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The mediating effect of technology in teaching and learning in the relationship between teacher readiness in ICT integration and cognitive performance

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Abstract. This research aims to know the mediating effect of technology in teaching and learning in the relationship between teacher readiness in ICT integration and cognitive performance to the 400 teacher respondents teaching Filipino in the province and in the Division of Davao del Sur. The technology in teaching and learning is the mediating variable in the study in the relationship between teacher readiness in ICT integration and cognitive performance. This study used non-experimental quantitative design and used descriptive correlation to gather data, ideas, evidence and information. The researcher used google forms to gather relevant data in this study. The adapted questionnaire was used as instrument as variables in this study, technology in teaching and learning, teacher readiness in ICT integration, and cognitive performance. The questionnaire was then evaluated and assessed by the experts. Based on the objectives of this study using mean, the result showed that there is a high level of teacher readiness in ICT integration, cognitive performance at technology in teaching and learning. Using Pearson-r, the result showed that there is a significant relationship between technology in teaching and learning to the teacher readiness in ICT integration, also there is a significant relationship between technology in teaching and learning and cognitive performance and lastly there is a significant relationship between teacher readiness in ICT integration and cognitive performance. Furthermore, using medgraph Sobel z-test, the result of the study showed that there is a partial mediation in the effect of technology in teaching and learning in the relationship between teacher readiness in ICT integration and cognitive performance.

Keywords. education, teacher readiness in ICT integration, cognitive performance, technology in teaching and learning, correlation, mediating effect, teaching and learning in the Philippines

Introduction

The poor cognitive performance of teachers could affect their delivery in teaching thus training helps them develop their strategies (Veloo et al. 193). Individual skills are greatly affected by the environment that surrounds them. In shaping skills especially cognitive performance affects them from their childhood experience. In school, on the other hand, it will be molded where they have a lot of time spent there. Further it will be developed not only on the environment but also by the physical condition within the classroom and the psychological aspects, however, being ready and enthusiastic of the teacher and the interaction with his

students, respect for co-teachers and the total weight of a classroom helps him (Bandiera et al.; Indumathi and Ramakrishnan 103; Milkie and Warner 10).

Cognitive performance is significant because it affects learning and it helps teachers learn well from a technological environment, the issue of Information Communication and Technology or ICT and its inclusion in school teaching is certainly significant (Ali et al.; Ghavifekr and Rosdy 175) With the help of technology, it aids the cognitive performance of teachers in teaching and learning and together with their interest in using it they are given the chance to know what competencies and how to improve the quality of their teaching (Alves et al. 51).

With teacher readiness teachers should well informed and prepared especially in the use of technology within the classroom considering students cognitive performance and of giving transition or the provision of tasks to students. The transition as an aspect of classroom management is the change from one task to the next that takes place within the classroom. (Ertmer at Otternbreit-Leftwich 271; Gebremedhin and Fenta 4). The technology is not just a mere thing that needs to be used in how teachers teach but now it is a new avenue for the process of teaching and learning (Nartey 648; Singh and Chan 7).

From the dynamic aspect of teaching, the way teachers integrate them will also be affected. (Inan and Lowther 145). Based on the recent studies, the technology plays a vital role in teaching and learning process since it deepens the competencies to be acquired even cognitive performance (Ali et al.; Commodari and Di Blasi 226). Because of these changes it is important to identify other ways to develop professional skills that can result in the developmental aspect of teachers 'cognitive performance, schools and higher education institutions need more research on trainings in technology as a necessary strategy for professional development. This study aims to describe the impact on the implementation of technology in teaching and learning between the variables teacher readiness in ICT integration and cognitive performance in teaching and look for significant results.

Method

This research used non-experimental quantitative design and descriptive correlation as method of the study. This is correlation because this entails to know the relationship between variables (Calmorin 6) in the teacher readiness in ICT integration, cognitive performance and technology in teaching and learning through the use of survey questionnaire as instrument to gather data. The objective of this study is to determine the mediating effect. The Mediating effect was used to transfer the effect of independent variable to the dependent variable (MacKinnon 54).

