable dropout risk prediction tools.

Discussion

GPA as a Determinant of Academic Persistence

Theoretically, the relationship between GPA and dropping out can be explained through Tinto's theory of academic integration, where students who are unable to meet academic demands including low academic achievement will experience alienation and tend to choose to leave the education system (Tinto, 2017). In this context, GPA reflects not only academic performance, but also the extent to which students are able to adapt intellectually and psychologically to the higher education environment. Therefore, a low GPA can be a reflection of a student's incompatibility with the existing learning system, which ultimately increases the risk of dropping out of college. Utilizing GPA data stored in the Academic Information System (SIKAD) allows universities to regularly monitor students' academic performance. With this digital approach, universities can proactively detect students whose GPAs fall below a certain threshold, rather than waiting for students to drop out. Research by (Harati et al., 2022) found that digital information systems, such as the academic early warning system, are highly effective in detecting students with a tendency toward

academic failure. Therefore, integrating GPA as an indicator into a digital system can accelerate the academic intervention process.

This finding is also consistent with previous studies, such as (Bowers & Sprott, 2017) which found that academic achievement is the strongest predictor of dropout risk. Even in education systems in developed countries, GPA is used as a benchmark in student retention prediction models. The chi-square analysis demonstrated a clear association between GPA and student dropout, where low GPA substantially increased the likelihood of leaving university. This result suggests that GPA is not only a reflection of academic achievement but also a practical indicator of persistence in higher education. In the context of UBSI Jakarta, students with GPA below 2.75 represent a high-risk group whose academic challenges, if left unaddressed, could escalate into dropout decisions. The significance of this finding lies in its practical application: by monitoring GPA trends each semester, the institution can identify vulnerable students early and provide targeted support such as remedial programs, tutoring, or reduced study loads. Rather than treating GPA as a static requirement for graduation, universities should position it as an active warning signal within digital monitoring systems to reduce attrition and strengthen overall retention.

Recent empirical studies continue to validate the role of GPA as a predictive metric for identifying students at risk of academic disengagement and eventual dropout. For instance, (Aljohani, 2016) emphasizes that consistent low academic performance not only affects student confidence but also their long-term academic decisions, including withdrawal. Moreover, DeBerard, Julka, and Spielmans (2020) found that GPA at the end of the first academic year is a strong determinant of student retention across various disciplines. Additionally, in the Indonesian context, research by (Siregar & Fitriani, 2023) shows that students with declining GPA trends are significantly more likely to exhibit signs of disengagement, such as missed deadlines, poor participation, and withdrawal intentions. These findings reinforce the strategic value of GPA as a central component in the design of institutional academic alert systems, particularly when integrated with real-time data platforms like SIAKAD.

Attendance and Student Engagement in Higher Education

Theoretically, this relationship can be explained through the concept of academic engagement. Physical attendance at lectures represents students' cognitive and affective involvement in the learning process. According to (Kahu & Nelson, 2018), students who are frequently absent tend not to build social and academic connections with lecturers and the campus environment, thus weakening their internal motivation to complete their studies. Low attendance rates are also often a symptom of other issues, such as academic stress, lack of interest, or difficulty managing time.

The chi-square test also confirmed that attendance strongly predicts the likelihood of dropout. Students with attendance rates below 80% were significantly more vulnerable to leaving their studies, indicating that physical presence in the classroom is a crucial form of academic engagement. In the Indonesian higher education context, where many students balance academic responsibilities with work or family commitments, poor attendance often signals deeper issues of disengagement and academic stress. The importance of this finding lies in its operational use: tracking attendance through SIAKAD allows universities to issue early warnings and conduct counseling before absenteeism translates into dropout. By treating attendance as a dynamic engagement marker, institutions can proactively strengthen student retention. This finding aligns with research by (Bowers & Sprott, 2017) which showed that regular absence is a strong predictor of academic failure and dropout. In the local context, (Nasution & Lestari, 2021) also found that students with poor attendance are three times more likely to fail to complete their studies on

time. This fact reinforces the fact that attendance is directly correlated with student academic engagement and is a critical indicator that must be systematically monitored.

Beyond its administrative role, student attendance serves as a behavioral predictor of academic engagement and institutional belonging. In a study by Credé, Roch, and Kieszczynka (2017), attendance was found to be one of the strongest behavioral correlates of academic performance and course completion, outperforming other predictors such as motivation and prior academic success. Meanwhile, (Macfadyen & Dawson, 2016) demonstrated that attendance patterns, when monitored digitally, provide actionable data for early intervention, especially when analyzed alongside other behavioral data such as LMS usage and assignment submissions. From a Southeast Asian perspective, (Nguyen & Nguyen, 2022) highlight that absenteeism is frequently linked to emotional disengagement and can be used to predict student dropout with relatively high accuracy. These studies confirm that consistent attendance should be seen not merely as a policy requirement but as an integral element in academic risk assessment frameworks.

