

STUDENTS' PERCEPTIONS OF ICT INTEGRATION IN STEM AND HUMANITIES CLASSROOMS IN SECONDARY SCHOOLS

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Abstract

This study examines students' perceptions of ICT integration in STEM and Humanities areas. The researchers employed descriptive quantitative. Data were collected through an online questionnaire consisting of Likert-scale items and open-ended questions. A total of 139 secondary school students from several schools participated in the study. The findings revealed that students had positive perceptions towards ICT use in the teaching process. The findings also revealed that students perceived ICT to be used more frequently in STEM subjects than in Humanities disciplines, suggesting the presence of a potential subject-wise digital divide. Overall, the study concludes that while ICT integration is positively perceived by students, differences in its implementation across subject areas remain existed.

Keywords: *humanities, ICT integration, STEM, secondary, students' perceptions*

PERSEPSI SISWA TERHADAP INTEGRASI TIK DI KELAS STEM DAN HUMANITAS DI SEKOLAH MENENGAH

Abstrak

Penelitian ini mengkaji persepsi siswa terhadap integrasi Teknologi Informasi dan Komunikasi (TIK) dalam bidang STEM dan Humaniora. Peneliti menggunakan pendekatan kuantitatif deskriptif. Data dikumpulkan melalui kuesioner daring yang terdiri atas butir-butir skala Likert dan pertanyaan terbuka. Sebanyak 139 siswa sekolah menengah dari beberapa sekolah berpartisipasi dalam penelitian ini. Hasil penelitian menunjukkan bahwa siswa memiliki persepsi yang positif terhadap penggunaan TIK dalam proses pembelajaran. Temuan juga mengungkapkan bahwa siswa memandang TIK digunakan lebih sering pada mata pelajaran STEM dibandingkan pada disiplin ilmu Humaniora, yang mengindikasikan adanya potensi kesenjangan digital berdasarkan mata pelajaran. Secara keseluruhan, penelitian ini menyimpulkan bahwa meskipun integrasi TIK dipersepsikan secara positif oleh siswa, perbedaan dalam implementasinya di berbagai bidang mata pelajaran masih tetap ada.

Kata kunci: *humaniora, integrasi TIK, STEM, menengah, persepsi siswa*

INTRODUCTION

The rapid advancement of Information and Communication Technology (ICT) has significantly influenced educational practices worldwide (Bilan et al., 2023). Today's students are known as digital natives who grow up with technology since birth. Digital native learners are interested in more interactive, multimedia-rich, and collaborative experiences (Suman, 2023; Rathnasekara et al., 2025). As a result, conventional teaching practices is seen irrelevant with their needs and preferences. The traditional methods with no involvement of ICT may no longer captivate or effectively engage these young learners. In contemporary education, integrating ICT into teaching practice is no longer optional but it has become an essential part of effective pedagogy. The integration of ICT in educational settings facilitate a more interactive and engaging learning environment that resonate with today's learners.

In addition, ICT use in the teaching process has brought some numerous benefits including enhanced students' engagement (Ullah & Anwar, 2020; Sabri et al., 2024; Shettigar et al., 2025), personalized learning (Shemshack & Spector, 2020; Lee et al., 2018; Schmid et al., 2023), collaboration (Henderson, 2020; Balol, 2023), and digital literacy development (Mudra, 2020; Anani et al., 2021; Siregar, 2024). From teachers' side, ICT helps teachers to provide differentiated instruction that accommodates diverse learning styles and abilities (Karatza, 2019) as today's technology has facilitated collaborative learning through discussion forums, shared documents, and virtual teamwork, it helps students develop communication and problem-solving skills that increasingly values in the modern workforce. These not only transforms how knowledge is imparted but also empowers students to be proactive, lifelong learners in fast changing digital landscape.

