ICT ENGAGEMENT, READING INTEREST AND COOPERATIVE LEARNING: A STRUCTURAL EQUATION MODEL ON WRITING SKILLS

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ABSTRACT

Aim: The purpose of this study is to explore the most appropriate model in students' writing skills by using structural equation modelling to assess the relationship between ICT involvement, literacy interest, cooperative learning, and writing skills.
Study design: This study uses a quantitative non-experimental design.
Place and Duration of Study: This study was carried out among Grade 11 senior high school students enrolled in public schools of Region X (Northern Mindanao) in the Philippines during the second semester of the academic year 2023-2024.
Methodology:A stratified random selection approach was employed to choose 400 Grade 11 Senior High School pupils. Data were collected using four survey questionnaires. The data was evaluated by determining the mean and standard deviation, using Pearson product-moment correlation, and doing multiple regression analysis to determine the variables' correlations. The SEM was used to identify the best-fit model for writing skills.
Results: The study discovered significant linkages between ICT engagement, reading interest, cooperative learning, and writing skills and all of which were regularly demonstrated by students. Higher ICT involvement, increased reading interest, and active cooperative learning all improved writing skills. Model 5 was chosen as the best fit with compositional writing interest, teacher impact, and school administration support as important variables. Social contact and interest in ICT, reading motivation and relevance, skill development, and cooperative learning engagement were all important predictors of enhanced student writing skills.
Conclusion: The study found out that ICT engagement, reading interest, andcooperative learning all play important roles in enhancing Grade 11 Senior High School students' writing skills in the public schools of Region 10. Based on findings, the researcher highly recommend that teachers can provide meaningful tasks such as creating a website for the community and using social media for advocacy. Additionally, select activities such as group projects, case studies, and experiments, and conduct seminars or workshops on writing. Finally, stabilize the Home Visitation Program and contact local village officials for support.

Keywords: education, ICT engagement, interest in reading, cooperative learning, writing skills, SEM, Philippines

SDG #4- Quality Education

1. INTRODUCTION

Writing is one of the most difficult abilities to acquire in language acquisition, and many students struggle throughout the process due to challenges with grammar, syntax, spelling, punctuation, and word choice (Budjalemba&Listyani, 2020; Peter & Singaravelu, 2020). These difficulties stem from the complex interplay of mechanical, linguistic, cognitive, and psychomotor aspects of writing (Elbashir, 2023), compounded by a lack of motivation and confidence (Bulqiyah, Mahbub&Nugraheni, 2021). Students' limited writing skills, often tied to low language proficiency, contribute to frequent errors in composition, including grammatical mistakes and unnecessary information (Beh & Ganapathy, 2023; Ulit, 2018; Totto & Ramos, 2021). Poor grammatical knowledge poses a barrier to writing, while teaching these skills presents challenges for educators, further complicating the transfer of writing knowledge (Maslawati & Moses, 2019). Despite these obstacles, strong writing skills are crucial for everyone, as they reflect one's ability to think and communicate effectively across different contexts, from academic to professional settings (Gautam, 2019; Bora, 2023). Strong writing is essential for success in education, future employment, and personal expression (Bhavani & Shankar, 2023). Therefore, it is crucial to address these issues as soon as possible to provide effective solutions (Arevalo & Napil, 2023).

A study conducted in the Philippines revealed that a significant number of students exhibited weak writing skills, as evidenced by numerous grammatical errors, punctuation mistakes, and inclusion of

irrelevant information in their compositions (Ulit 9-30; Totto& Ramos 9-22). This deficiency in writing hindered students' ability to develop proficiency in the language. Additionally, teachers faced challenges in effectively transferring knowledge about writing skills (Maslawati & Moses 3385-3391).

To address these concerns, this studyemployed Structural Equation Modeling (SEM) to identify the best fit model for writing skills. This study seeks to provide insights and solutions for improving writing skills among Grade 11 Senior High School students by investigating the relationship between information and communication technology (ICT) involvement, reading interest, and collaborative learning.

Previous research has emphasized the importance of ICT engagement in enhancing the writing skills. Involvement in Information and Communication Technology (ICT) has an important relationship with the development of writing skills, as it provides innovative ways for learning and interaction. According to (Fernández Batanero et al. 2020), the use of ICT enhances students' writing ability by providing opportunities for real-time feedback and collaboration. To add to this, (Abdul Aziz and Ramamuthie 2021) mention that using digital platforms increases motivation and deepens understanding, resulting in improved writing skills.

