# Constructivist teaching practices and educational technology use among educators of the University of Baguio

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**Abstract**

Constructivist teaching practices and educational technology use has been noted to be positively correlated. The study investigated this and the effect of teaching experience, highest educational attainment, knowledge of availability of ed-tech, and extent of use of ed-tech unto the extent of practice of constructivist teaching methods from 95 educators in the University of Baguio. Results indicated that most of the respondents use constructivist teaching methods with cooperative learning as the most used teaching pedagogy and peer tutoring the least. Extent of practice of the different constructivist teaching methods was not affected by the respondents' teaching experience and knowledge of availability of ed-tech. However, statistically significant correlations were seen between the respondents' extent of use of ed-tech and their extent of practice of the different constructivist teaching methods. There were no significant differences seen on the respondents' extent of practice of project-based learning, inquiry based learning, guided instruction and peer tutoring considering the respondents' highest educational attainment. Significant differences were, however, noted for cooperative learning. Among the reasons cited by the respondents for using constructivist teaching methods included their desire for student development, better learning and for student motivation and class participation. The respondents noted physical factors, student factors, factors inherent to the method, and teacher factors as the most common challenges they face in implementing constructivist teaching methods.

**Keywords***:* constructivist teaching, educational technology, correlation, cooperative learning, analysis of variance

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## Introduction

Constructivism in teaching and learning is often associated with teaching approaches that promote student-centered learning, active learning or learning by doing. Scholars of constructivism view learning as an active process where learners are encouraged to apply guesswork and intuitive thinking through self-discovery of the principles, concepts and facts. Earlier proponents of the socio-cultural dimension of constructivism purport that learning occurs as learners interact with the people and tools of the environment, and deepen their enculturation with the practices of the community (Barab & Duffy, 2000). Pedagogical approaches such as project-based learning, problem-based learning and inquiry-based learning were developed from these conceptions of constructivism.

Numerous constructivist teaching practices thrive and some of these teaching methods are supported by literature in their effectiveness in classroom instruction. They are: 1. constructionism, also called design-based or project-based learning (Li, Cheng, & Liu, 2013; Sabelli, 2008; Alesandrini & Larson, 2002), 2. guided instruction (Fisher & Frey, 2010), 3. inquiry and problem-based learning (Hakverdi-Can & Sonmez, 2012; Crane, 2009; Schmidt & Loyens, 2007), 4. cooperative learning (Hsiung, 2012), and 5. peer teaching (Krych, et. al., 2005).

There is much evidence now of a shift from teacher-focused knowledge transmission pedagogies to learner-focused social constructivist knowledge generation pedagogies according to Arinto (2013). Because new paradigms, designs, and pedagogies are put in play for the 21st century learner, teachers' roles followed similar evolutions. The role of the teachers in today's "Classroom 2.0" has now evolved from a talking-head broadcaster and transmitter of static information, to a facilitator, adviser, content expert, coach, group facilitator, gatekeeper, and orchestrator of collaborative knowledge creation (Berk, 2009; Greenhow, Robelia & Hughes, 2009; Edutopia, 2008). Much of these roles advocate constructivist teaching methodologies, learning models and philosophy.

Studies have shown that educators who are more attuned towards using constructivist practices and teaching methods are more active educational technology users than others (Polin & Moe, 2015). For example, Remegio, Simpao, and Cabang (2017) found in their study that when educators of the Sultan Kudarat State University develop intermediate forms of technology pedagogy knowledge and technology content knowledge, these contributed to their confidence for constructivist-oriented technology integration. However, empirical studies have also shown that teachers do not fully exploit the affordances of technology (ICT) tools for constructivist teaching suggesting that technology integration in a constructivist-oriented pedagogy could be an area of particular challenge for them (Starkey, 2010; Lim & Chai, 2008).

