

Analysis of ChatGPT Usage Intensity Patterns on Student Creativity and Productivity Using a Data Analytics and SEM-PLS Approach

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ABSTRACT

The development of *Artificial Intelligence* (AI), particularly ChatGPT, has provided significant support for students in carrying out academic activities. This study aims to examine the effects of *Perceived Usefulness*, *Perceived Ease of Use*, *Subjective Norm*, *Task Relevance*, *Content*, *Accuracy*, *Format*, and *Timeliness* on the Intensity of ChatGPT Usage, as well as the effects of ChatGPT Usage Intensity on Student Creativity and Student Productivity. This study employed a quantitative approach by distributing an online questionnaire to active students at Universitas Dinamika Bangsa, Universitas Islam Negeri Sulthan Thaha Saifuddin Jambi, and Universitas Jambi. Data were analyzed using the *Structural Equation Modeling-Partial Least Squares (SEM-PLS)* method with the assistance of *SmartPLS* software. The results indicate that all eleven proposed hypotheses were supported. The eight exogenous variables have a positive and significant effect on the Intensity of ChatGPT Usage, while the Intensity of ChatGPT Usage has a positive and significant effect on both Student Creativity and Student Productivity. Furthermore, Student Creativity also has a positive and significant effect on Student Productivity.

Keyword: ChatGPT, Usage Intensity, Student Creativity, Student Productivity, SEM-PLS



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1. INTRODUCTION

The development of digital technology in the Industrial Revolution 4.0 era, and its ongoing transition toward Society 5.0, has transformed higher education through the adoption of *Artificial Intelligence* (AI). AI no longer functions merely as an automation tool; it has become an intelligent system capable of processing and generating information through *Natural Language Processing* (NLP). This shift is evidenced by the strategic role of *generative AI* in supporting modern learning [1][2][3].

ChatGPT, an AI-based chatbot developed by OpenAI and released in November 2022, is one of the most widely adopted forms of generative AI in academic environments. ChatGPT is designed to provide contextual responses to natural-language instructions and to generate human-like text [4]. Its use in education spans writing assistance, academic problem-solving, idea development, and self-paced learning. At the same time, the growing use of ChatGPT has triggered debate regarding policy and academic-ethics implications [5]. As an NLP-based system, ChatGPT opens new opportunities for digital learning, idea generation, and the efficient composition of academic content [6].

Prior studies have reported positive impacts of ChatGPT on students, including improved comprehension of course material, assistance in completing assignments, and improved learning performance [7]. A meta-analysis found a large positive effect of ChatGPT on *learning performance* and a moderate positive effect on *learning perception* and *higher-order thinking*. Other quantitative studies have revealed a positive correlation between the intensity of ChatGPT usage and students' creativity and academic achievement, indicating that generative AI contributes to broadening ideas and completing tasks more productively [8].

In the local context of Jambi City, the use of ChatGPT has become a tangible phenomenon in student academic activity. Preliminary observation indicates that ChatGPT is used for literature searching, assignment preparation, understanding course material, and exam preparation. The high intensity of this usage suggests that ChatGPT has become an integral part of the student learning ecosystem. However, such intensive use is not yet fully supported by empirical understanding of its measurable impact on creativity and productivity. A scientific study is therefore needed to systematically analyze the pattern of ChatGPT usage intensity and its implications for student creativity and productivity, using a *Data Analytics* approach combined with *Structural Equation Modeling–Partial Least Squares* (SEM-PLS) [9][10].

On the other hand, intensive ChatGPT usage also raises academic concerns. Several studies have reported the risk of AI dependency, which may reduce students' active engagement in critical thinking and affect their analytical ability when used without adequate digital-literacy guidance. Concerns about academic integrity have also emerged, since ChatGPT can easily generate human-like text, increasing the risk of plagiarism and unethical practices in academic assignments [11].