Studiesshowtherelationshipbetweenreadinginterestandspecificwritingskills.Accordingto(Basri, Ermnato&Yusianaetal.1-6), students withahighinterestinreadingshowedbetterabilitytowriteexpositorytexts,becausetheyunderstood clear,realisticwritingbetter.Similarly,(Ermanto and Novita237-243)foundthat students wholovedtoreadwerebetteratwritingreportsfromtheirobservations.(Rasyid, Sari and Syahrul446-453)alsosaythatknowledgefromreadingisusedbystudentstobemoreeffectiveinwriting. Furthermore,(Andraetal.271-282)and(Adeketal.48-53)identifiedasignificantrelationshipbetweenreadinginterestandwritingskills,wheredeepreadinginteractionsprovidemodelsandtechniquesforimprovingthequalityoftheirwrittenworks(MayritaandPratiwi,420-432;Celik,206-214).

Various studies have highlighted the effectiveness of cooperative learning in enhancing writing skills. According to (Pham 2021), Kaweera et al. (2019), and Alroomi (415-421), cooperative learning (CL) improves writing proficiency through student collaboration. The environment fostered by cooperative learning encourages students to express themselves, resulting in strengthened writing abilities (Alroomi, 415-421; Shammout, 791-797). Additionally, Shammout (791-797) revealed that CL promotes trust and teamwork while reducing conflict, leading to a more positive learning experience. Furthermore, Liao (68-72) emphasized that CL not only enhances writing instruction but also aligns with curriculum goals and increases students' interest in writing.

This study focuses on Grade 11 senior high school students attending public schools in Region X (Northern Mindanao) in the Philippines during the second semester of the academic year 2023–2024. The researcher hopes to provide a full understanding of the factors influencing writing skills by researching the interplay of ICT involvement, reading interest, and collaborative learning.

The researcher would also like to investigate students'level of engagement in ICT with emphasis on ICT interest, perceived ICT competence, perceived autonomy in ICT use, and ICT as a topic in social interaction. It also tries to examine the reading interest of students level in terms of students' reading effort, students' motivation in reading, and students' assumption in reading. Furthermore, the study seeks to assess students' perception on cooperative learning towards individual involvement, team dynamics, and skill development. Finally, the study intends to assess students' writing skills with a particular emphasis on interest of the students in composition writing, composition writing of students as influenced by their parents, influence of teacher to the writing ability of the learners, support of peers in composition writing, support of the school administration to the writing skill of learners, and influence of social media in students' composition writing.

Moreover, the researcher hopes to find substantial relationships between ICT involvement and writing skills, reading interest and writing skills, and cooperative learning and writing abilities. Above all, it aims to explain the distinct impact of ICT involvement, reading interest, and cooperative learning on students' writing abilities. The study's objectives are to provide insights into the intricate dynamics of writing skills, ultimately creating instructional strategies to increase students' writing abilities.

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In the diagram, the relationship between ICT engagement, reading interest,cooperative learning, and writing skills can be seen.

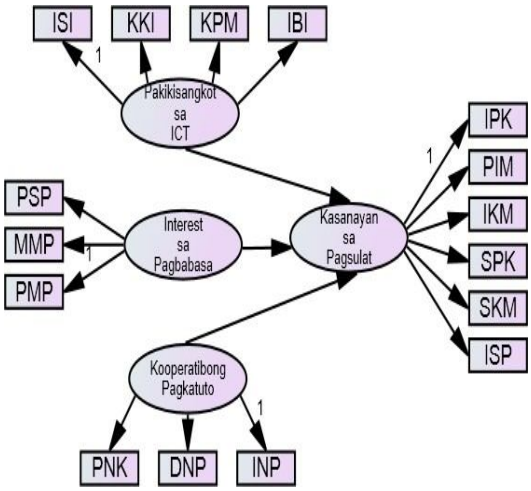

Figure 1. Conceptual Model Showing the Direct Relationship of Latent Exogenous Variables.

However, the analysis revealed that of the ICT engagement indicators, ICT as a topic for social interaction and interest in ICT were the most significant predictors of writing skills. Similarly, within the reading interest construct, student motivation for reading and student effort in reading emerged as the strongest predictors. In the cooperative learning domain, skill development and individual participation were identified as the most influential factors.

Regarding writing skills, three out of the six indicators-student interest in writing compositions, teacher influence on writing ability and school administration support for writing skills—remained as significant predictors. The developed model demonstrates a direct relationship between the exogenous and endogenous variables. While the endogenous variable 'writing skills was measured using multiple indicators only three were found to be significant predictors in the final model. These included student interest in writing compositions teacher influence on writing ability and school administration support for writing skills. Several variables including awareness of ICT capabilities awareness of using ICT independently student effort in reading, group dynamics, and parental influence on writing were excluded from the final model due to insignificant beta values or p-values.

Moreover, the researcher would like to discover significant correlations between ICT engagement, reading interest, cooperative learning and writing skills of students. Mostly, it seeks to explain the combined and distinct influence of ICT engagement, reading interest, cooperative learning and writing skills of students. In this way, students will get interested in language learning. This can be helpful to other researchers who are into the same kind of study. It can be a basis for the said study and, in the process, be developed in the outcome of their studies.

