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The Mediating Effect of ICT-Based Instruction on Attitudes and Motivation of Students' in Science

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ABSTRACT

This study determined the mediating role of ICT-based instruction on the relationship between attitudes and motivation of students in science. The quantitative approach using the correlational technique and analysis was utilized in this study with a sample of 309 students coming from the Public Schools in the Division of Bukidnon, Municipality of Kitaotao, Kitaotao I, Kitaotao II, and Kitaotao III Districts using stratified random method of sampling. Data from the respondents was collected using sets of modified survey questionnaires, and the results were analyzed for reliability and content validity. Regression analysis, Pearson-r, and the mean were used to examine the data. The findings showed that the levels of science attitudes of students were rated moderate, and the science motivation of students was rated high. While ICT-based instruction was likewise given a high rating. Furthermore, there was a strong correlation between the factors. The connection between science attitudes and the science motivation of students was significant. There is also a significant relationship between science attitudes of students and ICT-based instruction. And a significant relationship between ICT-based instruction and the science motivation of students. On the mediating effect, a partial mediation exists between the impact of ICT-based instruction on the correlation between attitudes and motivation of students in science.

INTRODUCTION

Filipino students' lack of interest and motivation is one issue associated with their poor academic performance (Rogayan & Bautista, 2019). Many students fail to perceive the relevance and practical application of scientific knowledge in their everyday lives. The traditional science curriculum often focuses on abstract concepts and disconnected facts, which fail to establish meaningful connections to real world contexts. A similar study by Krishan & Al-rsa'l (2022), reported that the third-grade Jordanian students face problems like a lack of motivation towards learning science and low achievement of scientific concepts contained in the sciences. Furthermore, students' motivation is influenced by their perceptions of the goal emphases of their environment, including parents, peers, teachers, and school culture. Misalignment between students' goals and environmental expectations can lead to decreased motivation (Fortus & Touitou, 2021).

Research has shown that motivation propels behavior in the direction of achievement. Since motivation drives efforts and directs behaviors toward academic goals, Steinmayr *et al.* (2019) emphasized that a student's degree of motivation is frequently linked to their success in school. As a matter of reality, many researchers submitted that motivation is vital and significant in getting good academic performance for students (Sarkis *et al.*, 2020; Winter, 2018). Hong *et al.* (2020) contends that in order to account for this complexity and the systemic nature of motivation, it is necessary to model these elements concurrently in order to comprehend students' motivations. Since motivation and learning have an impact on one another, this intricacy is further amplified when studying the co-development of learning and motivation. Studying the motivation and science learning can be difficult, which results in a lack of studies that take a motivational systemic viewpoint when looking into students' science learning (Hong *et al.*, 2020). The aim of the research is to determine whether students' attitudes and motivation toward science are mediated by the use of information and communication technology (ICT) in science education. Conversely, it aims to determine if ICT-based instruction can influence and enhance students' overall interest, engagement, and enthusiasm in science, potentially through its effect as a mediator in the relationship between traditional instruction and students' science attitudes and motivation. This research can shed light on the effectiveness of incorporating technology in science education and its potential benefits for students' perceptions and motivation in the field of science.

Science attitude and science motivation are closely intertwined, as one's attitude toward science significantly influences their motivation to pursue scientific endeavors. A person who is enthusiastic about science or some other topic that will stimulate students to concentrate on it, be motivated and interested. The importance of psychological factors such as motivation and attitude for the successful completion of a goal cannot be denied (Gregersen & Mercer, 2023). It was found that students with negative attitudes toward science are less motivated

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to participate in class, while those with favorable attitudes toward science are more motivated to do so. The use of ICT-based instruction in the teaching environment is generally an instructional tool that help students improve their attitudes and motivation (Wang *et al*., 2022).