In Indonesia, the phenomenon of ChatGPT usage has grown alongside increasing student digital literacy and the readiness of technological infrastructure in higher-education institutions. Empirical studies show that students from various study programs use ChatGPT to search for references, formulate initial ideas for scientific writing, solve academic problems, and improve the efficiency of coursework completion [12][13][14]. Nevertheless, research that specifically and quantitatively assesses how the intensity of ChatGPT usage affects student creativity and productivity through a *Data Analytics* and SEM-PLS approach remains limited, particularly one grounded in a relevant technology-acceptance theory such as the *Technology Acceptance Model 2* (TAM 2), which emphasizes task relevance and system output quality.

TAM 2 extends the original *Technology Acceptance Model* by positioning *Perceived Usefulness* (PU) and *Perceived Ease of Use* (PEOU) as core determinants of technology adoption, while adding *Subjective Norm* (SN) and *Task Relevance* (TR) as antecedents that reflect social influence and job/task fit [18][20]. This study further integrates four dimensions of the *End User Computing Satisfaction* (EUCS) model — *Content* (CT), *Accuracy* (AC), *Format* (FM), and *Timeliness* (TL) — which represent the quality of the information output produced by an information system and are commonly used to explain user satisfaction and continued system usage [19][21]. Combining TAM 2 and EUCS allows the present study to examine both the acceptance-related and the output-quality-related antecedents of ChatGPT usage intensity within a single structural model.

Based on the conditions described above, this study was conducted to analyze the pattern of ChatGPT usage intensity in relation to student creativity and productivity using a *Data Analytics* and SEM-PLS approach. It is expected to provide a comprehensive understanding of AI's contribution to the quality of learning in higher education, while also serving as a basis for institutions in formulating strategic, ethical, and sustainable technology-use policies.

Based on this background, the research problems addressed in this study are: (1) what is the pattern and level of ChatGPT usage intensity among students in supporting academic activities; (2) how does ChatGPT usage intensity significantly affect student creativity; and (3) how does ChatGPT usage intensity significantly affect student productivity. Accordingly, this study aims to analyze the pattern and level of ChatGPT usage intensity among students, to examine the effect of ChatGPT usage intensity on student creativity and productivity, and to examine the role of student creativity in the relationship between ChatGPT usage intensity and student productivity.

2. RESEARCH METHOD

This study employed a quantitative approach using the *Structural Equation Modeling–Partial Least Squares* (SEM-PLS) method, processed with *SmartPLS* software, to analyze the relationships among the variables in the research model. This method was chosen because it is suitable for analyzing predictive latent constructs, allowing the study to test the factors that influence ChatGPT usage intensity as well as its impact on student creativity and productivity [28]. The research procedure was organized into three main stages: (1) a preparation stage, comprising problem identification, a literature review, the formulation of the research model and hypotheses, and the design of the Likert-scale questionnaire

instrument; (2) an implementation stage, comprising online data collection through Google Forms and data processing with SEM-PLS; and (3) an analysis and closing stage, comprising the interpretation of the results, hypothesis testing, and the formulation of conclusions and recommendations.

The research model integrates TAM 2 and the four EUCS dimensions as independent exogenous variables. Structurally, the model places *Perceived Usefulness* (PU), *Perceived Ease of Use* (PEOU), *Subjective Norm* (SN), *Task Relevance* (TR), *Content* (CT), *Accuracy* (AC), *Format* (FM), and *Timeliness* (TL) as eight direct predictors of Usage Intensity (IU). Usage Intensity (IU) subsequently influences Creativity (CR) and Productivity (PR) directly, while Creativity (CR) is also positioned as a variable that directly affects Productivity (PR). Overall, the model comprises eleven latent constructs and was designed to test eleven hypotheses using the SEM-PLS approach, as illustrated in Figure 1.