2. MATERIAL AND METHODS

2.1. Research Design

This study used a non-experimental, quantitative research design, focusing on counting and interpreting data to analyze outcomes. In non-experimental research, no independent variables are manipulated, and no control group is involved, making it observational in nature (Glasofer and Townsend 24-27). Quantitative methods involve analyzing numerical data with statistical techniques to explore variables like "who," "how many," and "how much" (Apuke 40-47). These methods were employed to test the hypothesis and describe the relationship between ICT engagement, reading interest, cooperative learning, and writing skills.

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Furthermore, a causal model was also employed in the study, assuming that respondents represent probabilities linking features, categories, and types through analysis to determine if they were formed via specific mechanisms. This approach provides a quantitative narrative of its impact, illustrating how changes in the independent variable correspond with variations in the dependent variable (Rehder, 1141-1159). Structural equation modeling (SEM), a family of statistical models, was used to explain relationships between variables by examining equations similar to multiple regressions. SEM was applied to identify the best-fitting model and validate it, making it essential for analyzing ICT engagement, reading interest, cooperative learning, and writing skills (Bag, 64-69).

The study employed a range of statistical tools for data analysis and interpretation, including Mean, Standard Deviation, Pearson Product Moment Correlation, Multiple Regression, and Structural Equation Modeling (SEM). To assess model suitability, Goodness of Fit Statistics for the Alternative Model were analyzed using the Analysis of Moment Structure (AMOS). Key criteria included Chi Square/Degree of Freedom (CMIN/DF), P-Value, Normative Fit Index (NFI), Comparative Fit Index (CFI), Goodness of Fit Index (GFI), Tucker-Lewis Index, Root Mean Square Error of Approximation (RMSEA), and P-close, ensuring the model's accuracy and suitability.

The mean was utilized here in describing ICT engagement, reading interest, cooperative learning and students' writing skills. It was also applied to measure the dispersion of a frequency distribution using the standard deviation. A Pearson Product Moment Correlation was used to find out whether there was a significant relationship between ICT engagement, reading interest, cooperative learning and students' writing skills. Goodness of Best Fit Statistics for the Alternative Model through Analysis of Moment Structure (AMOS). To determine the fit model, all the presented key indicators must align with the following principles.

This study, appropriated research guidelines were essential to complete the research. The researcher would adhere to and follow all standards in conducting the study in accordance with the assessment protocol and standardized criteria, especially in the management of population and data, but not limited to that.

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List 1 : Summary of goodness of fit measures of five generated models

Model	P-value (>0.05)	CMIN/ DF (0<value<2)	GFI (>0.95)	CFI (>0.95)	NFI (>0.95)	TLI (>0.95)	RMSEA (<0.05)	P-close (>0.05)
1	.000	5.927	.838	.837	.812	.807	.111	.000
2	.000	4.062	.889	.901	.874	.880	.088	.000
3	.000	3.638	.893	.915	.887	.897	.081	.000
4	.009	3.011	.912	.936	.907	.921	.071	.424
5	**.095**	**1.471**	**.986**	**.993**	**.980**	**.986**	**.034**	**.808**

Legend: CMIN/DF – *Chi Square/Degrees of Freedom* NFI–*Normed Fit Index*
GFI – Goodness *of Fit Index* TLI–*Tucker-LewisIndex*
RMSEA – *Root Mean Square of Error Approximation*CFI–Comparative*FitIndex*

Table 6 shows that the variables discussed earlier-ICT engagement, reading interest, cooperative learning have a considerable influence on students' writing skills. ICT tools, as highlighted by Noordan and Yunus (2051-2069), enhance student engagement and provide access to a wider range of reading materials, potentially increasing reading interest as suggested by Schindler et al. (1-28). This enhanced exposure to diverse writing styles can contribute to the development of writing skills, as students gain a deeper understanding of various writing techniques (Chin Nee, 223-237).

In conducting this study, appropriate research guidelines are essential to complete the ongoing research. The researcher will adhere to and follow all standards in conducting the study in accordance with the assessment protocol and standardized criteria, especially in the management of population and data, but not limited to that. Complete and properly organize all the necessary attachments for submitting the questionnaire, forms, and also consider the ethics involved in the study regarding the confidentiality of the data, consent, and protection of the participants in the conducted research. Once the submitted papers for approval were returned, the researcher was given a Certificate of Approval with UMERC Protocol No. UMERC-2023-448.

2.2. Research Respondents

The study selected 400 Grade 11 senior high school students from various public schools in Region X (Northern Mindanao) who were enrolled in Filipino subjects during the second semester of the 2023-2024 academic year. Respondents were chosen through stratified random sampling, ensuring representation across different population strata using the Raosoft Sample Calculator, which accounted for the heterogeneous nature of the population (Parsons 1-11; Yildiz et al. 824). Students under 18 or those not enrolled in Filipino subjects were excluded. Participation was voluntary, with strict requirements for parental consent, and students who lacked consent forms or did not attend the orientation were not allowed to participate. No penalties were imposed for refusing to participate, and students were free to withdraw at any time without losing any legal privileges or benefits.