Teaching experience does not necessarily mean that one is proficient in the constructivist teaching approaches and in using educational technologies to their teaching because some studies have found that years of teaching experience and age have a negative effect on the teachers' computer anxiety (Aldunate & Nussbaum, 2013). Also, Lee and Tsai's (2010) survey of in-service teachers found that older teachers with more teaching experience tend to be less confident in their web-based TPACK. TPACK or technological, pedagogical and content knowledge, is a paradigm of instruction incorporating technology to content knowledge and teaching pedagogy (Koehler & Mishra, 2009) and it is rooted in the constructivist philosophy (Polin & Moe, 2015). Fontanilla (2015) likewise found that there was a negative correlation between years of teaching experience with technology knowledge (TK) and a positive correlation in the TPACK domains of content knowledge (CK), pedagogy knowledge (PK), and pedagogy-content knowledge (PCK). Furthermore, Hafalla[2] (2018) found that age and teaching experience were significant predictors of the teachers' facilitative use of technology for learning (FTL) ($p<0.05$), albeit with an inverse relationship.

Results from previous studies also suggested that learned educational technologies of the respondents during their higher levels of learning (in their masteral and doctorate levels) did not usually transfer to adoption in their educational practices (in ICT for example Cohen, Manion, & Morrison, 2004). Furthermore, Hafalla[2] (2018) found that educators tend to assign more importance to adopt technology in class as a school requirement as he attains a master's degree as compared to a doctorate or bachelor's degree. This finding suggests that the motivations for adopting technology in class why it is so manifested for the master's group is maybe due to institutional or governmental policies (Hafalla[2], 2018). This result is further indicative of the progress of many teachers in technology integration to their constructivist teaching that as he matures, technology integration and the drive to learn new technologies mellow down. As seen in Schiller's (2003) study, personal characteristics such as educational level and educational experience, among others, can influence the adoption of technology by the teachers.

Thus, it is fundamental to study the educators' constructivist teaching pedagogy and their use of educational technologies for teaching since it has been proven that such methods facilitate the educator's TPACK (Hafalla[1], 2018) and outcome-based teaching and learning (OBTL) methods and as a way to cultivate technology integration practices in the academe. Furthermore, constructivist teaching practices promote positive social dynamics through group engagement (Hsiung, 2012). Previous research gives evidence that educators from the School of Teacher Education (STE) in the University of Baguio practice constructivist pedagogies (Hafalla[1], 2018), however, for other schools, no research exists and this gives rise to the need to bring to light the constructivist teaching practices of the whole university. Challenges and reasons to such practices also need to be surfaced *en route* to better OBTL practices and training methods for educators. Saavedra and Opfer (2012) further opined that learning 21st century skills require 21st century teaching methods and that many of these teaching designs and methods as well as the application of emerging technologies in the educational field are far from being fully explored. The rigor of research may need enhancements and much research must still be done on them regarding their applicability in the educational setting to address classroom teaching and learning.

Hence, the purpose of the study is to investigate the extent of practice of the constructivist teaching methods among educators within the University of Baguio, determine the challenges to the proliferation to such practices and the reasons why educators do practice the methods, and investigate the effect of several factors to such practices.

Specifically, the study seeks to answer the following questions:

1. What is the extent of practice of the constructivist teaching methods among educators in the University of Baguio?

2. What are the types of reasons why the respondents do practice the different constructivist methods?

3. What are the types of challenges encountered by the educators on the implementation of constructivist teaching practices?

4. How do teaching experience, educational attainment, availability and extent of use of educational technologies affect the constructivist teaching practices of educators?

## Methodology

The study is a descriptive-quantitative research on the constructivist teaching practices (CTP) of educators in the University of Baguio using a pre-validated survey questionnaire developed by the proponent (Hafalla[1], 2018). A “good” to “excellent” Cronbach’s alpha level (0.80 to 0.93) of the different areas of the CTP scale deemed it to be a reliable instrument as seen in Table 1. The study investigated the effect of several variables such as teaching experience, educational attainment, and availability and extent of use of educational technologies unto the educators’ constructivist teaching practices.