In the realm of modern education, the integration of Information and Communication Technology (ICT) has brought about a paradigm shift in the way students engage with various subjects, including science. A crucial element of this change is how it affects students' science attitudes. Students' attitudes about science have a significant impact on their learning performance and future career goals. Timotheou *et al.* (2022) suggested that ICT Integration in schools impacts more than just students' performance; it also affects students science attitude. Furthermore, Su *et al.* (2022) also document that AI technologies effectively strengthens students' attitudes towards learning. Majority of students had basic skills in the use of ICT for their academic purposes (Paul & Roy, 2023). As we navigate the digital age, understanding and harnessing the synergy between students' attitudes and ICT-based instruction becomes increasingly vital for educators, curriculum designers, and policymakers aiming to foster a deep and lasting appreciation for science among the next generation. There is a lot of interest in the relationship between science motivation and instruction based on information and communication technology (ICT). Studies of Chang *et al.* (2019) and Wei-Kai *et al.* (2019), reported that the use of digital resources in education, such as augmented reality or AR, provides the opportunity for students to practice the contents more. This translates into improved retention of conceptual knowledge and, therefore, improved motivation and academic performance. Berami (2023) mentioned that the use and integration of ICT-based instruction in Science classroom significantly impact students' performance relative to their National Achievement Test (NAT) result.. Since, carrying out activities from these resources allows students to access sources, materials and useful educational content to acquire academic skills and knowledge that contribute to improve their academic interest and grades (Chang *et al.*, 2019), contributing to educational accessibility (Soriano-Sánchez & Jiménez-Vázquez, 2023) and favoring innovation (Soriano-Sánchez & Jiménez-Vázquez, 2022). This study's objective was to look into the mediating role of ICT-based instruction on the connection between attitudes and motivation of students in science. Specifically, the study has the following goals: to identify the level of science attitudes of students regarding of my science teacher, anxiety towards science, value of science to society, self-confidence in science, and desire to do science; to describe the level of science motivation of students in terms of self-efficacy, active learning strategies, science learning value, performance goal, achievement goal and learning environment stimulation; to identify the level of ICT-based instruction in terms of the teacher introduces ICT in classroom and the integration of ICT in classroom; to determine the significant relationship of science attitudes and motivation, science attitudes and ICT-based instruction, and ICT-based instruction and science motivation; and to determine the mediating effect of ICT-based instruction on the correlation of attitudes and motivation of students in science. Through these objectives, the research contributes to the broader field of education and pedagogy, shedding light on the potential benefits of integrating technology into science classrooms.

LITERATURE REVIEW

This study was anchored to Self-determination Theory. The motivation theory known as self-determination theory (SDT) contends that a person's success in learning is primarily down to their own self-motivated (Ryan & Deci, 2000). To put it another way, a person's will will determine how much energy is required to get a favorable result. This theory offers a helpful perspective for analyzing the ICT elements at the center of the current study. The Program for International Student Assessment (PISA) gauges a student's perceived competence and autonomy, as well as their interest and social interactions with ICT, in order to determine how comfortable they are with it. The second theory support for this study is Theory of Planned Behavior (TPB) developed by Ajzen (1991), which identifies actual behavior (AB) as the main variable that depicts an individual's discernible reaction to a certain target in a particular circumstance. Both behavioral intention (BI) and perceived behavioral control (PBC) are hypothesized by TPB to predict AB. According to Ajzen, BI is a measure of a person's willingness to carry out a specific activity, while PBC is the behavior's perceived ease or difficulty. In turn, BI is influenced by the relevant subjective norm (SN), PBC, and attitude toward the behavior (ATB) in the issue. According to TPB, outcome assessments and behavioral attitudes have an impact on ATB. Motivation to comply and normative views have an impact on SN. Therefore, researchers argue that by adding perceived behavioral control, the theory of planned behavior can explain the relationship between attitudes and motivation better than previous theories (Ajzen, 2002; Crawley & Koballa, 1992). Venkatesh *et al.* (2003), developed a more modern theory known as the Unified Theory of Acceptance and Use of Technology (UTAUT). The primary variable in the UTAUT is use behavior, which researchers define as an individual's level of acceptance and utilization of a new technology. Behavioral intention and enabling circumstances determine use behavior. According to Davis *et al.* (1989), behavioral intention measures how strongly a person intends to carry out a particular behavior, whereas facilitating conditions measure how much a person believes that the organizational and technical infrastructure needed to support the technology is in place (Venkatesh *et al*., 2003). Performance expectancy, effort expectancy, and social influence all influence behavioral intention. According to Venkatesh *et al.* (2003), performance expectation is the extent to which a person

thinks that utilizing technology will improve his or her job performance; EE is the degree of ease that comes with using the technology; and SI is the extent to which a person feels that significant others think that he or she should use the technology.