In Indonesia, the importance of technology has been mandated through the implementation of the Merdeka Curriculum. In this current curriculum, teachers are supposed to emphasize digital literacy, student-centered learning, and 21st century skills (Haq, 2024; Hunaepi & Suharta, 2024). In addition, teachers are encouraged to use digital tools not only to deliver content but also to foster critical thinking, creativity, collaboration, and communication. Correspondingly, in the regulation of the Minister of National Education Number 16 of 2007, the Ministry of Education and Culture has defined ICT teacher competency standards under Professional Competency Number 24, which emphasizes 'utilizing information and communication technology to communicate and develop oneself'. The Indonesian government also initiatives to improve technological infrastructure. Despite these efforts, research suggest that the extent and quality of ICT integration vary considerably across schools, teachers, and subject areas (Machmud et al., 2021; Widiastuti, 2025). It can be influenced by factors such as teachers' digital competence, access to technological resources, pedagogical beliefs, and subject-specific instructional needs.

Although ICT integration has become a national priority, the implementation remains uneven across educational contexts. Previous studies have widely explored ICT integration in educational contexts, particularly focusing on teachers' readiness, students' perceptions, learning outcomes, and technology acceptance. The findings of those studies have indicated that ICT has positive influence on students' motivation and engagement, while teachers generally demonstrate favorable attitudes towards technology use. Even so, existing studies also examine ICT integration at the school or institutional level rather than across specific academic disciplines. Consequently, relatively little is known about whether students experience different levels and forms of ICT integration across subject areas. Given that subjects differ in their learning objectives, pedagogical approaches, and instructional practices, investigating ICT integration from a disciplinary perspective may provide a more nuanced understanding of students' digital learning experiences. These differences may contribute to a "subject-wise digital divide".

STEM and Humanities subjects may use technology differently. As STEM subjects might incorporate technology as simulations, virtual laboratories, coding tools, interactive software, and data analysis platforms. STEM education often emphasizes scientific inquiry and engineering design that make technological tools essential. Meanwhile, Humanities subjects tend to integrate technology as multimedia resources, online discussions, collaborative writing tools, and digital story telling (Tay et al., 2015). Many studies on technological use in teaching and learning but there is still few of examining on how teachers and students perceive, adopt or resist ICT integration. This case between two fields within educational context show the distinction and diverse functionalities to adapt specific needs of each discipline.

Therefore, this study seeks the students' perspective on how each subject areas use technology. Students are the main recipients of technology-based instruction so making their perceptions are matter. By understanding these viewpoints may provide valuable insights into improving ICT integration strategies, enhancing the overall learning experience, and fostering a more inclusive educational environment.

The following are research questions that used as researchers' guidance: (1) how do secondary school students perceive the integration of ICT in their learning experiences?; (2) what are students' attitudes toward the use of ICT in STEM and Humanities classrooms?; and (3) what barriers and supports do students perceive regarding ICT integration in their schools?.

This study contributes to the discussion or literature on ICT integration in education by examining students' perceptions from a disciplinary perspective. By comparing STEM and Humanities subject in using ICT, this study provides a more nuanced understanding of technology integration and explores the possibility of a subject-wise digital divide. In addition, the findings are wished to provides insights on the implementation of the current curriculum, Merdeka curriculum, which emphasises digital literacy and technology supported learning. By identifying areas where ICT integration remains uneven, the research can inform strategies to enhance equitable access to meaningful digital learning experiences for students in terms of academic discipline.

METHOD

This study was aimed at exploring students' perspective on how STEM and Humanities subject areas use technology. To find the answers, the researchers employed descriptive quantitative. The research subjects consisted of 139 students from several secondary schools in East Java including Surabaya, Gresik, and Pasuruan, who were selected using simple random sampling, ensuring that each student had an equal chance of being included in the study. The respondents represented diverse educational backgrounds and learning experiences.