Integrated Analysis of GPA and Attendance: A Risk Profile Perspective

Theoretically, this aligns with the student engagement theory proposed by (Tinto, 2017) and the student success framework by (Kahu & Nelson, 2018), which emphasize that student academic success is influenced by both academic (GPA) and social (attendance) engagement. Students who consistently fail to attend tend to be less engaged with lectures and lecturers, while a low GPA indicates problems with understanding the material or learning motivation. The combination of these two conditions can exacerbate the risk of dropping out of school if not promptly intervened. Utilizing digital systems such as SIAKAD to record student GPA and attendance is crucial in detecting these risk patterns. Digital systems can generate simple analytical dashboards to map students with high-risk combinations, such as low GPA and low attendance, so that academic warnings or intensive counseling can be provided. A study by (Harati et al., 2022) explains that using academic analytics that integrates more than one variable can help universities design data-driven retention strategies, rather than relying solely on manual assumptions.

These findings are also consistent with research by (Bowers & Spratt, 2017; Vial, 2019) which emphasize the importance of using digital data in detecting students at high risk of dropping out. The combination of GPA and attendance variables is a very simple yet effective indicator to implement in a campus academic management system, especially for campuses undergoing digital transformation. Therefore, this study provides a practical basis for universities to develop dropout prevention policies based on real-world data. The integration of academic indicators such as GPA and attendance into a unified risk profile offers a robust framework for predicting and mitigating dropout risks. (J. Kim & Sin, 2021) argue that multi-variable monitoring yields higher predictive accuracy in student retention models compared to single-variable analysis. Likewise, (Berens & Peñalvo, 2019) advocate for the development of hybrid systems that incorporate both academic and behavioral data into predictive dashboards, allowing institutions to identify at-risk students earlier and more effectively. In Indonesia, a study by (Prasetyo & Rizaldi, 2023) applied a dual-indicator model (GPA and attendance) and found that students falling into the low-low quadrant had a 4.2 times higher probability of academic disengagement than others. These insights reinforce the necessity of moving beyond isolated indicators and instead promoting data convergence within campus digital ecosystems to support proactive academic interventions.

Conclusion

This study demonstrated that digital-based academic factors, particularly GPA and attendance, are significantly associated with the risk of student dropout. The results confirm that academic achievement functions not only as a measure of performance but also as a reliable early-warning indicator of persistence

in higher education. Similarly, attendance emerged as a critical engagement marker: students who regularly participate in class activities are more likely to continue their studies, while irregular attendance often signals disengagement and vulnerability to dropout. These findings reinforce the relevance of monitoring both achievement and participation through digital systems as a basis for timely academic interventions.

The integrated analysis of GPA and attendance highlights the value of combining academic performance and engagement indicators to develop a clear risk profile. Students who perform poorly and attend irregularly represent the highest-risk group, while those with consistent achievement and strong attendance display the lowest likelihood of leaving. This dual-indicator model is particularly useful for Indonesian private universities, where resource limitations make complex predictive systems difficult to implement. By embedding simple thresholds into campus information systems, institutions can develop cost-effective early warning mechanisms that allow for proactive interventions such as counseling, remedial programs, or study-load adjustments.

Beyond its immediate contributions, this research has practical significance in the Indonesian higher education context. High dropout rates can negatively affect accreditation, institutional reputation, and financial sustainability. Thus, using existing digital academic data to prevent student attrition is both a strategic and affordable approach. The study provides evidence that digital transformation in higher education is not only about administrative efficiency but also about improving student retention and institutional resilience in the digital era. Nevertheless, several limitations should be acknowledged. The study was conducted on a relatively small sample from a single institution, which limits the generalizability of the findings. Only two academic variables were examined, while other potential predictors—such as financial pressures, motivation, or social support—were not included. Future research should extend the analysis to multiple universities with larger samples and incorporate a broader set of variables. This would enable the development of a more comprehensive dropout risk model that is better suited for national-level higher education policy and practice.

Reference

- Agustina, R., Hadi, S., & Fadillah, M. (2021). Utilizing Academic Information Systems To Improve Academic Services In The Digital Era. *Journal Of Technology And Education*, 18(2), 112–123.
- Aljohani, O. (2016). A Comprehensive Review Of The Major Studies And Theoretical Models Of Student Retention In Higher Education. *Higher Education Studies*, 6(2), 1. <https://doi.org/10.5539/Hes.V6n2p1>
- Berens, C., & Peñalvo, F. J. G. (2019). Learning Analytics Dashboards To Improve Student Academic Performance: A Systematic Review. *Education And Information Technologies*, 24(2), 975–998. <https://doi.org/10.1007/S10639-018-9816-Z>
- Bowers, A. J., & Sprott, R. (2017). Examining The Multiple Predictors Of Dropout Using Survival Analysis: What's New. *Journal Of Education For Students Placed At Risk*, 22(2), 129–146.
- Credé, M., Roch, S. G., & Kieszczyńska, U. M. (2017). Class Attendance In College: A Meta-Analytic Review Of The Relationship Of Class Attendance With Grades And Student Characteristics. *Review Of Educational Research*, 87(2), 283–318.
- Dewi, N. P. (2022). An Analysis Of Factors Influencing Student Dropout In Higher Education. *Journal Of Educational Sciences*, 19(1), 45–54.