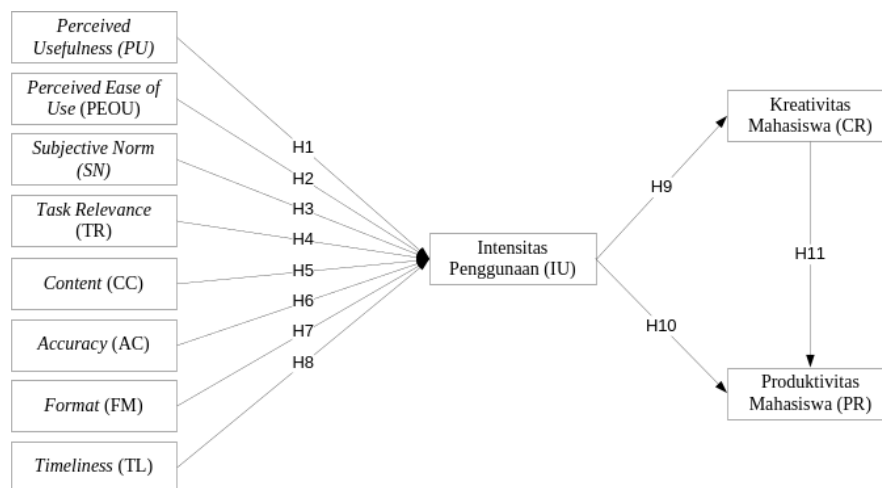


Fig 1. Research Model

The eleven research hypotheses formulated from the model above, grounded in TAM 2, EUCS, and prior literature on AI use in education, are presented below.

H1. *Perceived Usefulness* (PU) → Usage Intensity (IU).

Perceived usefulness is a primary factor influencing technology acceptance and use under TAM 2; the greater the benefit students perceive from ChatGPT, the higher its usage intensity [18][20].

H2. *Perceived Ease of Use* (PEOU) → Usage Intensity (IU).

Ease of use reduces the barriers to interacting with the technology, encouraging students to use ChatGPT more intensively in academic activities [18].

H3. *Subjective Norm* (SN) → Usage Intensity (IU).

Social influence from the academic environment — lecturers, peers, and institutions — can encourage students to accept and use ChatGPT more intensively [20].

H4. *Task Relevance* (TR) → Usage Intensity (IU).

The fit between ChatGPT's functions and students' academic needs increases their motivation to use the technology to complete various coursework [20].

H5. *Content* (CT) → Usage Intensity (IU).

Relevant, complete, and need-appropriate content quality increases satisfaction and thereby encourages continued ChatGPT use [19][21].

H6. *Accuracy* (AC) → Usage Intensity (IU).

The accuracy of information provided by ChatGPT increases user trust, encouraging more frequent use [19].

H7. *Format* (FM) → Usage Intensity (IU).

Systematic and easy-to-understand presentation of information provides a better user experience, thereby increasing ChatGPT usage intensity [19].

H8. Timeliness (TL) → Usage Intensity (IU).

Response speed and timeliness in presenting information allow ChatGPT to meet students' academic needs efficiently, thereby increasing usage intensity [19].

H9. Usage Intensity (IU) → Student Creativity (CR).

Intensive ChatGPT use gives students the opportunity to explore diverse information, perspectives, and alternative solutions, thereby enhancing creativity in completing academic tasks [7][23].

H10. Usage Intensity (IU) → Student Productivity (PR).

Intensive use of ChatGPT helps students obtain information faster, improves task-completion efficiency, and supports greater academic productivity [10][7].

H11. Student Creativity (CR) → Student Productivity (PR).

Students with a high level of creativity tend to produce more innovative and effective solutions, which in turn improves productivity in academic activities [22][24].

The operational definitions of the research variables were formulated to make each construct measurable and empirically testable. The variables consist of exogenous, mediating, and endogenous variables. *Usage Intensity* (IU) is defined as the frequency, duration, and depth/proportion with which students utilize ChatGPT to support academic activities, measured through three indicators. *Student Creativity* (CR) reflects students' ability to generate new ideas and alternative solutions when using ChatGPT for academic tasks, measured through three indicators. *Student Productivity* (PR) reflects the efficiency and effectiveness of academic task completion resulting from ChatGPT use, measured through three indicators. The eight exogenous constructs (PU, PEOU, SN, TR, CT, AC, FM, and TL) were each measured using two to four indicators adapted from the TAM 2 and EUCS literature.

All constructs were measured using a five-point Likert scale, in which respondents rated each questionnaire statement from "Strongly Disagree" to "Strongly Agree," as summarized in Table 1 [15]. The resulting raw scores (1–5) were subsequently processed and analyzed using the SEM-PLS approach.