Table 1
*Cronbach’s Alpha Values** of the CTP Scale*

| Latent Constructs | Alpha* | Interpretation |
|---|---|---|
| Design-based or Project-based Learning (Constructionism) | 0.81 | Good |
| Guided Instruction | 0.87 | Good |
| Inquiry or Problem-based Learning | 0.83 | Good |
| Cooperative Learning | 0.80 | Good |
| Peer Tutoring | 0.93 | Excellent |

* >0.90=Excellent, 0.70-0.90=Good, 0.60-0.70=Acceptable, 0.50-0.60=Poor, <0.50=Unacceptable

** Based on 22 cases

Respondents of the study comprised educators of the University of Baguio during the second semester of SY 2016-2017 excluding the School of Law. A total of 139 or 30.28% of the targeted sample participated in the study with 95 of the respondents used for the statistical analysis. Permission to administer the survey questionnaire was sought from the offices of the VP for Academic Affairs and the UBRDC. Respondents of the study were sought to answer the survey questionnaire on a voluntary basis. Names of the respondents were omitted in the survey questionnaire to safeguard their identity. Also, respondents had the option to withdraw anytime in their participation to the study. Furthermore, confidentiality of the data collected was assured by the researcher through proper coding.

For the analysis of the data, weighted means answered specific problem number one. Thematic analysis of the educators' responses answered problem numbers two and three. ANOVA, t-test and bivariate correlation analysis using Pearson's correlation coefficient gave light to the effect of the variables teaching experience, educational attainment, availability and extent of use of educational technologies unto the educators' extent of practice of the constructivist teaching methods.

## Results and Discussion

### Extent of Practice of Constructivist Teaching Methods

The constructivist teaching practices of the respondents were investigated. Figure 1 and Table 2 presents the summary of the results of the survey. Results in Figure 1 indicates that, in general, most of the teachers surveyed "often practiced (OP)" the different constructivist teaching methods (M=3.99, SD=1.01) with most of the teachers using cooperative learning techniques (M=4.37, SD=0.65),followed by guided instruction (M=4.25, SD=0.62) and project-based learning (M=3.92, SD=0.65) corroborating Arinto's (2013) findings. However, many of the teachers least practiced peer tutoring (M=3.41, SD=1.06) mimicking results from previous studies (Hafalla[1], 2018). Though it was found that the utilization of peer teaching in educational settings has been effective in the development of teamwork, leadership, and communication skills in addition to improving students' understanding of course content (Krych et al., 2005), the respondents posited their lowest score on this constructivist method. This result puts the educators at a disadvantage as it limits their constructivist teaching repertoire. Previous researches on the reasons for such low use of peer tutoring among educators indicated that most do not use this method because of time constraints, the availability of more effective constructivist methods that they could employ depending on the subject matter at hand, lack of familiarity with the method, and that preparation prior to using this method entailed much planning which their busy teaching schedules did not allow (Hafalla[1], 2018).

Results of the specific indicators of each constructivist teaching method indicated that for CL (cooperative learning), most of the teachers "allow students to question the teachers (me) for clarifications so that everything is clearly understood before the start of the group activity" (M=4.72, SD=0.63). This technique eliminates ambiguity in the conduct of the group activity and saves precious time towards the swift accomplishment of the group task. Also, most of the teachers "monitor, observe, and intervene when necessary during the progress of the students in their group activity" (M=4.49, SD=0.75) which corrects the students' mistakes in conducting their group activities. Furthermore, most of the teachers "explain to the students the criteria for the academic task, time limits (one hour, several days, weeks, etc.), accountability, their roles, expected behaviors and decision making within the group" (M=4.47, SD=0.83) which ensures clear instructions and eliminates ambiguity in the conduct of the activities. This practice shadows their pragmatic beliefs and practices which were also found in previous studies (Hafalla[2], 2018).