Their consent to participate in the conducted study is voluntary. Their participation must be authorized with a consent form signed by their parents. The participants also underwent an orientation to gain awareness of the information that would be requested from them related to the conducted study.

2.3. Research Instrument

This study employed expert-validated questionnaires sourced from various online platforms to gather

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data on student engagement in ICT, reading interest, cooperative learning, and writing skills. There were several processes taken to confirm the instrument's realibility. First, the researcher met with the adviser and an expert panel befire revising the study's questionnaire.
Second, a pilot test was administered to 30 Grade 11 students who were not part of the study participants. To assess the validity of each item, statistical analysis was performed, and the Cronbach alpha approach was utilized. Third, the researcher gathered information from the library, the internet, newspapers, and other resources that could be employed in the study. Finally, the Likert Scale was utilized to score the data. Furthermore, the Likert Scale was used, with participants rating their responses based on their level of agreement with the items provided.

The first questionnaire, adapted from (Olga Kunina-Habenicht 1-4) , consisted of 21 items assessing students' interest in ICT, awareness of its capabilities, independent use, and social interaction with ICT. Three exogenous variables and one endogenous variable were evaluated using Nokelainen and Tirri's "Multiple Intelligences Profiling Questionnaire," with minor adjustments. A second questionnaire, adapted from Zur et al., included 29 items focused on reading efforts, motivation, and perceptions. Additionally, a cooperative learning instrument, based on Haliza Othman's work, had 26 items, while the writing skills questionnaire, adapted from Dominador Gamilo, contained 59 items. A pilot test with 30 Grade 11 students not included in the main study established reliability and validity through Cronbach's Alpha, yielding values of .774 for ICT involvement, .776 for reading interest, .869 for cooperative learning, and .894 for writing skills, confirming the acceptability of the questionnaires with a total expert rating of 4.46.

3. RESULTS AND DISCUSSION

3.1 Level of ICT Engagement

Table 1 shows that students use language learning strategies at a high level, with an overall mean score of 4.08 and a standard deviation of 0.41. ICT interest had a mean score of 3.98 with a standard deviation of 0.49, perceived ICT competence had a mean score of 3.67 and a standard deviation of 0.56, perceived autonomy in ICT use had a mean score of 3.88 with a standard deviation of 0.56, ICT as a topic in social interaction had a mean score of 3.78 with a standard deviation of 0.66, and affective strategies had a mean score of 3.90 indicating that students frequently engage in ICT.

Table 1 : Use of Language learning strategies at a high level students

Indicator	(SD)	Mean	Descriptive Level
ICT interest	0.49	3.94	High
Perceived ICT Competence	0.56	3.67	High
Perceived Autonomy in ICT use	0.56	3.88	High
ICT as a Topic in Social Interaction	0.66	3.65	High
Overall	0.41	3.78	High

Various studies have shown that technology has a significant influence on students' learning, particularly in promoting a collaborative learning environment (Hamilton-Hankins et al. 1-122). In this way, students actively improve their skills (Walters and Wen 1-14), and in addition, it enhances student interaction (Agah and Anihenya 25-35). It also leads to a deeper understanding of language by fostering enjoyment and creativity (Amadi 115-25). According to Abid et al., technology improves skills, organization, information processing, and academic performance (1117-21). Furthermore, Azmi's study shows that the effective use of technology creates a more open and digital learning

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environment that enhances both learning and engagement (111-18). The integration of ICT in education helps students develop critical 21st-century skills and boosts their performance (Hasin and Nasir 59-64; Vesudevan 28-40). Other studies also reveal that frequent use of ICT increases proficiency in its use and provides benefits to students (Hori and Fujii 6463-75).

3.2Level of students' reading interest

Table 2 presents the level of reading interest among Grade 11 students in Region X, measured through indicators such as effort in reading, motivation to read, and students' perception of reading. The overall mean score was 3.78, classified as "high," with a standard deviation (SD) of 0.47. The data revealed that student motivation to read had the highest mean score of 3.92 and an SD of 0.54, while effort in reading had the lowest mean of 3.57 and an SD of 0.53, though both indicators were still rated as "high." Overall, the reading interest level of Grade 11 students in public schools in Region X is categorized as high.

Table 2. Level of students' reading interest

Indicator	(SD)	Mean	Descriptive Level
Students' reading effort	0.53	3.57	High
Students' motivation in reading	0.54	3.92	High
Students' assumption in reading	0.58	3.87	High
Overall	0.47	3.78	High

The study's results confirm a positive relationship between reading interest and student success. Zur et al. (148-157) found that students with high reading interest have deeper comprehension, while Muhamad (1154-1161) noted its positive impact on classroom performance. Interested readers more easily understand material and generate creative solutions (Dewi et al., 241-250). Additionally, higher reading interest enhances text analysis skills (Aprilia et al., 368-372) and engagement (Gede Agu Agung et al., 412-427). Teguh (57-68) states that such interest encourages active material searching, while Rahmawati et al. (111-120) emphasize its role in developing reading skills. Finally, Arofaha and Ningsia (11201-11206) assert that reading interest significantly improves learning outcomes by providing students with more information and deeper text comprehension.