There are three sets of questionnaires adapted from different authors or adapted questionnaires and approved by the experts. The comments and suggestions of the experts were well received and derived for the benefit and implementation of the said instrument and the total mean assessed by the experts was 4.46 and described as excellent. The borrowed standardized questionnaires adopted the content because it had already been executed and validated by the author and it had undergone modification. The first set of questionnaires discusses the readiness of the teacher to integrate ICT whose indicators are Knowledge Acquired by In -Service Teachers on the Use of Technology, Attitudes to ICT, Level of ICT use by Teachers in Teaching and Learning, Obstacles Facing In-Service Teachers in the Teaching-Learning Process derived from the study of (Ghavifekr and Rosdy 175). The second set was used as an instrument in measuring cognitive performance. The instrument was taken and modified from the study of (Indumathi and Ramakrishnan 103). The third set of

questionnaires was taken and modified from the study of (Singh and Chan 7) in which it had ten items. The mediating variable in this research.

During the pilot testing (Cronbach Alpha) the total result of the independent variable teacher readiness in ICT integration was 0.884 which was described as excellent, the variable cognitive performance was 0.938 which was described as very good and the mediating effect which is technology in teaching and learning was 0.693 which is moderate. Google Forms was used as the technology used to collect the data.

Contingent with UMERC approval UMERC-2021-25, the researchers set schedule with the division superintendent on the conduct of survey involving the teachers. Before the administration of the questionnaires, the study was introduced by the researchers to the respondents and the research tool, and its purpose was explained to them. Then, the researchers oriented the respondents about the appropriate manner of accomplishing the questionnaires and explained to them all the items thoroughly to ensure valid and reliable results. The entire survey process took one months – September to October 2020.

In analyzing the data, mean and standard deviation were used to describe the levels and teacher readiness in ICT integration and cognitive performance and technology in teaching and learning. Pearson-r was used to determine the significance of the relationship between teacher readiness in ICT integration and cognitive performance while Sobel z-test was employed to measure the mediating effect of technology in teaching and learning in the relationship between teacher readiness in ICT integration and cognitive performance.

Results and Discussion

Shown in Table 1 the level of teacher readiness in ICT integration which has an overall mean score of 3.90 (SD=0.456), describe as High or the teacher readiness in ICT integration was often expressed. To give direction, the following indicators are in a high level or the teacher readiness in ICT integration was often expressed: level of use of ICT used for teaching and learning by teachers (= 4.11, SD = 0.485), Attitudes towards ICT (= 4.03, SD = 0.481), knowledge possessed by in-service teachers on the use of technology (= 3.80, SD = 0.683), and obstacles faced by in-service teachers in the teaching-learning process (= 3.66, SD = 0.785). The results showed that the level of readiness of teachers in the integration of ICT is high.

Table 1. *Level of Teacher Readiness in ICT Integration*

Indicators	Mean	SD	Descriptive Level
knowledge level possessed by in-service teachers in using ICT	3.80	.683	high
Attitude towards ICT	4.03	.481	high
level of ICT used for teaching and learning by teachers	4.11	.485	high
the obstacles faced by the in-service teachers in teaching-learning process	3.66	.785	high
Overall	3.90	.456	high

Overall, this means that often teachers used technology in teaching and learning to the learners, they are open for changes and the high knowledge possessed by the teachers from the use of technology even if there are obstacles, they still have high readiness in ICT integration in the teaching and learning process.

Having a high level in the indicator use of ICT by teachers in teaching and learning the study supports that teacher who positively used ICT have good results (Adiyarta et al. 12041). If ICT cannot help, it should not be used in teaching and learning (Basargekar at Singhavi) thus teachers and students will be fully given the opportunity to be productive through the use of technology in teaching and learning. Having a high level of attitudes towards ICT means that teachers have a positive attitude towards technology, and they like to use it in educational work (Ayub et al.).

On the other hand, the level of knowledge possessed by in -service teachers on the use of technology is also high. Due to the rapid development of ICT it is becoming more necessary by our society (Olivieret al. 327). Almost all schools have facilities available to teachers. These facilities are also slowly being embraced by teachers to integrate into their teaching. ICT is also often used in communication making presentations and forecasts by students. The use of technology also helps in the teaching and learning process (Biswas 34).

