Data Finding Analysis and discussion with TPACK Framework Model Articles

Alex Alexandre

Doctorate in Educational Technology Leadership

EDTC 810 – Statistics for Educational Research

Dr. Mark Connolly

April 17, 2022

Introduction

This assignment covers five articles that are discussed and analyzed. There is an elaboration on the “findings” of every author in the article. The data, the way they were collected, the “investigative techniques” are explored and correlated to the research methods: quantitative or mixed methods research. In addition, “the findings are linked to the research and subsidiary questions” and to what has been learned in the course similar to the formulation in the prompt. Every one of the articles discusses a different aspect of the TPACK framework models. The discussion stresses on descriptive and inferential statistics.

Development

The first article, **“**TPACK Development in Science Teaching: Measuring the TPACK Confidence of In-service Science Teacher,” was purposed for the knowledge of how training in the elements of TPACK impacts science teachers. The objective was to feel the effects of TPACK, to “understand” them, to “identify” them, and to “measure” them (Graham et al., 2009). This article was developed for the assessment of an “increase in teacher’s confidence” after training sessions for in-service and preservice teachers (Graham et al., 2009). As a result, four aspects of the TPACK framework were surveyed in this article: TPK, TCK, TK, and TPACK. There was a survey, a pretest, and a posttest. A paired-samples t-test was used for the descriptive and inferential analysis of the measurements. There was a sampling with 15 participants and a survey with 15 respondents.

For the descriptive statistics, the means and standard deviations were documented for each of the categories. For the descriptive analysis, the means are 3.18 and 4.25 for TPACK, and for TPK, the means are 3.57 and 4.57. “Results indicate a significant increase for all constructs” (Graham et al., 2009). The survey had two open-ended questions that were coded making this article a quantitative –qualitative mixed method research. For inferential statistics, there is the p-value that shows a significant difference between the measurement of the pretest and that of the posttest. The p-values for the variables were .002, .001. .005, and .019. These values are less than .05. This is an indication that there was a significant difference between the means of the pretest to the means of the posttest.

Relating the “findings to the research questions,” it means that the null hypothesis may be rejected, and the alternate hypothesis upheld. What the results demonstrated is that scientists have a way to identify and to measure the technological, pedagogical, and content knowledge of teachers. Through training, teacher’s abilities to implement the TPACK’s concepts, for learning and motivation, can be improved. Findings show the area where teachers have the most confidence, and where confidence needs improvement. The greatest level of confidence is in TK, and the area that is in need of improvement is TCK with the lowest level of confidence (Graham et al., 2009).

This article connects what has been learned in the course when it discusses and establishes statistical differences. It continues with references to sampling, means, and standard deviations. In addition, for the survey, Likert scale was used with a variation of 1 to 6 whereas 1 is the least confident and 6 is the most confident. The data, with a pretest and a posttest, were examined through a paired-samples t-test. With a paired-samples t-test, there is a causal relationship between the dependent and the independent variable. Moreover, this article sets statistical differences at less than .05 similar to what was learned in the course.

The second article, “How Useful are our Models? Pre-Service and Practicing Teacher Evaluations of Technology Integration Models,” was researched to evaluate the usefulness of technological models such as “TPACK, SAMR, TIP, TIM, RAT, and TAM” (Kimmons et al., 2018). Since “Educators and practitioners” look more into TPACK and SAMR than other models, researchers probe on the reasons (Kimmons et al., 2018). This research was quantitative with a survey questionnaire. The participants were preservice and in-service teachers. There was a sampling with 129 participants. “The survey had nine questions on the attitudes of teachers towards theory and technology.” The research questions were to investigate “teachers’ attitudes toward theory and technology and the teachers’ theoretical values for the integration of technology” (Kimmons et al., 2018

“Connecting the research questions to findings,” teachers want a match between theory and technology, which means a product that they understand and that they can use in their daily practices. There was a focus on “theoretical values” that are associated with these models, and the “attitudes” of users toward “theory and technology” (Kimmons et al., 2018). What the researcher found is that “theory should be clear” with its connection with technology and “outcomes” (Kimmons et al., 2018). “Teachers who have been teaching for less than one year believe that engagement was a greater benefit of technology than teachers who have more than five years of experience” (Kimmons et al., 2018). Participants explained that the “values that were important to them were clarity and the role of technology" rather than "fruitfulness" (Kimmons et al., 2018). "Classroom experience does not affect theoretical values" (Kimmons et al., 2018).