Table 1. Five-Point Likert Measurement Scale

Score	Response Category	Weight
1	Strongly Disagree (SD)	1
2	Disagree (D)	2
3	Neutral (N)	3
4	Agree (A)	4
5	Strongly Agree (SA)	5

The population of this study comprised all active students at Universitas Dinamika Bangsa Jambi (UNAMA), Universitas Islam Negeri Sulthan Thaha Saifuddin Jambi (UIN), and Universitas Jambi (UNJA) who had used or were using ChatGPT for academic activities, either to understand course material, complete assignments, or develop ideas and references. A non-probability purposive-sampling technique was employed, with the following criteria: (1) an active student at UNAMA, UIN, or UNJA; (2) had used ChatGPT for academic activities; and (3) willing to serve as a respondent and complete the questionnaire in full.

The minimum sample size was determined using the 10-times rule commonly applied in SEM-PLS research, which states that the minimum sample size equals 10 times the largest number of indicators for any single latent variable [16][15]:

$$n = 10 \times m \quad (1)$$

where n is the minimum sample size and m is the largest number of indicators on a single variable. In this study, the largest number of manifest indicators for a single latent variable was four (on *Perceived*

Usefulness), yielding a minimum required sample of $n = 10 \times 4 = 40$ respondents. To improve model stability, parameter-estimation accuracy, and the statistical power of the SEM-PLS analysis, this study targeted 150–170 respondents, a number considered to satisfy SEM-PLS feasibility standards and to adequately represent the characteristics of the population. A total of 170 valid responses were ultimately obtained.

Instrument testing was carried out to ensure that the questionnaire satisfied the validity and reliability criteria required for further analysis, evaluated through the outer (measurement) model in SEM-PLS [16]. *Convergent validity* was assessed through the outer loading and *Average Variance Extracted* (AVE) values: an indicator is considered valid if its outer loading is ≥ 0.70 , although a loading between 0.50 and 0.70 remains acceptable if the construct's AVE is ≥ 0.50 ; an AVE ≥ 0.50 indicates that a construct explains more than 50% of its indicators' variance. *Discriminant validity* was assessed using the Fornell–Larcker criterion and the *Heterotrait–Monotrait Ratio* (HTMT); a construct is considered to possess good discriminant validity when the square root of its AVE exceeds its correlations with other constructs and its HTMT value is below 0.90. *Reliability* was assessed through Cronbach's Alpha and *Composite Reliability* (CR), with both values required to be ≥ 0.70 .

Prior to the main data collection, a pilot test was conducted with 30 qualifying student respondents. The pilot-test evaluation of the outer model showed that all indicators fully met the feasibility criteria: outer loadings ranged from 0.841 to 0.968 (well above the ≥ 0.70 threshold), AVE values ranged from 0.746 to 0.929 (above the ≥ 0.50 threshold), and both Cronbach's Alpha and Composite Reliability ranged from 0.821 to 0.963 (above the ≥ 0.70 threshold). These results empirically confirmed that the questionnaire instrument was valid, reliable, and suitable for the main data collection without any revision or removal of indicators.

The collected data were analyzed in two stages. First, *descriptive analysis* was used to map respondent demographic patterns and ChatGPT usage intensity, using the percentage formula adapted from [15]:

$$P = (f / n) \times 100\% \quad (2)$$

where P is the percentage, f is the frequency of respondents choosing a particular answer, and n is the total number of respondents.

Second, *inferential analysis* was carried out using the SEM-PLS algorithm to test the hypotheses and evaluate the model. Following [16] and [25], model evaluation in SEM-PLS does not rely on a single covariance-based formula but on several metric parameters: (a) *Average Variance Extracted* (AVE ≥ 0.50), which measures the proportion of indicator variance explained by its latent construct; (b) *Composite Reliability* (CR ≥ 0.70), which measures internal-consistency reliability; (c) the *Coefficient of Determination* (R^2), which measures how well the exogenous and mediating variables explain the endogenous constructs (Creativity, Productivity, and Usage Intensity), with values closer to 1 indicating stronger predictive power; and (d) the *Path Coefficient* (β) together with *T-Statistics*, used to test the significance of direct and indirect effects through a bootstrapping procedure; a hypothesis is accepted if the T-Statistic ≥ 1.96 (at $\alpha = 0.05$) or the P-value < 0.05 .