On the other hand, shown in Table 2 the result of statistical description in measuring the level of technology in teaching and learning of the teachers in MASUKIB cluster. The overall mean of technology in teaching and learning was 3.67 (*SD*=0.621), which interpreted as high or the use of technology in teaching and learning was often observed.

Table 2. *Level of Technology in Teaching and Learning*

Indicator	Mean	SD	Descriptive Level
Overall	3.67	.621	high

Generally, we could say that the elements in ICT integration in teaching and learning were observed and teachers do have skills and means in using technology. The facilities of their school were used in teaching and learning.

There is a high-level result of this variable, and it is strong and positive this can be deemed to have a huge impact on the teaching and learning process. This means that teachers' have high use of technology in teaching and learning. One study state that teachers play an important role in the field of teaching and learning and they believe that their skill in using technology will be compromised if they do not use it in teaching (Singh and Chan 7).

Technology should be used not only because it is easier to use but also because it helps teachers in the teaching and learning process (Ayub et al.). It is said that teachers have the ability in the integration of technology in teaching and learning they also have the skills to embrace in any way on how to use technology. They can use technology in the teaching and learning using facilities and equipment from their respective schools for their students.

Shown in Table 3 the result of statistical description on the level of cognitive performance of teachers in ICT integration of teachers in teaching and learning which has an overall mean of 3.84 (SD=0.458), described as high or the teacher's cognitive performance in teaching and learning is often observed. The high-level results of indicators. From the highest, flexibility (= 3.96, SD = 536), self-perception (= 4.22, SD = 0.567), memory (= 3.81, SD = 0.554), thinking (= 3.81, SD = 0.544), attention (= 3.67, SD = 0.556). It can be observed from the result that the use of technology by teachers in teaching and learning is of high level of cognitive performance in students.

Table 3. *Level of Cognitive Performance*

Indicator	Mean	SD	Descriptive Level
Memory	3.81	.554	high
Attention	3.67	.556	high
Flexibility	3.96	.536	high
Self-perception	3.95	.587	high
Thinking	3.81	.544	high
Overall	3.84	.458	high

This high -level result can be said to make technology more effective in teaching and learning. The level of flexibility is so high that it can be said that students can easily adapt to any innovative methods that contribute to learning. It is also easy for them to understand the lessons with technology. It will be noted that although the level of memorization and thinking is high, it can be said that it still needs enough time for it. The attention is high even though it is in the latter can be said that the attention was affected by the use of technology from their environment. In addition, this high level can be said to give impetus to teachers to use technology in the field of teaching and learning.

Having a high level in flexibility indicator can be deemed that students easily adapt to any innovative techniques that will help their learning. As time changes, they can easily adapt to modern learning methods. Any intensity of change will not affect or detract this from their understanding (Dina et al. 12025).

Further, Students make their own decisions to improve their knowledge. It helps them to come up into meaningful problem-solving techniques. It plays an important role in the academic success of students. With this result it can be said that the self-perception of the students is high especially with the help of technology (Alioon at Delialioğlu 656).

Shown in table 4 the result of the relationship of the independent variable (teacher readiness in ICT integration), dependent variable (cognitive performance), and mediating variable (technology in teaching and learning). Analyzing Correlation Bivariate using Pearson product moment correlation was employed to describe the relationship between variables.

Table 4. *Correlation Analysis of the Variables*

Pair	Variables	Correlation Coefficient	*p*-value	Decision of Ho
IV and DV	teacher readiness in ICT integration and cognitive performance	0.724	0.000	Rejected
IV and MV	teacher readiness in ICT integration and technology in teaching and learning	0.544	0.000	Rejected
MV and DV	technology in teaching and learning and cognitive performance	0.638	0.000	Rejected

The first zero-ordered correalation analysis between the teacher readiness in ICT integration and cognitive performance shows a calculated r-value of 0.724 from the probability

value of $p<0.000$ which we could say that significant on the level of 0.05. This means that there is a positive and strong relationship in the relationship of the two variables. Therefore, the hypothesis of no significant relationship was rejected.