3.3 Level of Cooperative Learning

Table 3 shows that the level of cooperative learning among Grade 11 students in Region X, measured based on indicators of individual participation, group dynamics, and skills development, achieved an overall mean score of 3.94 (SD = 0.46) with a descriptive level of "high." Individual involvement had the highest mean score of 3.98 (SD = 0.52), while skills development had the lowest mean score of 3.90 (SD = 0.58), but both were still at a high level. Overall, the results indicate that the cooperative learning level of students in public schools in Region X is high, suggesting a productive learning environment where students are actively involved, team dynamics are effective, and skills development is continually progressing.

Table 3. Level of cooperative learning

Indicator	(SD)	Mean	Descriptive Level
Individual involvement	0.52	3.98	High

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Team dynamics	0.5	3.93	High
Skill development	0.58	3.9	High
Overall	0.46	3.94	High

According to the studies of Hung (1223-1240), Azieyana (744-747), Wang (62-66), Gillies (1-14), and Anijah (128-135), cooperative learning offers numerous benefits to students, including the development of teamwork, problem-solving, communication skills, and the ability to form opinions, analyze information, and make decisions. Additionally, it promotes collaboration, lifelong learning, and academic motivation. Latorre-Martínez et al. (429-442) emphasize the importance of active student participation in improving performance, while Fakhra Aziz et al. (211-217) highlight that it strengthens motivation, communication, and critical thinking skills. Bolliger et al. (205-222) further show that active involvement enhances academic performance and reduces feelings of isolation. These positive outcomes are linked to the collaborative nature of group dynamics (Misra and Tyagi, 70-73), hence, student-centered teaching strategies are recommended to develop these skills (Mkulu, Nyoni, and Paschal, 364-373).

3.4Level of Students' Writing skills

Table 4 shows the writing proficiency of Grade-11 students in Region X, assessed through indicators like interest in writing, parental and teacher influence, peer support, school administration backing, and the impact of social media. The overall mean score is 3.90 with a high descriptive level (SD = 0.43). Teacher influence scored highest at 4.08 (SD = 0.53), while parental influence had the lowest mean of 3.79 (SD = 0.57), both still rated high. Overall, the students' writing proficiency in Region X public schools is deemed high.

Table 4. Level of Students' Writing skills

Indicator	(SD)	Mean	Descriptive Level
Interest of the students in composition writing	0.52	3.87	High
Composition writing of students as influenced by their parents	0.57	3.79	High
Influence of teachers to the writing ability of the learners	0.53	4.08	High
Support of peers in composition writing	0.56	3.85	High
Support of the school administration to the writing skill of learners	0.54	3.88	High
Influence of social media in students' composition writing	0.52	3.92	High
Overall	0.43	3.9	High

Technology has transformed writing instruction, with ICT improving student writing skills (Hashim et al., 314-330). Tools like chat functions facilitate collaboration and communication (Al-Rowayeh, 453-460), and technology enhances writing across various genres (Mallahi, 165-178). Encouraging ICT integration in teaching is vital as the world becomes more digital (Mwinkaar & Yelleto, 312-317; Saha, 794-800). Effective writing development involves support from teachers, peers, and parents, alongside meaningful topics, engaging methods, and digital tools (Mirshekaran et al., 1270-1276; Christanti & Kartikawati, 59-67). Social media and platforms like Facebook Groups further enhance writing skills (Gistituanti et al., 98-112).

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3.5 Significance on the Relationship between ICT engagement and writing skills

Table 5 reveals a significant correlation between ICT involvement and writing skills ($r = .480$, $p < .001$). This finding rejects the null hypothesis, indicating a substantial relationship between the two variables. Consequently, it can be inferred that a higher level of ICT integration is associated with improved student writing proficiency.

The data revealed significant correlations between all ICT involvement indices and writing skills. P-values were consistently below .05, indicating that these relationships were statistically significant. The strongest correlation was found between ICT as a topic of social interaction and writing skills ($r = .382$), followed by awareness of independent ICT use ($r = .368$), awareness of ICT capabilities ($r = .357$), and interest in ICT ($r = .273$). These findings support the conclusion that there is a significant relationship between ICT involvement and writing proficiency."