Although participants like the appearance of the SAMR more than TPACK, SAMR is "favored for its practicality" (Kimmons et al., 2018). Integration must produce a tool that teachers are able to use. It is not about "appeal, but usefulness." It should be about "a design that teachers can apply in their immediate context for the development of their classroom and the promotion of their students" (Kimmons et al., 2018). Teachers are not into the "popularity and aesthetic" of models. "Participants considered the value of technology as an engagement tool" (Kimmons et al., 2018). Visual appeals have to satisfy the integration that is necessary to involve and engage students in their work.

There were tests such as one-way ANOVA and paired-samples t-tests. The mean for the connection of "theory to technology was .62, and for theory to be clear, it was 58. For practicality, the mean was 54, and for connected outcomes, the mean was 54 (Kimmons et al., 2018). The independent variable was classroom experience. The dependent variable was the attitude of the teacher. One factor showed a significant difference with $F = 3.08$ and $p < .05$. It was about the "role of technology and method of engagement" (Kimmons et al., 2018). The teachers with the "least experience are more likely to use technology for engagement than the teachers with the most experience" (Kimmons et al., 2018). The mean for the importance of clarity was .89, and for outcomes, it was .86. For the role of technology, it was .81. There was no significant differences in classroom experience as an independent variable and theoretical values as dependent variables among groups, showed the ANOVA test. Participants did not support that TPACK and SAMR align with their theoretical values with M = 46, and M = 27. For visual appeal as the independent variable, and technology and theory factors as the dependent variable, there was a significant difference for practicality with $F = 3.36$ and $p < .05$ meaning "educational theory can have practical value for classroom experience" (Kimmons et al., 2018). Inferential statistics reveal a high Cronbach's of .81 and a low Cronbach's of 41 (Kimmons et al., 2018).

This article makes reference to the concepts that were studied in the course. It uses one-way ANOVA and paired-samples t-test, which were studied. It has a survey, a sampling, and participants. The measurements involve dependent and independent variables. This article has many subdivisions. Therefore, it is beneficial to use paired-samples t-tests that allow at most two groups, and the one-way ANOVA that can go beyond two independent groups. The F-value, means, and significant differences are reported, meaning there is interaction of descriptive and inferential statistics and analyses. These concepts were all studied.

The third article, "Development of survey of technological, pedagogical and content knowledge (TPACK)," was studied to develop a survey intended to measure TPACK. There are "surveys that measure separately" each one of the TPACK domains, but this survey would "measure the connection among the domains." (Sahin, I., 2011). Its purpose is to establish "the dynamic interaction between technology, pedagogy, and content" (Sahin, I., 2011). Five phases such as the "item pool, the survey validity and reliability, the discriminant validity, the test-retest validity, and the survey translation" were used to develop this survey (Sahin, I., 2011). The first version of the survey had 60 items, which were reduced to 47 after a revision of the items. To revise the survey, a scale such as "totally measuring, somewhat measuring, or not measuring" was used (Sahin, I., 2011). Respondents would measure TPACK with the completion of this survey that uses a five choice Likert scale such as "1 = not at all, 2 = little, 3 = moderate, 4 = quite, and 5 = complete" (Sahin, I., 2011).

To measure the validity of the survey, "EFA (exploratory factor analysis) for subscale, KMO (Kaiser-Meyer-Olkin) for sampling, and BTS (Bartlett's Test of Sphericity) for "factor extraction" were used (Sahin, I., 2011). This was important to ensure the satisfaction of "psychometric criteria" and the "suitability of the characteristics of data" (Sahin, I., 2011). "For reliability, Cronbach's alpha coefficient was used" (Sahin, I., 2011). For the discriminant validity, there was "a research for the criterion-related validity" (Sahin, I., 2011). "The test-retest validity was tested with the administration of the survey twice in a two-week period" (Sahin, I., 2011). For phase 5, "the survey was translated into English." For phase one, there were 10 participants. Phase two had 348, and phase three had 205. Phase four had 384 preservice teachers. The participants were both male and female in all the phases.