The above-cited theories clearly supported the variables indicated in the study. This is the reason why the researcher has chosen the cited theories, as these clearly establish and guide the connection of motivation, attitudes and ICT-based instruction.

The integration of ICT-based Instruction which is the mediating variable creates effective learning environments and supports students' active, self-directed, and productive engagement with knowledge. There are two indicators in this variable based on study conducted by Kelani (2022) which are student's opinions on how teachers implement ICT in the classroom and the benefits of doing so. The way teachers use ICT into the classroom is the main focus of students' perceptions of their introduction. However, the benefits of ICT integration in the classroom are related to the perceived benefits of ICT integration in the classroom.

Furthermore, students' attitudes towards science are one of the crucial elements that have a major role to motivate students in order to continue their studying in science. According to Tai *et al.* (2022), it has five indicators which include perception of the teacher, anxiety towards science, value of science to society, self-confidence in science, and desire to do science. Perception of the teacher is how students perceive their teacher in teaching science. Anxiety towards science is how students feel anxiety during science period. Value of science to society is how students value the field of science in their community, while self-confidence in science is how confident students are during oral and written discussion. Lastly, desire to do science is students' interest to learn science.

Finally, the dependent variable is science motivation of students by Tuan *et al.* (2005) includes six indicators which are self-efficacy, active learning strategies, science learning value, performance goal, achievement goal, and learning environment stimulation. Self-efficacy is when students have faith in their own abilities to succeed in science-related learning assignments. Students that actively use a range of tactics to build new information from their prior understanding are said to be using active learning strategies. When students develop their problem-solving skills, engage in inquiry-based learning, challenge their own thinking, and discover how science relates to everyday life, they are said to be learning science with value. They will be inspired to study science if they are able to recognize these significant values. Students' performance goals in science classes are to compete with their peers and attract the teacher's attention. The term "accomplishment goal" describes how students feel when they improve their proficiency and performance in science classes. stimulation of the learning environment. The curriculum, the way teachers taught, and the interactions between students all had an impact on how motivated the students were to learn science in the classroom.

Exploring whether this effect varies in different cultural and educational contexts could be valuable. While this study focused on ICT-based instruction as a mediating factor, there could be other factors not explored that mediate the relationship between science attitude and motivation, which would represent another research gap. Addressing these research gaps can help to provide a more comprehensive understanding of how ICT-based instruction impacts students' science attitude and motivation especially schools in rural areas in the Division of Bukidnon, and the factors that influence this relationship. Researchers can further investigate these areas to enhance the existing knowledge in this field.

The mediating effect of ICT-based instruction on science attitude and science motivation of students carries significant implications in the field of education and has a global impact. This innovative approach to teaching and learning leverages technology to enhance students' engagement with science subjects and foster positive attitudes and motivation. Moreover, the global significance of this approach extends to its role in bridging educational disparities as envisioned in SDG 4 which focuses inclusive, equitable, and quality education. ICT-based instruction can reach students in underserved regions, providing them with equal access to learning resources and opportunities that were previously limited by physical books, expensive science laboratories, and costly visual materials. As a result, it has the potential to reduce educational inequalities on a global scale, empowering students and equipping them with the knowledge and motivation to pursue careers in science-related fields.

MATERIALS AND METHODS

This section presents various methodologies in the study, including research respondents, materials and instrument, and design and procedures.

Research Respondents

The respondents in this study were senior high school students who were in Grades 11 and 12. The number of respondents was 309 students from the total population. Private schools and other grade levels was not included in the study. The research was conducted in a public school in the Division of Bukidnon specifically in Kitaotao I, II, and III Districts and the application Raosoft sampling calculator was used to obtain the desired sampling. So according to Raosoft Survey (1992) this application is suitable for quantitative research.