Table 5. Significance on the relationship between ICT engagement and writing skills

ICT Engagement	Writing Skills						
	IPK	**PIM**	**IKM**	**SPK**	**SKM**	**ISP**	**Overall**
ICTI	.202** .000	.102* .041	.259** .000	.157** .002	.303** .000	.296** .000	**.273** **.000**
PIC	.299** .000	.264** .000	.238** .000	.219** .000	.360** .000	.334** .000	**.357** **.000**
PIU	.303** .000	.213** .000	.276** .000	.268** .000	.380** .000	.328** .000	**.368** **.000**
ISI	.328** .000	.274** .000	.245** .000	.321** .000	.314** .000	.350** .000	**.382** **.000**
Overall	**.396** **.000**	**.302** **.000**	**.349** **.000**	**.341** **.000**	**.467** **.000**	**.453** **.000**	**.480** **.000**

Legend:
ICTI- ICT interest PIU-Perceived autonomy in ICT use
ISI-ICTas a topic in social interaction
ISI-ICTas a topic in social interaction
PIC-Perceived ICT competence

3.6. Significance on the relationship between reading interest and writing skills

Table 6 shows a significant relationship between reading interest and writing skills of students, with an overall correlation coefficient ($r = .615$) between interest in reading and writing skills was found to be statistically significant ($p < .005$), indicating a strong positive relationship between the two variables. This finding supports the alternative hypothesis, rejecting the null hypothesis that there is no correlation.

The results of this table show a significant correlation between reading interest and writing skills. This finding is supported by Yusiana study (1-6) found a positive correlation between reading interest and the ability to write expository texts, suggesting that students who enjoy reading are better equipped to

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produce clear and factual writing. Similarly, Novita and Ermanto (237-243) observed that students with a higher interest in reading demonstrated superior skills in writing observational reports. Sari, Ramadan, and Rasyid (446-453) further proposed that reading fosters the acquisition of knowledge, which students subsequently apply to produce effective written work.

Table 6. Significance on the relationship between reading interest and writing skills

	Writing Skills						
Reading Interest	**IPK**	**PIM**	**IKM**	**SPK**	**SKM**	**ISP**	**Overall**
SRE	.490** .000	.420** .000	.349** .000	.413** .000	.422** .000	.352** .000	.511** .000
SMR	.504** .000	.355** .000	.440** .000	.424** .000	.460** .000	.431** .000	.545** .000
SAR	.452** .000	.391** .000	.464** .000	.377** .000	.442** .000	.409** .000	.529** .000
Overall	.561** .000	.453** .000	.488** .000	.471** .000	.515** .000	.463** .000	.615** .000

Legend:
SRE-Students' reading effort SMR-Students' motivation in reading
SAR-Students' assumption in reading

The results of this table show a significant correlation between reading interest and writing skills. This finding is supported by Yusiana study (1-6) found a positive correlation between reading interest and the ability to write expository texts, suggesting that students who enjoy reading are better equipped to produce clear and factual writing. Similarly, Novita and Ermanto (237-243) observed that students with a higher interest in reading demonstrated superior skills in writing observational reports. Sari, Ramadan, and Rasyid (446-453) further proposed that reading fosters the acquisition of knowledge, which students subsequently apply to produce effective written work.

3.7 Significance on the relationship between cooperative learning and writing skills

Table 7 shows a significant relationship between cooperative learning and students' writing skills, with an overall R-value of .607 and a p-value of .005 (significant), which is lower than the .05 significance level specified for this study. As a result, the hypothesis is rejected in favor of the alternative hypothesis, demonstrating a strong correlation between cooperative learning and students' writing skills.

This table's findings show that there is a significant relationship between cooperative learning and writing skills. The findings of this study align with the conclusions of Bondal and Tilwani (132-146) and Jusoh et al. (1399-1412), who have demonstrated that cooperative learning is a valuable tool for enhancing writing skills. The shift towards student-centered learning through cooperative learning underscores the creation of supportive and encouraging environments that foster significant improvements in writing abilities, including content, organization, and mechanics. Shammout's research (791-797) further emphasizes the additional benefits of cooperative learning, highlighting that students engaged in collaborative work not only develop stronger writing skills but also experience a

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more positive and competitive-free learning environment, which can contribute to enhanced self-esteem.

Table 7. Significance on the relationship between cooperative learning on writing skills

Cooperative Learning	Writing Skills						
	IPK	PIM	IKM	SPK	SKM	ISP	**Overall**
II	.441** .000	.333** .000	.409** .000	.400** .000	.502** .000	.475** .000	**.533** .000**
TD	.455** .000	.374** .000	.448** .000	.418** .000	.486** .000	.384** .000	**.535** .000**
SD	.417** .000	.302** .000	.420** .000	.382** .000	.450** .000	.442** .000	**.502** .000**
Overall	**.507** .000**	**.389** .000**	**.495** .000**	**.464** .000**	**.555** .000**	**.505** .000**	**.607** .000**

Legend:
II-Individual Involvement
TD-Team dynamics
SD-Skill development

3.8Significance on the Influence between ICT engagement, reading interest, cooperative learning on writing skills

Table 8 presents the results of multiple regression analysis revealing that ICT involvement, reading interest, and cooperative learning have a significant combined influence on writing skills ($F = 126.546$, $R^2 = .700$, adjusted $R^2 = .490$, $p < .001$). These findings reject the null hypothesis indicating that the three independent variables significantly predict writing ability. The adjusted R^2 value of .490 suggests that approximately 49% of the variance in writing skills can be explained by these variables.