Primary data were obtained directly from respondents through the questionnaire, while secondary data — scientific journals, reference books, and academic publications on ChatGPT, technology adoption, creativity, productivity, and the SEM-PLS method — supported the development of the theoretical foundation, the research model, and the interpretation of the results. Data collection and analysis were supported by Google Forms, Microsoft Excel, SmartPLS, and standard reference-management software.

3. RESULTS AND DISCUSSION

A. Respondent Characteristics

This study collected data from 170 valid respondents who were active students and ChatGPT users at three universities in Jambi City: UNAMA, UIN, and UNJA. Respondent characteristics were profiled based on gender, age, university of origin, and current semester, as summarized in Table 2.

The majority of respondents were female, accounting for 116 respondents (68.2%), while male respondents totaled 54 (31.8%). By age group, most respondents (58.2%) were between 20 and 30

Analysis of ChatGPT Usage Intensity Patterns on Student Creativity and Productivity Using a Data Analytics and SEM-PLS Approach (Sri Muliani Nurrohmah)

years old, indicating that most ChatGPT users among the sample belong to the young-adult group that tends to be more active in utilizing digital technology and artificial intelligence for academic and professional activities. By university of origin, the largest share of respondents came from UNAMA (38.8%), followed by UNJA (37.1%) and UIN (24.1%), reflecting a relatively balanced distribution across the three institutions and providing a more representative picture of ChatGPT usage among students in the region. By current semester, most respondents (45.9%) were in semesters 5–6, suggesting that the majority of ChatGPT users among the respondents are mid-to-upper-level students who face greater academic demands, such as assignment preparation, research, and thesis completion.

Table 2. Respondent Characteristics (n = 170)

Characteristic	Category	n	%
Gender	Female	116	68.2
	Male	54	31.8
Age	< 20 years	51	30.0
	20–30 years	99	58.2
	> 30 years	20	11.8
University	UNAMA	66	38.8
	UIN	41	24.1
	UNJA	63	37.1
Semester	3–4	35	20.6
	5–6	78	45.9
	7–8	57	33.5

B. Measurement (Outer) Model Evaluation

Convergent validity was evaluated through outer loading and AVE values. As shown in Table 3, all 26 indicators across the eleven constructs produced outer loadings between 0.831 and 0.951, exceeding the ≥ 0.70 threshold and confirming that every indicator is a valid measure of its intended construct.

Table 3. Outer Loading Results

Indicator	Variable	Outer Loading	Criterion	Remark
AC1	Accuracy	0.901	>0.70	Valid
AC2	Accuracy	0.937	>0.70	Valid
CR1	Student Creativity	0.861	>0.70	Valid
CR2	Student Creativity	0.856	>0.70	Valid
CR3	Student Creativity	0.831	>0.70	Valid
CT1	Content	0.938	>0.70	Valid
CT2	Content	0.903	>0.70	Valid
FM1	Format	0.927	>0.70	Valid
FM2	Format	0.937	>0.70	Valid
IU1	Usage Intensity	0.860	>0.70	Valid
IU2	Usage Intensity	0.866	>0.70	Valid
IU3	Usage Intensity	0.846	>0.70	Valid
PEOU1	Perceived Ease of Use	0.889	>0.70	Valid
PEOU2	Perceived Ease of Use	0.909	>0.70	Valid
PEOU3	Perceived Ease of Use	0.860	>0.70	Valid
PR1	Student Productivity	0.870	>0.70	Valid
PR2	Student Productivity	0.837	>0.70	Valid

PR3	Student Productivity	0.863	>0.70	Valid
PU1	Perceived Usefulness	0.856	>0.70	Valid
PU2	Perceived Usefulness	0.875	>0.70	Valid
PU3	Perceived Usefulness	0.863	>0.70	Valid
PU4	Perceived Usefulness	0.860	>0.70	Valid
SN1	Subjective Norm	0.934	>0.70	Valid
SN2	Subjective Norm	0.850	>0.70	Valid
SN3	Subjective Norm	0.857	>0.70	Valid
TL1	Timeliness	0.914	>0.70	Valid
TL2	Timeliness	0.903	>0.70	Valid
TR1	Task Relevance	0.879	>0.70	Valid
TR2	Task Relevance	0.951	>0.70	Valid

Table 4 presents the *Average Variance Extracted* (AVE) for each construct, all of which exceed 0.50, confirming adequate convergent validity for every latent variable in the model.