On the other hand, most teachers' least practiced "ensuring that the students follow the correct tutoring procedure of presenting material again by the tutor and providing feedback by the tutee" (M3.30, SD=1.20) in peer tutoring. This might indicate that most of the teachers are also not familiar with the correct tutoring procedure that is why they are adamant in implementing this teaching technique. This was also seen in their low scores in "instructing the pairs of tutors and tutees of their topic for tutoring or disseminate the materials to them" (M=3.33, SD=1.15), "assigning the respective partners for tutoring" (M=3.34, SD=1.15) and "monitoring the progress of tutor and tutees and providing them feedback" (M=3.34, SD=1.25). These results points to the possibility that while some do practice peer tutoring techniques, however, most of the teachers are not confident in applying the technique.

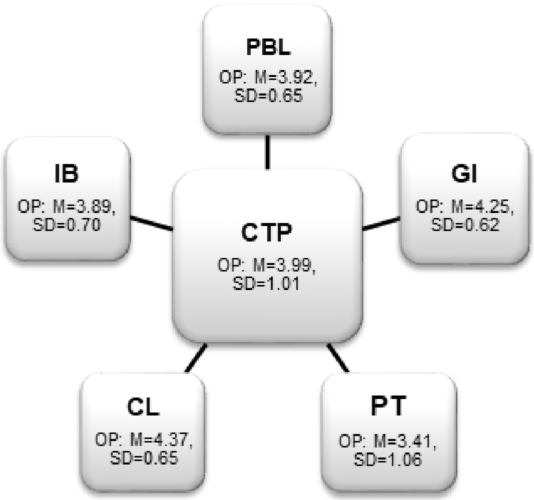



*Figure 1.* Teachers' Extent of Practice of Constructivist Teaching Methods (CTP)

Legend: * CTP-Constructivitst Teaching Practices, PBL- Design-based or Project-based Learning (Constructionism), GI- Guided Instruction, IB-Inquiry-based or Problem-based Learning, CL- Cooperative Learning, PT- Peer Tutoring, CTP-Constructivist Teaching Practices

** AP–always practiced, OP–often practiced, NSP–not so often practiced, RP–rarely practiced, NP–never practiced

*** M- mean, SD- standard deviation

Table 2

*Teachers' Extent of Practice on the Constructivist Teaching Methods*

| Indicators | Average Values | Standard Deviation | Descriptive Interpretation* |
|---|---|---|---|
| Design-based or Project-based Learning (Constructionism) (PBL) | | | |
| 1. I involve students in drawing their own conclusions through creative experimentation | 3.85 | 0.98 | OP |
| 2. I instruct students to make social objects or products in class (i.e. projects, programs, presentations, artifacts, portfolios, etc.) | 4.03 | 0.83 | OP |
| 3. I assist students in their creations/activities | 3.01 | 1.28 | NSP |
| 4. The students are hands-on in solving the problems they encounter in their creations/activities | 4.15 | 0.79 | OP |
| 5. I encourage students to help one another in their creations/activities | 4.57 | 0.68 | AP |
| PBL Average Value: | 3.92 | 0.65 | OP |
| Guided Instruction (GI) | | | |
| 6. During the start of class, I pose a question to stimulate the students curiosity | 4.00 | 0.88 | OP |
| 7. During class activities I pose stop-over questions to students to see if they understand previously covered topics/areas | 4.25 | 0.75 | OP |
| 8. I prompt students on the next logical step of the discussion/activity | 4.17 | 0.87 | OP |
| 9. I give cues to students to shift their attention to focus on specific information, errors, or partial understandings. | 4.23 | 0.81 | OP |
| 10. I explain further the topic/ when students do not have sufficient knowledge to complete tasks on their own. | 4.56 | 0.68 | AP |
| 11. I model the activity when students do not have the necessary knowledge to complete the task on their own | 4.30 | 0.80 | OP |
| GI Average Value: | 4.25 | 0.62 | OP |
| Inquiry or Problem-based Learning (IB) | | | |
| 12. I present a series of carefully constructed problems or issues/ scenarios to the students at the start of the class/topic/activity | 4.17 | 0.85 | OP |