Table 8. Significance on the influence between ICT engagement, reading interest, cooperative learning on writing skills

Writing Skills				
ExogenousVariables	*B*	β	*t*	*Sig.*
Constant	.859		5.242	.000
ICT Engagement	.177	.170	4.032	.000
Reading Interest	.325	.358	7.851	.000

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Cooperative Learning	.290	.310	6.549	.000

R	.700
R^2	.490
ΔR	.486
F	126.546
P	.000

Table 8 shows that the variables discussed earlier-ICT engagement, reading interest, cooperative learning have a considerable influence on students' writing skills. ICT tools, as highlighted by Noordan and Yunus (2051-2069), enhance student engagement and provide access to a wider range of reading materials, potentially increasing reading interest as suggested by Schindler et al. (1-28). This enhanced exposure to diverse writing styles can contribute to the development of writing skills, as students gain a deeper understanding of various writing techniques (Chin Nee, 223-237).

3.9 Summary of Goodness of Fit Measures of Five Structural Models

The final objective of this research is to determine which model best fits the variables as predictors of writing skills. To satisfy goodness of fit measures, the suggested framework in Fig. 1 must be adjusted. Table 7 summarizes the five models that were created for this study. Structural Model 5 is the best among all the models analyzed. It has a P-value of .095, indicating statistical significance. The CMIN/DF ratio is 1.471, which falls within the ideal range. The GFI (0.986), CFI (0.993), NFI (0.980), and TLI (0.986) are all above 0.95, demonstrating excellent fit. Additionally, the RMSEA is low at 0.034, indicating minimal error, and the P-close value is 0.808, further supporting the model's good fit. Thus, model 5 is clearly the most optimal among the five models examined.
The results of the goodness of fit for Model 3 are highly acceptable because all the indices met the established criteria against the obtained fit values. These indices fulfilled the requirements of goodness of fit measures, indicating that the developed model fits well. To identify the most suitable model, all indices must fall within acceptable ranges: the chi-square/degrees of freedom ratio should be less than 5 with a corresponding p-value higher than 0.05; the RMSEA should be below 0.05 with a P-close value greater than 0.05; and other indices such as the NFI, TLI, CFI, and GFI should all be higher than 0.95. Model 5 meets all these criteria, making it the best fit model.

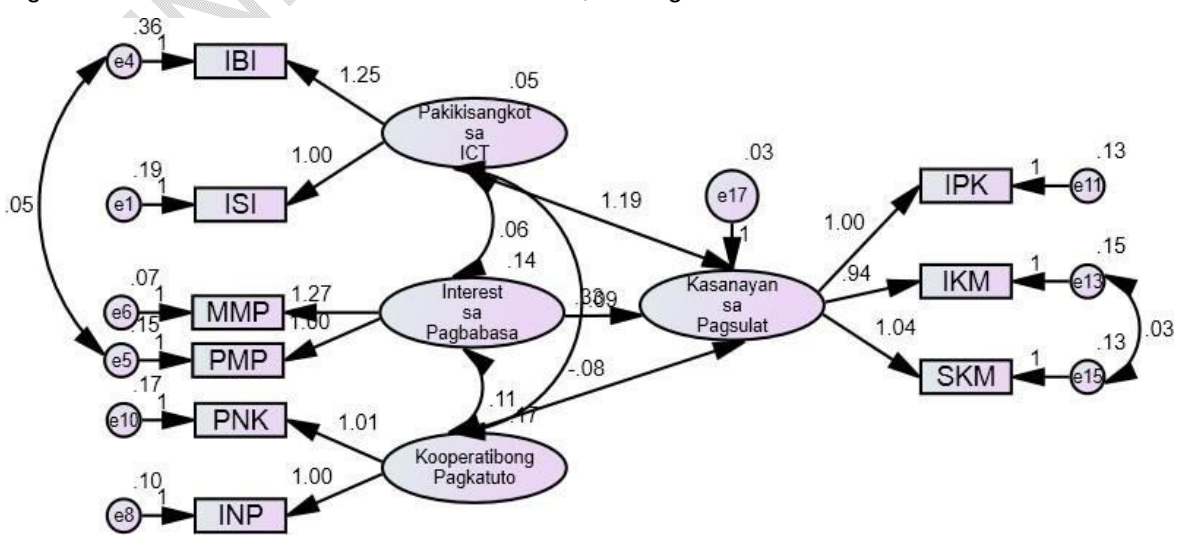

Figure 2. Best fit model on writing skills of G11 students

This section analyzes the relationships between ICT engagement, reading interest, cooperative learning and writing skill of students. Five alternative models were tested to find the best-fitting model for the students' writing skills. Each model comprised two sub-models: the measurement model, which indicates the factor loadings on their latent constructs, and the structural model, which describes the relationships between the latent variables.