Materials and Instrument

Three questionnaires were used in this study. First, the ICT-based instruction questionnaire was adapted from Raphael R. Kenin's study Knowledge and Perceptions of Students Regarding their Teachers ICT Integration in Secondary Schools in Benin. It had 19 items in total, with two subscales: nine items measuring students' opinions

of teachers introducing ICT in the classroom, and ten items measuring the benefits of ICT integration in the classroom. The participants' answers to the 19 topics were measured using a five-point Likert scale, which went from (1) strongly agree to (5) strongly disagree. A panel of knowledgeable teacher educators with expertise in ICT use in the classroom has evaluated the tool. The instrument's build and content validity were confirmed by them. Alpha dependability for the second section of the survey was 0.855. Second, Tai *et al.* (2022) created a questionnaire about attitudes toward science that includes five indicators. Like all previous studies, the 17 items in the condensed instrument were scored on a 5-point Likert scale, with 1 denoting strongly disagree, 2 disagree, 3 neutral, 4 agree, and 5 strongly agree. Finally, science motivation adapted questionnaire used by Tuan, el at. (2005) on the development of a questionnaire to measure students' motivation towards science learning with six indicators and thirty-five items. Using a single student as the unit of analysis, the Cronbach alpha reliability coefficient for each scale varied from 0.87 to 0.70, demonstrating an equitable distribution of responses across all questions. Five-point Likert-type scales were used to create the items. A 1 on the scale means severely disagree, a 2 means disagree, a 3 means no opinion, a 4 means agree, and a 5 means highly agree.

Design and Procedures

This study was a non-experimental quantitative design and also it used descriptive-correlational design to assess the relationship between two or more variables. Such research is used to describe individual, event, and subject conditions without manipulation Siedlecki (2020). Also mentioned by Cresswell and Clark (2008), variables can be measured due to instruments and the use of statistics. This study also used mediation analysis that is increasingly used in the research field (Nguyen *et al.*, 2020). According to Bhandari (2021), it is a method of statistical analysis of whether a variable is a mediator using linear regression analysis. This study also aims to determine if the ICT-based instruction has a mediating effect on students' attitude and motivation.

In conducting this research, the researcher followed all the standards to carry out the said study. To be sure, here are the following step taken by the researcher: First, from the adapted questionnaire that the researcher analyzed, translated, and presented to the evaluators, the researcher analyzed it properly in order to conduct a good study. After being validated and revised by the researcher from correcting and adjusting the validators, the researcher got it ready for official approval. The researcher also hired an external validator to further increase the credibility of the instrument to be used. Second, after the questionnaire arranged, the researcher arranged everything required for the validation of works for validation in UMERC. Third, a letter was given to the school to ask for permission to conduct research. The letter was given to the school principal.

The statistics used in this study are as follows: Mean was used to obtain the level of ICT-based instruction, science attitude, and science motivation of students. Meanwhile the Pearson r. was used to identify significant relationships between ICT-based instruction, science attitude, and science motivation of students. Finally, in order to ascertain if ICT-based education significantly mediates the relationship between students' science motivation and attitudes, regression analysis was employed to examine the impact of science attitudes on science motivation.

This study undergo validation with the University of Mindanao Ethics Review Committee (UMERC) under protocol number UMERC-2024-167. The researchers fully considered ethical standards in conducting the study in accordance with ethical considerations. Additionally, the ethical standards for conducting the study included the required forms and documents as per the recommendations and approvals of the committee. This encompassed voluntary participation, privacy and confidentiality of the data, providing the informed consent form and assent form, honesty in presenting the data without any claims, proper procedures for selecting respondents, and obtaining permission from all parties involved in the study.

RESULTS AND DISCUSSION

Science Attitudes

Shown in Table 1 are the results for the level of science attitudes of students in science. The computations yielded an overall mean of 3.46 or moderate and a standard deviation of 0.45 and descriptive interpretation of moderate. This means that the respondents moderately manifest science attitudes. The results revealed that value of science to society has the higher mean score with the value of 3.97 which is described as high. The lowest indicator which is the anxiety towards science has obtained a lower score of 2.85 which described as moderate.