With a p-value at less than 0.001 for the KMO and BTS for the 47 items, "the items were qualified to be included in the survey" (Sahin, I., 2011). The percentage of variance for each factor varies from 76.107% for TPACK to 51.877% for TK. Therefore, there were "statistical significant correlations among the subscales of the survey," meaning that the TPACK's domains correlate (Sahin, I., 2011). The Pearson correlation coefficient between subscales was significant at $p < 0.05$ and $P< 0.01$. In addition, when "the correlations between the factor scores are examined," "highly positive and strong relationships are seen among all of the subscales" (Sahin, I., 2011). "After the survey was administered, the reliability coefficient p was less than 0.01 for every subscale, which confirms the test-retest reliability of the survey" (Sahin, I., 2011).

This article applies the concepts learned in the course. It speaks of correlation and Pearson correlation. It makes reference to variance, statistical significance, and "positive and strong relationships among variables." There is significance when p-value is less than 0.001. There is reference to sampling, surveying, and participants. In addition, data are measured, collected, and analyzed inferentially. These are concepts that were studied in the course.

The fourth article, "Technological Pedagogical Content Knowledge (TPACK): The Development and validation of an assessment instrument for preservice teachers," was a research study on the development of a survey that preservice teachers may use to assess their own knowledge of TPACK. The focus was on the "validation of a survey instrument" whose goal was the determination of the "intersection" of "the relationships and complexities of the three basic components of knowledge" (Schmidt et al., 2010). In this study, all the seven components of TPACK were included, TK, CK, PK, PCK, TCK, TPK, and TPACK. This was done that the knowledge that teachers need for the integration of technology could be developed (Schmidt et al., 2010). According to Schmidt et al. (2010), "Reliable assessment is a need" for the design of teacher professional development.

The survey was designed for elementary preservice teachers with a combination of TPACK and content areas. With the help of "expert raters, a survey with 75 items were constructed" (Schmidt et al., 2010). 124 incoming teachers participated in the development of this survey with “116 females and 8 males. The participants were “elementary teachers at 79%, early childhood at 14.5%, and other majors at 6.5%” (Schmidt et al., 2010). The variables were measured through a five-level Likert scale such as “strongly disagree, disagree, neither agree nor disagree, agree, and strongly agree, making connections between content, pedagogy, and technology in relation to the instructional goals” (Schmidt et al., 2010). It was a quantitative research study.

Factor analysis is important for correspondence to covariance, for the development of a rigorous instrument, and for internal consistency (Schmidt et al., 2010). “For internal consistency,” Cronbach’s alpha was used for each subscale. For “factor analysis of construct validity of knowledge domain subscale, “Varimax rotation and Kaiser normalization” were used (Schmidt et al., 2010). The purpose was to establish “covariations” among items using “reliability statistics” and to reject problematic items” (Schmidt et al., 2010). Therefore, 28 items, those that reduced the “reliability coefficient” were dropped (Schmidt et al., 2010). The survey proceeded with 47 items.

According to Schmidt et al. (2010), a survey is deemed reliable with an internal consistency range of .75 and .92 for Cronbach’s alpha. For TK, “the total variance was 49.36%” and Cronbach’s alpha was .82. The internal consistency alpha for CK for math was .85, and social studies, .84. For science, it was .82, and for literacy, .75. The highest internal consistency alpha was for TPACK at .92. The internal consistency alpha was acceptable for each subscale and also shows a strong correlation. The measurement correlations were for TPK, $r = .71$, TCK, $r = .49$, PCK, $r = .49$. There was a significant correlation at .001 level (Schmidt et al., 2010). It means that the survey was reliable “to measure TPACK and its related domains” (Schmidt et al., 2010). There was a mean for each subscale such that TK was 3.67 and PK, 3.97. PCK was 3.63, and TPK, 4.15. TCK was 3.84 and TPACK, 3.97.

The concepts that the course covered are mentioned in this article. The emphasis is on the designing and the validation of a survey. There was a sampling of participants that measured the survey for its validity and reliability using Likert scale. The variables were correlated with Pearson r-values and variance. There is reference to means and significant correlations. This means that descriptive and inferential statistics are part of the development. These concepts were all studied in the course.