This study used questionnaire and was administered through a Google Form. The questionnaire was divided into two sections. The first section was closed-ended items measured using a five-Likert scale from 1 (strongly Disagree) to 5 (Strongly Agree). The items were meant to gain (1) ICT Usage Experience that consisted of 6 items, it explored students' experiences with the use of technology in classroom, (2) Attitudes toward ICT, there were five statements which examined students' perceptions and beliefs about the benefits of technology in learning and (3) Barriers and Support that sought to answer students' views of technological infrastructure, challenges, and institutional support. The second section was open-ended questions that served as complementary data to provide additional explanations (students' experiences, perceptions, challenges, and preferences regarding ICT use in different subject areas) and enrich the interpretation of the quantitative findings.

Prior to data collection, the questionnaire was reviewed by two experts in educational technology and English language education to ensure content validity. Then, revisions were made based on their feedback to improve clarity and relevance. Quantitative data were

analyzed using SPSS with analytical steps that included: (1) validity and reliability test for questionnaire statements; (2) analyze the result based on percentages categories in Table 1 below; and (3) descriptive statistics to illustrate the level of ICT integration in learning. Responses to the open ended questions were reviewed and summarized to support the interpretation of quantitative results.

Table 1. Percentages (P) Categories

Interval	Category
$0 \leq P < 20\%$	Very Low (VL)
$20\% \leq P < 40\%$	Low (L)
$40\% \leq P < 60\%$	Enough (E)
$60\% \leq P < 80\%$	High (H)
$80\% \leq P < 100\%$	Very High (VH)

FINDINGS AND DISCUSSION

Findings

The ICT integration in learning questionnaire was first tested on 30 students other than the research subjects for validity and reliability tests. Of the 17 statements in the ICT integration questionnaire, only 15 statements were found to be valid. The results of the questionnaire validity test using SPSS are presented in Table 2 below.

Table 2. Validity Test Result

State- ment	Calculated R-Value	R- Table Value	Criteria	State- ment	Calculated R-Value	R- Table Value	Criteria
1	0.669	0.1666	Valid	9	0.432	0.1666	Valid
2	0.710	0.1666	Valid	10	0.690	0.1666	Valid
3	0.520	0.1666	Valid	11	0.583	0.1666	Valid
4	0.526	0.1666	Valid	12	0.590	0.1666	Valid
5	0.770	0.1666	Valid	13	0.466	0.1666	Valid
6	0.672	0.1666	Valid	14	0.476	0.1666	Valid
7	0.812	0.1666	Valid	15	0.638	0.1666	Valid
8	0.732	0.1666	Valid				

Based on the validation test results in Table 2, all calculated r values for the 15 questionnaire statements are greater than the r-table value. Therefore, 15 statements are valid and can be used. Next, a reliability test was conducted. The results of the reliability test using SPSS are presented in Table 3 below.

Table 3. Reliability Test Result

Cronbach's Alpha	N of Items
0.885	15

Based on the reliability test results in Table 3, the Cronbach's Alpha value was 0.885. The value is greater than 0.6, indicating that the statements in the questionnaire are reliable. Because all 15 statements in the ICT integration questionnaire in learning are valid and reliable, the questionnaire can be used in research.

Furthermore, the following are the results of the questionnaire on ICT usage Experience, Students' attitudes towards ICT use, and barriers and support for ICT integration.

ICT usage Experience

The findings yielded that ICT has integrated in students' classroom instruction. Most participants agreed that their teachers frequently use of technology during learning activities. These findings showed that ICT integration has been widely used in the participating secondary schools. In addition, the finding reported that ICT has supported their learning process. A large majority agreed that ICT helps them understand lesson better and increase their interest in learning. Also, it can be seen that high level of agreement yielded the same perspectives that digital media can promote students' engagement and comprehension. Furthermore, in general students are allowed to use technological device such as smartphones, laptops, and tablets for teaching and lesson purposes, this suggests that the participants' classroom environment support for technology-enhanced learning. Regarding disciplinary differences, the students moderately agreed that ICT is used more frequently in STEM subjects than in Humanities subjects.