Table 4. Average Variance Extracted (AVE)

Variable	AVE	Criterion	Remark
Accuracy	0.844	>0.50	Valid
Content	0.848	>0.50	Valid
Format	0.868	>0.50	Valid
Usage Intensity	0.735	>0.50	Valid
Student Creativity	0.722	>0.50	Valid
Perceived Ease of Use	0.785	>0.50	Valid
Perceived Usefulness	0.746	>0.50	Valid
Student Productivity	0.735	>0.50	Valid
Subjective Norm	0.776	>0.50	Valid
Task Relevance	0.838	>0.50	Valid
Timeliness	0.825	>0.50	Valid

Discriminant validity was further verified using the Fornell–Larcker criterion and the HTMT ratio. All constructs satisfied the requirement that the square root of AVE exceeds their correlation with other constructs, and all HTMT values were below the 0.90 threshold, confirming that each construct is empirically distinct from the others.

Reliability was assessed using Cronbach's Alpha and Composite Reliability, both of which exceeded 0.70 for all eleven constructs, as shown in Table 5, confirming that the instrument has good internal consistency.

Table 5. Reliability Test Results

Variable	Cronbach's Alpha	Composite Reliability	Remark
PU	0.886	0.921	Reliable
PEOU	0.865	0.916	Reliable
SN	0.861	0.912	Reliable
TR	0.815	0.912	Reliable
CT	0.823	0.918	Reliable
AC	0.818	0.916	Reliable

FM	0.848	0.929	Reliable
TL	0.788	0.904	Reliable
IU	0.820	0.893	Reliable
CR	0.807	0.886	Reliable
PR	0.819	0.892	Reliable

C. Structural (Inner) Model Evaluation

Structural-model evaluation was performed to measure the extent to which the model explains the relationships among latent variables, through the coefficient of determination (R^2), effect size (f^2), and hypothesis testing based on path coefficients. As shown in Table 6, the R^2 values for Usage Intensity (0.555), Student Creativity (0.318), and Student Productivity (0.426) fall within the moderate-to-good range, indicating that the exogenous and mediating variables explain a substantial proportion of variance in each endogenous construct.

Table 6. R-Square (R^2) Results

Variable	R-square	R-square Adjusted	Remark
Usage Intensity	0.555	0.533	Good model
Student Creativity	0.318	0.314	Moderate model
Student Productivity	0.426	0.419	Moderate model

The effect-size (f^2) analysis in Table 7 shows that *Perceived Usefulness* ($f^2 = 0.347$), *Content* ($f^2 = 0.162$), *Perceived Ease of Use* ($f^2 = 0.201$), and *Task Relevance* ($f^2 = 0.154$) exert a large effect on Usage Intensity, while *Subjective Norm*, *Accuracy*, *Format*, and *Timeliness* exert a medium effect. Usage Intensity has a large effect on Student Creativity ($f^2 = 0.466$) and a medium effect on Student Productivity ($f^2 = 0.136$), and Student Creativity has a large effect on Student Productivity ($f^2 = 0.189$). In terms of overall model fit, the *Standardized Root Mean Square Residual* (SRMR) values were 0.049 for the saturated model and 0.054 for the estimated model, both below the 0.08 threshold, confirming a good overall fit between the structural model and the data.