The fifth article, “Differentiation between TPACK level in junior and senior pre-service teacher to design science lesson” was used to articulate how preservice teachers use TPACK at different stages in their preparation. It is a mixed methods quantitative and qualitative study, which explains how technology has made it possible for teaching and learning to be “efficient and active” (Terra et al., 2020). The participants, 24 juniors and 24 seniors, completed a survey and presented their lesson plans to be analyzed for the TPACK factors such as TK, PK, CK, and TPACK that science teachers have to use to “make science easy to teach” (Terra et al., 2020). A questionnaire with the following nine categories were used: “way of thinking, way to develop understanding, sufficient knowledge, pedagogical knowledge, content knowledge, technological knowledge, TPACK, and learning experience” (Terra et al., 2020). With science content such as chemistry, biology, and physics, preservice teachers wrote “lesson plans with an objective, learning strategies, and work period based on TPACK's principles" (Terra et al., 2020). The lesson plan and the survey questions were correlated to match the domains of TPACK.

According to the questionnaire track result," the junior level students had a higher mean in every subscale with an average of 4.6 versus the seniors who had an average of 3.6. "Sufficient knowledge was the lowest for the juniors, and technology the lowest for the seniors" (Terra et al., 2020). The lesson plans were coded for themes and theories. In the lesson plans, for pedagogy students use group discussion, role play, direct instruction, and cooperative learning (Terra et al., 2020). For content materials, they used "acid and base, circulatory system, and heat and energy" (Terra et al., 2020).   For technology, they used "video animation, PowerPoint Presentation, and Phet simulation" (Terra et al., 2020).

Based on the findings, what a "science teacher lacks" may be supplied with the "displaying of videos, pictures, simulation, interactive cloud classroom, blended learning, and e-learning" (Terra et al., 2020). Integration of technology is a means to "broaden student's knowledge" (Terra et al., 2020). This will have its impact when teachers master technological knowledge and work with the belief that a combination of technology, educational strategies, and content mastery will provide the most benefit to students (Terra et al., 2020). TPACK can prepare teachers in the use of their computers to "increase their performance" (Terra et al., 2020). Classroom management may be improved with the activation of TPACK.

This article makes reference to some of the skills discussed in the course. It is a mixed methods research with a survey for the quantitative aspect, and lesson plans for the qualitative factor. The means of the survey were reported, which is the descriptive component. There was a sampling of participants. There was also an analysis of the means comparing junior level students to senior level students. Unfortunately, it has no inferential statistics analyzing significant differences, null and alternate hypotheses. It has no F-value and p-value to report.

Conclusion

In this paper, five articles were studied. They all relate to the TPACK framework model one way or another. The first article addresses the development of TPACK and the confidence of teachers in TPACK. The second article speaks on the usefulness of technological models. The third and the fourth article have some similarities. They both focus on the design of a survey that would assess abilities in TPACK. The fifth article compares third and fourth year's students that are learning to be science teachers. The analyses of the articles go back to what was learned in the implementation of descriptive and inferential statistics.

Reference List

Graham et al. (2009). TPACK Development in Science Teaching: Measuring the TPACK Confidence of In-service Science Teacher. TechTrends; Sep/Oct 2009; 53, 5; ProQuest Central.

Kimmons et al. (2018). How Useful are our Models? Pre-Service and Practicing Teacher Evaluations of Technology Integration Models. TechTrends; Washington Vol. 62, Iss. 1, (Jan 2018): 29-36. DOI:10.1007/s11528-017-0227-8.

Sahin, I. (2011). Development of survey of technological pedagogical and content knowledge (TPACK). TOJET : The Turkish Online Journal of Educational Technology; Adapazari Vol. 10, Iss. 1, (2011): n/a.

Schmidt et al. (2010). Technological Pedagogical Content Knowledge (TPACK): The Development and validation of an assessment instrument for preservice teachers. Tae S Journal of Research on Technology in Education; Winter 2009/2010; 42, 2; ProQuest Central pg. 123.

Terra et al. (2020). Differentiation between TPACK level in junior and senior pre-service teacher to design science lesson. Journal of Physics: Conference Series; Bristol Vol. 1563, Iss. 1, (Jun 2020). DOI:10.1088/1742-6596/1563/1/012061