| | | | |
|---|---|---|---|
| 13. I let the students discuss the problems/issues presented to them at the start of the class and discuss possible explanations or solutions (i.e., pre-discussion or brainstorming) before they receive further input | 3.92 | 0.94 | OP |
| 14. I let students formulate issues from their topic which forms the basis of their self -directed learning. | 3.86 | 0.90 | OP |
| 15. I let each group select relevant literature about the topic and plan their study activities to optimally prepare themselves for the next group meeting. | 3.70 | 0.95 | OP |
| 16. I let students assess whether their self-study activities were sufficient to fully understand the subject matter introduced in the problem. | 3.78 | 0.79 | OP |
| IB Average Value: | 3.89 | 0.70 | OP |
| Cooperative Learning (CL) | | | |
| 17. I usually group students with the objectives for social skills, such as team work or peer accountability in mind. | 4.20 | 0.89 | OP |
| 18. I explain to the students the criteria for the academic task, time limits (one hour, several days, weeks, etc.), accountability, their roles, expected behaviors and decision making within the group. | 4.47 | 0.83 | OP |
| 19. I allow students to question me for clarifications so that everything is clearly understood before the start of the group activity. | 4.72 | 0.63 | AP |
| 20. I monitor, observe, and intervene when necessary during the progress of the students in their group activity. | 4.49 | 0.75 | OP |
| 21. I use a mixture of self-assessment, group assessments and my own judgment to determine a final grade of the students during their group activity. | 4.34 | 0.84 | OP |
| 22. I give the students time to reflect upon their group learning experience by detailing their achievements and shortcomings. | 4.01 | 0.89 | OP |
| CL Average Value: | 4.37 | 0.65 | OP |
| Peer Tutoring (PT) | | | |
| 23. I train students on the process and strategies of tutoring. | 3.71 | 0.98 | OP |
| 24. I assign the respective partners for tutoring. | 3.34 | 1.15 | NSP |
| 25. I instruct the pairs of tutors and tutees of their topic for tutoring or disseminate the materials to them. | 3.33 | 1.15 | NSP |

| | | | |
|---|---|---|---|
| 26. I ensure that the students follow the correct tutoring procedure of presenting material again by the tutor and providing feedback by the tutee. | 3.30 | 1.20 | NSP |
| 27. I monitor the progress of tutor and tutees and provide them feedback. | 3.34 | 1.25 | NSP |
| PT Average Value: | 3.41 | 1.06 | NSP |

* AP–always practiced, OP–often practiced, NSP–not so often practiced, RP–rarely practiced, NP–never practiced

## Reasons of Educators for Practicing Constructivist Teaching Methods

Among the reasons that were cited by the respondents in using constructivist teaching methods in Table 3, "for student development" (f=21) topped the list. This is so since many of the constructivist teaching methods employ students' experiential learning as its modality which cultivates development on many of its faculties such as, creativity, HOTS (higher order thinking skills), interpersonal skills, accountability, self-directed learning, critical thinking, experimentation, and holistic learning which the respondents of the study have identified. This is followed by "for students' better learning" (f=19) which the respondents indicated that they use the method to "let the students widen their learning through experiments and/or to perform it in actual", "to ensure a good understanding about the topic and to facilitate learning" and "to discuss fully the topics/lessons to the students". All of these reasons point to the noble motives of the respondents to make the students learn. Also, "for student motivation and class participation" (f=12) was third in rank among the cited reasons. This is not surprising since constructivist teaching and learning methods advocate "experiential learning" which entails active participation from the students on the learning task and activities (Kolb & Kolb, 2009).