Table 1: Level of Science Attitudes

Indicators	SD	Mean	Descriptive Level
My Science Teacher	0.77	3.80	High
Anxiety towards Science	0.83	2.85	Moderate
Value of Science to Society	0.74	3.97	High
Self-confidence in Science	0.65	3.20	Moderate
Desire to do Science	0.80	3.47	Moderate
Overall	0.45	3.46	Moderate

This indicates that there is moderate level on students' science attitudes towards learning science in terms of value of science to society. According to Potvin *et al.* (2014), the societal value of science is a significant factor in shaping students' attitudes and motivation towards science. Similar with the study of Mao *et al.* (2021) that students who perceive science as relevant to society tend to have more positive attitudes towards learning science. On the other hand, science anxiety negatively impacts students' attitudes towards science and their academic achievement (Kaur *et al.*, 2020). Thus, addressing science anxiety through targeted interventions can improve students' attitudes and academic performance in science.

Science Motivation

Shown in Table 2 are the mean scores for the indicators of science motivation with an overall mean of 3.50 described as high with a standard deviation of 0.49. The high-level result indicated that science motivation is highly manifested. The cited overall mean score was the result gathered from the computed mean scores of its indicators. It could be gleaned from the data that the indicator with the highest mean rating of 3.88 or high is science learning value. In contrast, indicator with the lowest mean rating of 3.12 or moderate is performance goal.

The high level of science motivation is due to high ratings given by the respondents on the self-efficacy; active learning strategies; science learning value; performance goal; achievement goal; and learning environment stimulation, they displayed a high science motivation.

Table 2: Level of Science Motivation

Indicators	SD	Mean	Descriptive Level
Self-efficacy	0.60	3.38	Moderate
Active Learning Strategies	0.63	3.68	High
Science Learning Value	0.64	3.88	High
Performance Goal	0.75	3.12	Moderate
Achievement Goal	0.66	3.38	Moderate
Learning Environment Stimulation	0.69	3.58	High
Overall	0.49	3.50	High

This indicates that there is high level of students' science motivation towards learning science in terms of science learning value. Emphasizing the utility value of science, such as its relevance to personal and communal goals, significantly increases students' motivation in science and their intention to engage in science-related activities (Shin *et al.*, 2019). This is in line with the study of Tas *et al.* (2018), that students who perceive high task value and have a strong academic self-concept are more engaged in science classes, which in turn boosts their motivation and performance. Moreover, performance goals, which focus on demonstrating competence relative to others, have a moderate impact on students' motivation and academic performance. However, they are generally less influential compared to other motivational factors like science learning value (Sabanal *et al.*, 2023).

ICT-Based Instruction

Shown in Table 3 are the mean scores for the indicators of ICT-based instruction with an overall mean of 3.75 described as high with a standard deviation of 0.59. The high-level result indicated that ICT-based instruction is highly manifested. The cited overall mean score was the result gathered from the computed mean scores of its indicators. It could be gleaned from the data that the indicator with the highest mean rating of 3.75 or high is both the teacher introduces ICT in classroom and the integration of ICT in classroom.

Table 3: Level of ICT-Based Instruction

Indicators	SD	Mean	Descriptive Level
The Teacher Introduces ICT in Classroom	0.60	3.75	High
The Integration of ICT in Classroom	0.69	3.75	High
Overall	0.59	3.75	High

The high level of ICT-based instruction, as rated by the respondents, these indicators registered an overall high rating which was the product of the high scores rated by the students. Students' perceptions of teacher support for ICT and their own ICT competencies are positively correlated. Higher levels of perceived support led to better ICT competencies among students (Feng *et al.*, 2023). In addition, students' perceptions of ICT use in the classroom are generally positive, especially when they see it as enhancing their learning experience. However, the effectiveness of ICT is often limited by the level of access and the extent to which it is integrated into the curriculum (Alkaromah *et al.*, 2020). Thus, ICT integration in science classrooms increases student engagement and academic achievement (Wangchuk, 2023).