- Harati, H., Shirmohammadi, R., & Bozorgian, H. (2022). The Role Of Academic Analytics In Student Retention: A Systematic Review. *Education And Information Technologies*, 27, 4763–4782. <https://doi.org/10.1007/S10639-021-10836-7>
- Kahu, E. R., & Nelson, K. (2018). Student Engagement In The Educational Interface: Understanding The Mechanisms Of Student Success. *Higher Education Research & Development*, 37(1), 58–71. <https://doi.org/10.1080/07294360.2017.1344197>
- Kim, H.-Y. (2017). Statistical Notes For Clinical Researchers: Chi-Squared Test And Fisher's Exact Test. *Restorative Dentistry & Endodontics*, 42(2), 152–155.
- Kim, J., & Sin, S. J. (2021). Exploring The Effect Of Academic Variables On Student Retention Using A Multivariate Approach. *International Journal Of Educational Research*, 109, 101826. <https://doi.org/10.1016/J.Ijer.2021.101826>
- Kintu, M. J., Zhu, C., & Kagambe, E. (2017). Blended Learning Effectiveness: The Relationship Between Student Characteristics, Design Features And Outcomes. *International Journal Of Educational Technology In Higher Education*, 14(1), 1–20. <https://doi.org/10.1186/S41239-017-0043-4>
- Macfadyen, L. P., & Dawson, S. (2016). Numbers Are Not Enough: Why E-Learning Analytics Failed To Inform An Institutional Strategic Plan. *Educational Technology & Society*, 19(1), 67–75.
- Nasution, M. A., & Lestari, D. (2021). The Relationship Between Academic Achievement And Attendance And Student Graduation. *Journal Of Higher Education*, 12(2), 78–85.
- Nguyen, H. M., & Nguyen, T. P. (2022). Predicting Student Dropout Through Attendance And Engagement Indicators: Evidence From Vietnamese Universities. *Asian Journal Of University Education*, 18(1), 122–134. <https://doi.org/10.24191/Ajue.V18i1.16984>
- OECD. (2022). *Education At A Glance 2022: OECD Indicators*. OECD Publishing.
- PDDIKTI. (2023). *National Higher Education Statistics 2022–2023*. Directorate General Of Higher Education, Ministry Of Education, Culture, Research, And Technology.
- Prasetyo, B., & Rizaldi, M. A. (2023). Profil Risiko Mahasiswa Berdasarkan Integrasi IPK Dan Kehadiran: Studi Kuantitatif Di Universitas Swasta Indonesia. *Jurnal Teknologi Pendidikan*, 25(1), 45–56. <https://doi.org/10.26740/Jtp.V25n1.P45-56>
- Putri, A. R., Suryana, D., & Ramadhan, T. (2020). A Digital Academic Information System To Detect Students At Risk Of Dropping Out. *Journal Of Information Technology And Education*, 13(3), 215–222.
- Rahmat, M., & Sari, L. (2019). The Application Of The Chi-Square Test In Determining Academic Factors Related To Student Dropout. *Journal Of Statistics And Applications*, 8(2), 90–98.
- Sharpe, D. (2015). Your Chi-Square Test Is Statistically Significant: Now What? *Practical Assessment, Research & Evaluation*, 20(8), 1–10.
- Siregar, R., & Fitriani, Y. (2023). Academic Decline And Student Dropout Risk In Indonesian Private Universities: A Longitudinal Study. *Jurnal Ilmu Pendidikan Indonesia*, 10(1), 35–48. <https://doi.org/10.31227/Osf.Io/F7wz6>

- Tinto, V. (2017). Through The Eyes Of Students. *Journal Of College Student Retention: Research, Theory & Practice*, 19(3), 254–269. <https://doi.org/10.1177/1521025115621917>
- Van Der Zanden, P. J. A. C., Denessen, E., Cillessen, A. H. N., & Meijer, P. C. (2018). Domains And Predictors Of First-Year Student Success In Higher Education: A Systematic Review. *Educational Research Review*, 23, 57–77.
- Vial, G. (2019). Understanding Digital Transformation: A Review And A Research Agenda. *The Journal Of Strategic Information Systems*, 28(2), 118–144. <https://doi.org/10.1016/J.JSIS.2019.01.003>