In the same manner, in zero-ordered correlation analysis on teacher readiness in ICT integration and technology in teaching and learning the result has an *r*-value of 0.544 from the probability value of $p<0.000$ which means that significant in the level of 0.05. This means that there is still positive and strong relationship between these variables. Therefore, the hypothesis of no significant relationship was rejected.

In the third zero-ordered correlation analysis on technology in teaching and learning and cognitive performance which has an *r*-value of 0.638 from the probability value of $p<0.000$ which we could say that significant in the level of 0.05. This means that there is a positive and strong relationship between the two variables. Therefore, the hypothesis of no significant relationship was rejected.

The correlation between teacher readiness in ICT integration and cognitive performance describes as significant. This suggests that the teacher's readiness level in ICT integration is correlated with cognitive performance. This supports the study of Veloo et al. (193) and Koo et al. (173) who state that students' cognitive performance is influenced when teachers are well prepared to integrate technology with an specific goal to achieve in the teaching and learning process.

Moreover, the integration of ICT contributes to the effective learning of students with the help of the environments around them (Campbell; Singh and Chan 7). When the teacher is prepared for the technology to be used in teaching and learning, it will be able to effectively organize the concepts for the students to effectively learn.

On the other hand, the acceptance of ICT in the pedagogical field contributes to teacher readiness which also strengthens students' learning (Kilicer et al.; Kisla et al. 504). In the field of teaching and learning the flow of information becomes very meaningful especially if it is interactive especially with the help of technology as well.

In table 5, the data was analyzed using the linear regression method as input in the medgraph. Classified into step 1 to 4. The mediating analysis was designed by Baron at Kenny (1986) due to the presence of the mediating effect of the third variable. There are four steps to be met for a third variable to be acting as a mediator. In Table 5, these are categorized as Steps 1 to 4. In Step 1, teacher readiness in ICT integration as the independent variable (IV) significantly predicts cognitive performance, which is this study's dependent variable (DV). In step 2, teacher readiness in ICT integration significantly predicts technology in teaching and learning, the mediator (M). In step 3, technology in teaching and learning significantly predicts teacher readiness in ICT integration.

Table 5. *Regression Results of the Variables in the Four Criteria of the Presence of Mediating Effect*

Steps	Path	Beta (Unstandardized)	Standard Error	Beta (Standardized)
Step 1	C	0.727	0.035	0.724
Step 2	A	0.741	0.057	0.544
Step 3	B	0.256	0.028	0.346

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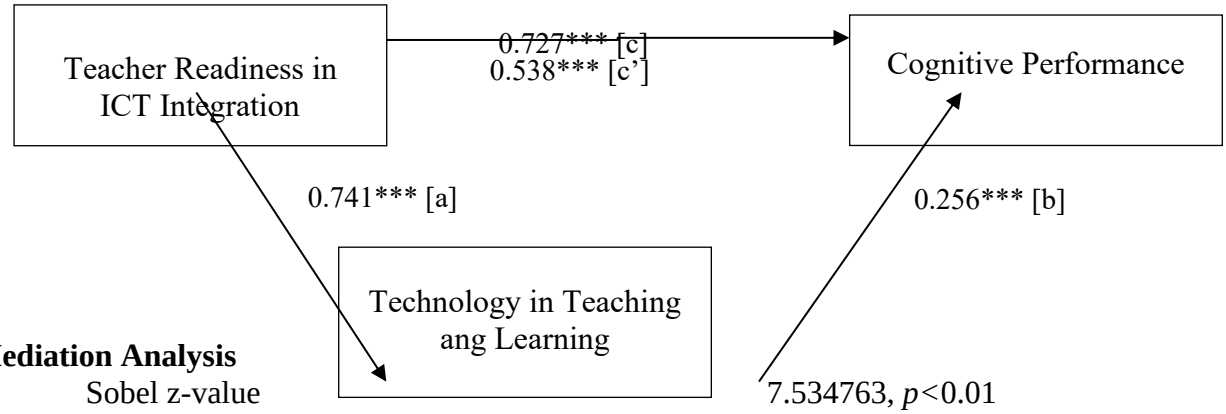
Step 4	c’	0.538	0.038	0.535