Relationship Between Science Attitudes and Motivation

Table 4 shows the significant relationship between learning experiences and understanding in Filipino

Table 4: Relationship between Science Attitudes and Motivation

Attitude	Motivation						
	SEL	**ALS**	**SLV**	**PG**	**AG**	**LES**	**Overall**
MST	.377** .000	.428** .000	.387** .000	.051 .368	.351** .000	.369** .000	.430** .000
ATS	.063 .266	-.137* .016	-.142* .012	.223** .000	-.110 .052	-.064 .266	-.031 .588
VSS	.385** .000	.551** .000	.626** .000	.157** .006	.374** .000	.416** .000	.552** .000
SIS	.630** .000	.429** .000	.449** .000	.262** .000	.528** .000	.422** .000	.600** .000
DDS	.522** .000	.482** .000	.475** .000	.294** .000	.435** .000	.507** .000	.602** .000
Overall	.640** .000	.567** .000	.578** .000	.328** .000	.505** .000	.537** .000	.698** .000

** p<0.05, ** p<0.01, ***p<0.001*

Legend:
MST- My Science Teacher
ATS- Anxiety towards Science
VSS- Value of Science to Society
SIS- Self-confidence in Science
DDS- Desire to do Science
SEL- Self-efficacy
ALS- Active Learning Strategies
SLV- Science Learning Value
PG- Performance Goal
AG- Achievement Goal
LES- Learning Environment Stimulation

subject. Presented in Table 4 is the correlation between science attitudes and motivation of students in science. It can be gleaned from the table that the correlation gained an overall r-value of 0.698 with a p-value of 0.001, which is less than the 0.05 level of significance. This indicates a significant relationship.

It can also be seen from the table that when science attitudes are correlated with science motivation reveals a significant correlation. This is due to the following overall r-values of the indicators: MST with 0.430, ATS with 0.031, VSS with 0.552, SIS with 0.600, DDS with 0.602, and the p-value is less than 0.001.

Relationship between Science Attitudes and ICT-Based Instruction

As presented in the table 5, the correlation has obtained an overall r-value of 0.514 with a p-value of 0.000. This implied that there is a significant relationship between attitudes and ICT-based instruction. It can also be seen from the table that science attitudes are significantly correlated to ICT-based instruction since the indicators revealed the following overall r-values my science teacher with 0.376, anxiety towards science with 0.065, value of science to society with 0.525, self-confidence in science with 0.353, desire to do science with 0.392, and p-value of less than

Table 5: Relationship between Science Attitudes and ICT-Based Instruction

Attitude	ICT-based Instruction		
	The Teacher Introduces ICT in Classroom	**The Integration of ICT in Classroom**	**Overall**
My Science Teacher	.335** .000	.349** .000	.376** .000
Anxiety towards Science	-.105 .065	-.019 .740	-.065 .255
Value of Science to Society	.426** .000	.523** .000	.525** .000
Self-confidence in Science	.252** .000	.382** .000	.353** .000
Desire to do Science	.316** .000	.392** .000	.392** .000
Overall	.398** .000	.529** .000	.514** .000

** p<0.05, ** p<0.01, ***p<0.001*

0.001. Thus, the two variables are significantly associated.

The research results of this study have relevance to Karma's *et al.* 2023 study, which showed a strong positive correlation between the use of ICT tools in teaching and improved student attitudes towards the subject matter. For instance, the integration of ICT tools in teaching grade seven science in Bhutan resulted in a significant improvement in students' attitudes and test scores. Similarly, the use of technology-enhanced instructional approaches in programming classes led to higher student engagement and positive attitudes (Phillips *et al.*, 2023).