Table 7. Effect Size (f^2) Results

Path	f-square	Category
Accuracy → Usage Intensity	0.067	Medium effect
Content → Usage Intensity	0.162	Large effect
Format → Usage Intensity	0.041	Medium effect
Perceived Ease of Use → Usage Intensity	0.201	Large effect
Perceived Usefulness → Usage Intensity	0.347	Large effect
Subjective Norm → Usage Intensity	0.082	Medium effect
Task Relevance → Usage Intensity	0.154	Large effect
Timeliness → Usage Intensity	0.070	Medium effect
Usage Intensity → Student Creativity	0.466	Large effect
Usage Intensity → Student Productivity	0.136	Medium effect
Student Creativity → Student Productivity	0.189	Large effect

Hypothesis testing was performed through bootstrapping in SmartPLS, with a path considered significant when the T-Statistic exceeds 1.96 and the P-value is below 0.05. Figure 2 presents the structural-model output (path coefficients) generated by SmartPLS, and Table 8 summarizes the hypothesis-testing results. All eleven hypotheses (H1–H11) were supported, confirming that every hypothesized relationship in the research model is statistically significant.

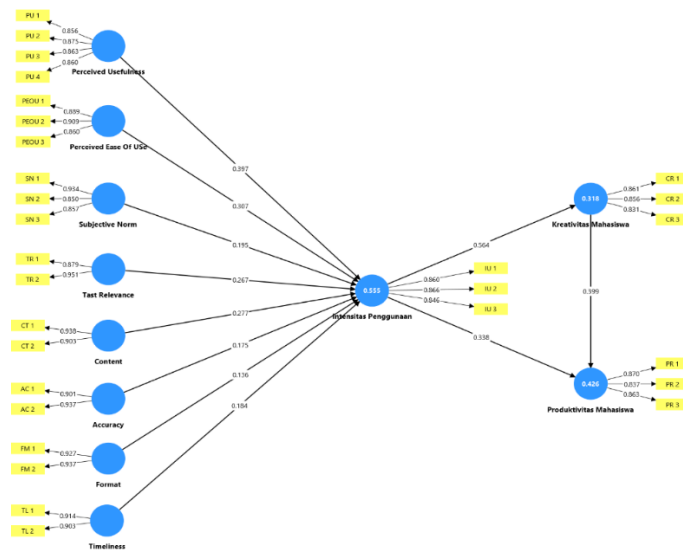


Fig 2. Structural Model (Path Coefficients) Output from SmartPLS

Table 8. Hypothesis Testing Results

Hyp.	Path	T-Statistics	P-Values	Result
H1	Perceived Usefulness → Usage Intensity	8.059	0.000	Supported
H2	Perceived Ease of Use → Usage Intensity	5.433	0.000	Supported
H3	Subjective Norm → Usage Intensity	3.454	0.001	Supported
H4	Task Relevance → Usage Intensity	4.852	0.000	Supported
H5	Content → Usage Intensity	4.991	0.000	Supported
H6	Accuracy → Usage Intensity	3.368	0.001	Supported
H7	Format → Usage Intensity	2.512	0.012	Supported
H8	Timeliness → Usage Intensity	3.293	0.001	Supported
H9	Usage Intensity → Student Creativity	11.006	0.000	Supported
H10	Usage Intensity → Student Productivity	4.873	0.000	Supported
H11	Student Creativity → Student Productivity	5.923	0.000	Supported

D. Discussion

Perceived Usefulness had a significant positive effect on Usage Intensity (H1), showing that the more students perceive ChatGPT as beneficial to their learning process, the more intensively they use it. This finding is consistent with TAM, which identifies perceived usefulness as the primary driver of technology acceptance and use [18], and aligns with recent studies confirming that perceived usefulness directly increases ChatGPT usage intensity among students [1][9].

Perceived Ease of Use also had a significant positive effect on Usage Intensity (H2), consistent with TAM's proposition that technology which is easy to learn and operate achieves a higher level of acceptance [18]. ChatGPT's natural-language interface substantially reduces users' cognitive barriers, thereby increasing the frequency and intensity of its use [10][26].

Subjective Norm significantly and positively affected Usage Intensity (H3), indicating that support and influence from peers, lecturers, and the academic community contribute to higher ChatGPT usage. This is consistent with UTAUT and TAM 2, which identify social influence as an important determinant of technology use [17][20]; peer normalization of AI use functions as a key catalyst for ChatGPT adoption [1].