Table 4. ICT usage Experience

Statement	Total Respondent's Answer					Total Score	Percentage	Category
	SD	D	N	A	SA			
My teachers often use digital tools when teaching.	2	3	30	35	49	483	69.5%	H
I often use digital tools when taking lessons.	3	4	33	29	70	576	82.9%	VH
I use ICT more often in STEM lessons than in Humanities lessons.	2	16	42	17	62	538	77.4%	H
I find it easier to understand the subject matter with the help of ICT.	2	2	24	46	65	587	84.5%	VH
I feel more interested in learning when using digital media.	1	1	17	47	73	607	87.3%	VH
My teacher allowed me to use technology devices such as cell phones, laptops and tablets for learning.	0	2	33	39	65	584	84.0%	VH
Mean							80.9%	VH

Students' Attitudes towards ICT

The findings indicate that the students mostly have positive attitudes toward ICT use in classroom. The statement who yielded strongest attitudes was that ICT makes learning more enjoyable. In addition, most students perceived learning more effectively through videos, applications, and online learning platforms. Furthermore, they agreed that ICT as a tool that enhances independent learning suggesting that digital technologies may support learner autonomy. Moreover, most participants reported that they were confident in using ICT devices at school. meanwhile, when asked whether ICT is more suitable for STEM subjects than Humanities, the students showed moderate agreement. This findings revealed that while the students can see the value of ICT across disciplines, they may perceive a stronger alignment between technology use and STEM learning activities such as simulations, data analysis, and problem-solving tasks.

Table 5. Students' Attitudes towards ICT

Statement	Total Respondent's Answer					Total Score	Percentage	Category
	SD	D	N	A	SA			
I believe that ICT makes learning more enjoyable.	0	0	25	41	73	604	86.9%	VH
I feel confident using ICT devices at school.	0	2	41	30	66	577	83.0%	VH
I learn better with the help of videos, apps, or learning sites.	0	3	21	39	76	605	87.1%	VH
Digital activities help me learn independently.	0	2	19	44	74	607	87.3%	VH
I think ICT is better suited to be used in STEM subjects than Humanities.	0	9	53	18	59	544	78.3%	H
Mean							84.5%	VH

Barriers and Support for ICT Integration

Regarding the barriers and supports, most students reported that schools mostly provide favorable conditions for ICT implementation. For example, the students said that internet access were enough to support technology use in learning. More notably, the highest mean score in the survey was recorded for the statement regarding the availability of ICT facilities and devices. Even though most students reported positive conditions, some challenges remain. The students moderately agreed that they sometimes feel perplexed when using ICT tools during lessons. This result means that although the students are familiar with technology, effective use of digital tools may still require additional guidance and training. At last, the students were eager to have a more technology-enhanced lesson opportunity.

Table 6. Barriers and Support for ICT Integration

Statement	Total Respondent's Answer					Total Score	Percentage	Category
	SD	D	N	A	SA			
Internet access at my school supports the use of ICT.	1	4	28	40	61	558	80.3%	VH
My school provides enough devices (computers, projectors, etc.) to learn to use ICT.	0	1	12	38	88	630	90.6%	VH
I sometimes feel confused when using ICT tools in lessons.	6	18	31	26	58	529	76.1%	H
I want to learn more often with the help of technology.	0	1	35	35	68	587	84.5%	VH
Mean							82.9%	VH

Discussion

The findings revealed that most students perceived positive experience in ICT integration across subject but it can be said that the students believed technology is more prevalent and naturally aligned with STEM learning than Humanities learning. This view emphasizes an important difference in how the students view the role of technology in promoting their educational experiences. It can be understood since STEM subjects use technology to do analytical thinking, and problem-solving. Technology in STEM disciplines facilitates hands-on experiments, simulations, and data analysis. On the other side, Humanities subjects make use of technology to facilitate collaboration through digital platforms.

In addition, the students find that ICT integration has brought learning more enjoyable so that their interest is increasing and helps them understand lesson more easily. As previous studies agreed on these findings that technology have consistently reported positive effects on student engagement and motivation (Efendi, 2017; Henderson, 2020; Shettigar et al., 2025). That happens because students nowadays are digital natives who live with digital technologies in their daily lives. So, technology use for learning meets their learning preferences and expectations.