Because the three steps (paths a, b and c) are significant, further mediation analysis through medgraph is warranted, involving the Sobel z test to assess the significance of mediation effect. If the effect of the independent variable on the dependent variable becomes non-significant at the final step of the analysis, full mediation will be achieved. It means all the effects are mediated by the mediator variable. In addition, if the regression coefficient is substantially reduced at the final step but remains significant, only partial mediation is obtained, which implies that part of the independent variable (teacher readiness in ICT integration) is mediated by the mediator (technology in teaching and learning) but other parts are either direct or mediated by other variables that are not included in the model. In this case, as gleaned in step 4 (denoted as c’), the effect of organizational climate on service quality was even found to increase after mediated by adversity response. With this, partial mediation took place since the effect was found to be significant at $p<0.05$ level.

Furthermore, shown in figure 3, the result of the computation of mediating effect. The Sobel test yielded a z-value of 7.534763 with a *p*-value of 0.010886, which is significant at 0.05 level. This means that mediating effect is partial, this means that the mediating effect is partial, as it has a direct impact of teacher readiness in ICT integration and cognitive performance the effect was postive ans strong with the presence of technology in teaching and learning. A positive Sobel z-test number said that teaching and learning technology does not reduce the effect, but it enhances the impact of teacher readiness on the integration of ICT and cognitive performance. The figure shows the results of the scale calculation on the extent of the effect on the mediator performed between the three variables.

Standardized Coefficients



Mediation Analysis

Sobel z-value	7.534763, $p<0.01$
Percentage of the total effect that is mediated	26.044063%
Ratio of the indirect to the direct effect	0.352156

Effect Size Measures

Unstandardized Coefficients

Total:	.727
Direct:	.538
Indirect:	.741
Ratio Index:	1.019

Figure 3. Medgraph Showing the Variables of the Study

The ratio index was calculated by dividing the indirect effect by the total effect; in this case, .741 and .727 the result is 1.019. This means that all 100 percent of the total impact of teacher readiness on the integration of ICT into cognitive performance coincides with technology in teaching and learning, and approximately 100 percent of the total number of impacts may be direct or mediated by other factors. variables not included in the model. The result shows a partial mediator. This proves that the mediating effect does not reduce the correlation if it does not strengthen the correlation of independent and non-independent variables.

Conclusion and recommendation

The findings in this study are unambiguous and confirmed the assumptions about the mediating effect of technology in teaching and learning in the relationship between teacher readiness in ICT integration and cognitive performance provided by Ghavifekr and Rosdy. (175). Based on the high level of teacher readiness in ICT integration means that their knowledge in using ICT plays a vital role in teaching and learning of the students. The high level of cognitive performance helps the teachers in the process of teaching and learning. The high level of technology in teaching and learning improved the effect of teaching and learning to the students. The respondents proved that there is a high level of teacher readiness in ICT integration, cognitive performance, and technology in teaching and learning means that there is a significant effect between these variables. The theory where this anchored was positively proved. Lastly, there is a partial mediation of the effect of technology in teaching and learning in the relationship between teacher readiness in ICT integration and cognitive performance.

Based on the results of the study, on the high level of teacher readiness in ICT integration suggests that the educational implementers shall give new opportunities to the teachers in a new training skills and competencies which can help the institution and teaching performance.

The high level of cognitive performance suggests that teachers shall improve and develop more in terms of integrating ICT in teaching and learning and how to effectively use them. This could help strengthen the quality of students' performance.

From the high level of technology in teaching and learning suggest that teachers shall continue sharpening their skills through training to help them to be more energetic and be motivated so that they will work collaboratively and interactively. Educational sectors, parents, teachers, and stakeholders shall continuously works hand in hand for the students.

In the significant relationship between variables suggests that teachers shall continue looking for effective strategies for their process of teaching. Further research can be done to even older ages in the education sector.

The partial mediation of technology in teaching and learning in the relationship between teacher readiness in ICT integration and cognitive performance suggests that all concern individuals in educational system shall continuously help to improve the quality of education. Furthermore, future researchers could explore variables which are not being defined or used in this study.

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