Table 3

*Major Themes of Educators' Reasons for Practicing Constructivist Teaching Methods*

| Major Themes | | Frequency | Percentage |
|---|---|---|---|
| I. | For Student Development | 21 | 26.92 |
| II. | For Students' Better Learning | 19 | 24.36 |
| III. | For Student Motivation and Class Participation | 12 | 15.38 |
| IV. | For Classroom Management | 12 | 15.38 |
| V. | In Consideration of Students' Diversity and Varied Learning Styles and Capabilities | 11 | 14.10 |
| VI. | To Satisfy Global Standards and OBE | 3 | 3.85 |

## Challenges of Educators on the Implementation of Constructivist Teaching Methods

Just like any other endeavors, practicing constructivist teaching has many challenges which the respondents of the study have identified and is shown in Table 4. Physical factors topped the respondents' challenges (f=30). Physical factors such as time, scarcity of teaching materials, workload (number of teaching units/hours), area (to conduct the learning activity), availability of laboratory, equipment, not updated equipment, and the availability of internet and WIFI as well as the lack of sufficient AV equipment (such as speakers and projectors) were some of the challenges noted by the respondents under this theme.

Of the second in rank, student factors (f=25), results indicated that the problems encountered by the respondents included the heterogeneity of the students in the classroom or the diverse learning styles of the students which might indicate that prepared activities might not be applicable to all the students, attitude of the students, student passivity and non-cooperation, lack of initiative, and their level of maturity. Exposure of the students to these types of teaching methods needs time for their adaption, hence, continued use by the teacher and continued exposure of the students to these activities may iron out their passivity, initiative and maturity to the teaching method.

Some respondents also cited that because of the inherent factors of the constructivist method (f=11), teachers have a challenging time adopting the method. Some noticed that the "implementation of the method does not ensure 100% success". Others point to the fact that "such practices may not be applicable for all subjects/lessons" and that "determining the applicable activity related to the topic and monitoring the said activity is also challenging ". Furthermore, respondents noted that there is a "need for the teacher to innovate" when one tries to adopt constructivist teaching methods.

Teacher factors were also cited by the respondents as among the challenges they face in adopting constructivist teaching methods (f=5). Among those indicated under this theme, "(teachers') familiarity with the method", "how to motivate the students and maintain their enthusiasm", and "how to sustain the active involvement of the students especially in group activities" were noted. Results of these indicators question the pedagogical knowledge of the teachers in facilitating the class via constructivist methods as teaching with these approaches necessitate the teachers' skill and knowledge in applying the method (Chai, Koh, & Tsai, 2010; Chai, Koh, & Tsai, 2011).

Table 4

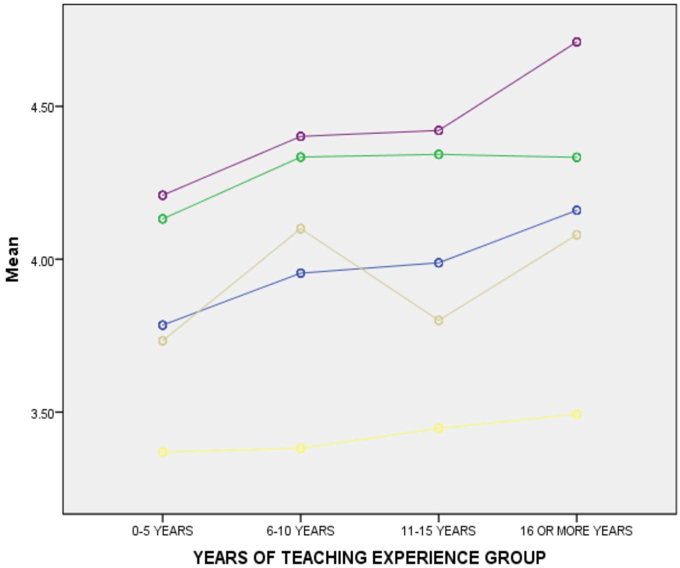
*Major Themes of Challenges to the Implementation of the Constructivist Teaching Methods*

| Major Themes | Frequency | Percentage |
|---|---|---|
| I. Physical Factors | 30 | 42.25 |
| II. Student Factors | 25 | 35.21 |
| III. Factors Inherent from the Constructivist Method | 11 | 15.49 |
| IV. Teacher Factors | 5 | 7.04 |