Moreover, the findings also revealed that ICT facilitates multimodal learning through videos, animations, simulations, and interactive applications (Nouri, 2019; Martínez Lirola, 2020). Such tools can be used to visualize abstract concepts more concrete and accessible as well as improving students' comprehension. This reflects constructivist perspectives that view technology is used for active knowledge construction rather than passive information reception (Isik, 2018; Firat et al., 2021; Levin et al., 2025).

Even though most students perceived positive views it does not indicate effective pedagogical integration. The students may enjoy technology because it is engaging, but meaningfulness of learning depends on how teachers design and facilitate technology-based activities (Zhang, 2022). Teachers hold responsibility to ensure technology tools not only used for the sake of modernity, but are carefully integrated into lesson plans to promote understanding.

Next, the findings identified that the infrastructure at the participating schools had sufficient internet access and technical devices, unlike earlier studies that revealed infrastructure as a major barrier to ICT implementation (Hermawan et al., 2018; Muljono et al., 2021; Rahmi et al., 2024). It means that government initiatives, school investment, and increased awareness of digital learning are increasing following the COVID-19. Such condition creates favourable learning environment for teachers to integrate technology into instruction.

At last, even the students are digital natives, they expressed confusion when using ICT tools as well. Their confidence in technology use does not guarantee they are trouble free. Confusion may happen from unfamiliar software, insufficient instructions, technical issues, or overly complex digital tasks. This is a reminder for teachers to support guidance during technology-enhanced learning. Technology used in the classroom not only needs access but also ample scaffolding that ensure students to use digital tools productively (Rajaram, 2019; Nguyen, 2022).

CONCLUSIONS

This study sought a light on secondary school students' perceptions of ICT integration in STEM and Humanities classrooms in Indonesian from three dimensions: ICT usage experience, students' attitudes toward ICT, and barriers and support for ICT integration. The findings indicate that ICT has become an integral component of classroom learning and is positively perceived by students. ICT support students' understanding of learning materials, increases their engagement and motivation, and provides opportunities for more independent learning through digital media. The students also reported that ICT is implemented across

different subjects, they perceived technology to be more frequently integrated into STEM subjects than Humanities subjects, reflecting differences in how technology is utilized across disciplinary contexts.

The findings further revealed that students generally hold positive attitudes toward ICT use in education. They viewed digital technologies as making learning more enjoyable and effective, particularly through videos, applications, and online learning platforms. Although schools were perceived to provide adequate internet connectivity and digital facilities, students still experienced occasional confusion when using ICT tools during learning activities. This suggests that successful ICT integration depends not only on the availability of technological infrastructure but also on effective pedagogical design and sufficient instructional guidance that enable students to use digital technologies meaningfully.

These findings contribute to the field of educational technology by providing that students' positive perceptions of ICT should not be interpreted as evidence of effective technology integration. Although ICT has become an essential component of education and is generally perceived positively by students, the positive perceptions of technology use in teaching and learning do not necessarily guarantee meaningful or effective learning process. Rather, the educational value of ICT depends on teachers' ability to integrate technology with appropriate pedagogical strategies that foster active learning, critical thinking, collaboration, and problem solving. Therefore, ICT is ultimately a pedagogical tool, and teachers play the pedagogical part to set up such a meaningful and effective learning process.

As the findings showed that ICT has well integrated into teaching practice. However, ICT should not only be used as a supplementary tool but it should be pedagogically integrated to create meaningful learning activities that can promote critical thinking, collaboration, and problem-solving. In addition, Humanities teachers should explore more innovative uses of ICT to enrich learning experiences. They can use digital storytelling, collaborative writing platforms, multimedia projects, virtual tours to provide more learning experiences. Finally, future research are encouraged to examine ICT integration from multiple perspectives, including teachers, school teachers, school leaders, and classroom observations.

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