Relationship between ICT-Based Instruction and Science Motivation

Table 6: Relationship between ICT-Based Instruction and Science Motivation

ICT-based Instruction	Motivation						
	SEL	**ALS**	**SLV**	**PG**	**AG**	**LES**	**Overall**
TTC	.400** .000	.502** .000	.422** .000	.223** .000	.406** .000	.479** .000	.539** .000
TIC	.468** .000	.578** .000	.571** .000	.299** .000	.508** .000	.554** .000	.661** .000
Overall	.479** .000	.596** .000	.551** .000	.289** .000	.506** .000	.570** .000	.663** .000

** p<0.05, ** p<0.01, ***p<0.001*

TTC- The Teacher Introduces ICT in Classroom
TIC- The Integration of ICT in Classroom
SEL- Self-efficacy
ALS- Active Learning Strategies
SLV- Science Learning Value
PG- Performance Goal
AG- Achievement Goal
LES- Learning Environment Stimulation

Table 6 presented the correlation between the ICT-based instruction and the science motivation of students. It can be seen from the table that the correlation gained an overall r-value of 0.663 and a p-value of less than 0.001, which is less than the 0.05 level of significance. This indicates a significant relationship between ICT-based instruction and science motivation of students. Thus, the null hypothesis of no significant relationship between ICT-based instruction and science motivation of students is rejected.

This confirms that students' learning experiences are significantly related to achieving communicative skills in Further, the table also showed that ICT-based instruction is significantly correlated to science motivation since the indicators revealed the following overall r-values: TTC with 0.539, and TIC with 0.661; and the p-value is <0.001. Thus, the two variables are significantly linked.

The result of this study support Areepattamannil's *et al.* (2020) assertion that ICT-based learning significantly enhances students' motivation in learning science. According to Shanmugam & Balakrishnan 2019, students report high levels of motivation when ICT elements are integrated into science learning, with factors such as assisted learning and stimulated interest being major contributors.

Table 7: Regression analysis showing the influence of attitude on motivation as mediated by ICT-based instruction

Step	Path	B	S.E.	β
1	C	.757	.044	.698***
2	A	.663	.063	.514***
3	B	.348	.035	.414***
4	c'	.526	.045	.485***

** p<0.05, ** p<0.01, ***p<0.001*

Presented in Table 7 are the steps that was categorized as Steps 1 to 4. The total effect value of 0.757 is attributed to the beta of science attitudes towards science motivation. The direct effect value of 0.526 is the beta of science attitudes towards science motivation with ICT-based instruction included in the regression. The indirect effect value of 0.663 is the value obtained from the original beta between attitude and motivation that now passes through ICT-based instruction to motivation (a*b, where "a" denotes the path A → ICT-BI and "b" pertains to path between ICT-BI → M) with indirect effect value of 0.348. With this, partial mediation occurred due to the fact that the effect was found to be significant at p<0.05. The Sobel-z test in table 8 yielded a z-value of 7.23,

Table 8: Results of statistical analysis on presence (or absence) of mediating effect

Combination of Variables	Sobel z	p-value	Mediation
attitude → ICT-based → motivation	7.238826	<0.05	Partial mediation

** p<0.05*

p<0.05. This means that mediating effect is partial, such that the original direct effect science attitudes to of motivation was positively increased upon the addition of ICT-based instruction. The positive value of Sobel z indicates that the addition of ICT-based instruction positively increased the effect of attitudes on motivation of students in science.

CONCLUSIONS

The level of science attitudes of students in science is moderate while the level of science motivation of students in science and ICT-based instruction is high. There is a significant relationship between attitude and motivation of students in science. There is also a significant relationship between attitude and ICT-based instruction of students in science and a significant relationship between ICT-based instruction and motivation of students in science. In addition, there is also a partial mediation on the effect of ICT-based instruction on the relationship between attitudes and motivation of students in science. The findings of the study confirm the notion about the mediating effect of effect of ICT-based instruction on the relationship between attitudes and motivation of students in science. The finding of the study supports The Self-Determination Theory (SDT) of Ryan & Deci (2000), suggesting that self-motivation is the causal factor behind an individual's success in learning.

One recommendation for school administrators to enhance student motivation to learn science is to foster positive attitudes toward ICT among educators and students. Since ICT-based instruction mediates the relationship between attitude and motivation, investing in proper ICT training and infrastructure for educators and learners is crucial. Teachers who are confident and skilled in using ICT will be better able to harness its benefits to motivate students.

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