Model 5 emerged as the most suitable structure, explaining the internal relationships among the exogenous variables (between ICT engagement, reading interest, cooperative learning) and their direct causal relationship to the endogenous variable, the students' writing skills.
The analysis revealed that of the ICT engagement indicators, ICT as a topic for social interaction and interest in ICT were the most significant predictors of writing skills. Similarly, within the reading interest construct, student motivation for reading and student effort in reading emerged as the strongest predictors. In the cooperative learning domain, skill development and individual participation were identified as the most influential factors.

Regarding writing skills, three out of the six indicators-student interest in writing compositions, teacher influence on writing ability and school administration support for writing skills—remained as significant predictors. The developed model demonstrates a direct relationship between the exogenous and endogenous variables. While the endogenous variable 'writing skills was measured using multiple indicators only three were found to be significant predictors in the final model. These included student interest in writing compositions teacher influence on writing ability and school administration support for writing skills. Several variables including awareness of ICT capabilities awareness of using ICT independently student effort in reading, group dynamics, and parental influence on writing were excluded from the final model due to insignificant beta values or p-values.

Table 9. Summary of goodness of fit measures of five generated models

Model	P-value (>0.05)	CMIN/ DF (0<value<2)	GFI (>0.95)	CFI (>0.95)	NFI (>0.95)	TLI (>0.95)	RMSEA (<0.05)	P-close (>0.05)
1	.000	5.927	.838	.837	.812	.807	.111	.000
2	.000	4.062	.889	.901	.874	.880	.088	.000
3	.000	3.638	.893	.915	.887	.897	.081	.000
4	.009	3.011	.912	.936	.907	.921	.071	.424
5	**.095**	**1.471**	**.986**	**.993**	**.980**	**.986**	**.034**	**.808**

Legend:

CMIN/DF - Chi-Square/Degrees of Freedom
GFI - Goodness of Fit Index
CFI - Comparative Fit Index
NFI - Norm Fit Index
TLI - Tucker-Lewis Index
RMSEA - Root Means Square of Error Approximation
P-close - P of Close Fit

The final objective of this research is to determine which model best fits the variables as predictors of writing skills. To satisfy goodness of fit measures, the suggested framework in Fig. 1 must be

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adjusted. Table 9 summarizes the five models that were created for this study. Structural Model 5 is the best among all the models analyzed. It has a P-value of .095, indicating statistical significance. The CMIN/DF ratio is 1.471, which falls within the ideal range. The GFI (0.986), CFI (0.993), NFI (0.980), and TLI (0.986) are all above 0.95, demonstrating excellent fit. Additionally, the RMSEA is low at 0.034, indicating minimal error, and the P-close value is 0.808, further supporting the model's good fit. Thus, model 5 is clearly the most optimal among the five models examined.

The results of the goodness of fit for Model 3 are highly acceptable because all the indices met the established criteria against the obtained fit values. These indices fulfilled the requirements of goodness of fit measures, indicating that the developed model fits well. To identify the most suitable model, all indices must fall within acceptable ranges: the chi-square/degrees of freedom ratio should be less than 5 with a corresponding p-value higher than 0.05; the RMSEA should be below 0.05 with a P-close value greater than 0.05; and other indices such as the NFI, TLI, CFI, and GFI should all be higher than 0.95. Model 5 meets all these criteria, making it the best fit model.

4. CONCLUSION AND RECOMMENDATIONS

Based on the results of this study, it was concluded that the respondents exhibited high levels of ICT involvement, reading interest, cooperative learning, and writing skills. Moreover, these variables were found to have a significant influence on writing ability, corroborating existing literature that highlights the positive relationship between ICT engagement, reading interest, and cooperative learning in enhancing writing skills.

The study developed a robust model demonstrating a direct relationship between the exogenous variables (ICT involvement, reading interest, and cooperative learning) and the endogenous variable (writing skills).These findings align with Albert Bandura's Social Learning Theory, which emphasizes the role of ICT as a powerful tool for developing writing skills. By providing opportunities for modeling, social interaction, feedback, and practice within a collaborative environment, ICT can enhance writing engagement and strengthen the connection between reading and writing abilities.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

CONSENT

The written consent of participants in accordance with international or university standards.

ETHICAL APPROVAL

The research was done using a thorough ethical process that followed accepted guidelines and principles. All required guidelines were followed to guarantee that participants' well-being and rights were maintained throughout the study. After submitting the research papers for review, the researchers were granted a Certificate of approval with UMERC Protocol No. UMERC-2023-448.

Disclaimer (Artificial intelligence)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

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