Analysis of ChatGPT Usage Intensity Patterns on Student Creativity and Productivity Using a Data Analytics and SEM-PLS Approach (Sri Muliani Nurrohmah)

Task Relevance had a significant positive effect on Usage Intensity (H4): the more relevant ChatGPT's functions are to students' academic needs, the higher their usage intensity, consistent with the Task Relevance construct in TAM 2 [20] and with evidence that task-appropriate AI tools improve learning performance and task completion [7].

Content, Accuracy, Format, and Timeliness — the four EUCS dimensions — each had a significant positive effect on Usage Intensity (H5–H8). Higher perceived content quality, information accuracy, presentation clarity, and response timeliness each increase user satisfaction and, consequently, the frequency of ChatGPT use [19][21][12][9][27][10]. These results confirm that output-quality dimensions from the EUCS framework remain highly relevant for explaining continued use of a generative-AI system such as ChatGPT.

Usage Intensity had a significant positive effect on Student Creativity (H9), consistent with meta-analytic evidence that ChatGPT use positively affects higher-order thinking and creativity [7]. By exposing students to diverse information, perspectives, and alternative solutions, ChatGPT functions as a cognitive partner that stimulates divergent thinking [23], helping students explore multiple viewpoints that spark new ideas and more innovative solutions [9].

Usage Intensity also had a significant positive effect on Student Productivity (H10), reinforcing prior findings that ChatGPT substantially accelerates information search and initial drafting, leading to higher learning productivity [27]. ChatGPT helps students obtain information more quickly, organize ideas, and complete tasks more efficiently; automating lower-order cognitive tasks also frees up students' time for deeper analysis, thereby increasing overall efficiency and productivity [10][24].

Finally, Student Creativity had a significant positive effect on Student Productivity (H11). Consistent with theories of organizational behavior and educational psychology, creativity is a key catalyst for effective problem-solving [22][24]. Creative students generate new ideas, identify more effective solutions, and approach academic problems more innovatively; they resolve academic obstacles faster because they have more alternatives available, while also producing higher-quality output. This confirms that student creativity plays an important mediating role between technology usage intensity and academic productivity.

4. CONCLUSION

Based on the results of data analysis and hypothesis testing using SEM-PLS, this study draws three main conclusions. First, *Perceived Usefulness, Perceived Ease of Use, Subjective Norm, Task Relevance, Content, Accuracy, Format, and Timeliness* each have a positive and significant effect on ChatGPT Usage Intensity, indicating that the higher students' perceptions of ChatGPT's benefits, ease of use, social influence, task relevance, and information quality, the higher their usage intensity in supporting academic activities. Second, ChatGPT Usage Intensity has a positive and significant effect on both Student Creativity and Student Productivity; intensive use of ChatGPT helps students obtain information, explore ideas, accelerate task completion, and improve learning effectiveness, which in turn enhances academic creativity and productivity. Third, Student Creativity has a positive and significant effect on Student Productivity, confirming that creativity is an important factor supporting improved student productivity, and that the effectiveness of ChatGPT in enhancing academic productivity depends substantially on students' creative capacity in processing AI-generated information.

Based on these findings, students are advised to use ChatGPT wisely and responsibly as a learning-support tool — not merely to obtain instant answers, but also to explore ideas, strengthen creativity, deepen understanding of course material, and improve academic productivity, while still verifying the information obtained to safeguard academic quality and accuracy. Higher-education institutions are advised to provide education and guidelines on the responsible use of AI-based technology so that students can optimize ChatGPT use without compromising academic ethics, critical-thinking ability, or the originality of scientific work, and to consider integrating AI literacy into innovative learning-support programs. Future research is encouraged to incorporate additional variables that may influence student creativity and productivity, such as digital literacy, learning motivation, critical-thinking ability, or AI-usage ethics, and to broaden the respondent scope across different educational levels and fields of study to obtain more comprehensive findings.

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Analysis of ChatGPT Usage Intensity Patterns on Student Creativity and Productivity Using a Data Analytics and SEM-PLS Approach (Sri Muliani Nurrohmah)

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