**Effect of Teaching Experience, Highest Educational Attainment, Availability and Extent of Use of Ed-Tech on the Extent of Practice of Constructivist Teaching Methods**

The effect of the respondents' number of years teaching (teaching experience), their highest educational attainment, knowledge of the availability and their extent of use of available educational technologies on their practice of constructivist teaching methods were investigated. Results for the effect of teaching experience are presented in Figure 2 and Table 5.

Scrutiny of the trend of the line graphs in Figure 2 indicated that, in general, teaching experience has a positive relationship on the teachers' extent of practice of the different constructivist methods. This result conforms to findings from Fontanilla (2015) and Hafalla[2] (2018) on the positive effect of teaching experience towards the teachers' mastery of teaching pedagogy (pedagogical knowledge). Figure 3 also posits the fact that most respondents practice cooperative learning techniques while they least practiced peer tutoring, further cementing results from Figure 2. However, as teaching pedagogy is a varied landscape, the effect of teaching experience towards a specific constructivist teaching approach is yet to be investigated. Table 5 brings to light the results of this investigation via one-way ANOVA.




Legend:CL (Cooperative Learning), GI (Guided Instruction), IB (Inquiry-based Learning), PBL (Project-based Learning), PT (Peer Tutoring)

*Figure 2*. Years of Teaching Experience vs. the different Constructivist Teaching Methods

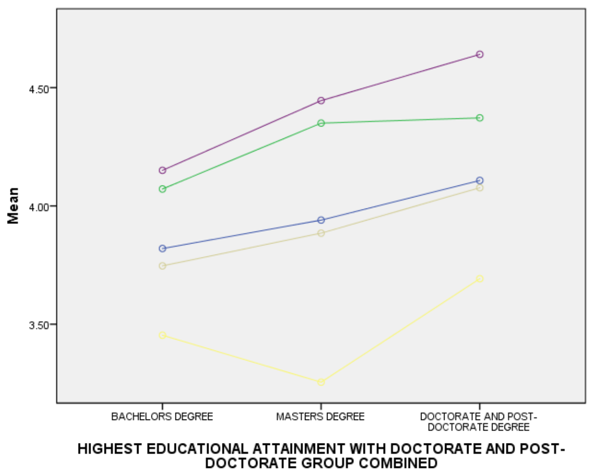
Table 5

*Effect of Years of Teaching Experience on the Practice of the different Constructivist Teaching Methods Using One-way ANOVA*

| Constructivist Teaching Method | Years of Teaching Experience | | | | F | p-value |
|---|---|---|---|---|---|---|
| | Groups | n | Mean | SD | | |
| Project-based Learning | 0-5 years | 39 | 3.78 | 0.79 | 1.33 | .27 |
| | 6-10 years | 22 | 3.95 | 0.67 | | |
| | 11-15 years | 17 | 3.99 | 0.40 | | |
| | 16 or more | 15 | 4.16 | 0.40 | | |
| Guided Instruction | 0-5 years | 39 | 4.13 | 0.78 | .81 | .49 |
| | 6-10 years | 22 | 4.33 | 0.60 | | |
| | 11-15 years | 17 | 4.34 | 0.33 | | |
| | 16 or more | 15 | 4.33 | 0.44 | | |
| Inquiry-based Learning | 0-5 years | 39 | 3.73 | 0.85 | 1.79 | .15 |
| | 6-10 years | 22 | 4.10 | 0.75 | | |
| | 11-15 years | 17 | 3.80 | 0.32 | | |
| | 16 or more | 15 | 4.08 | 0.38 | | |
| Cooperative Learning | 0-5 years | 39 | 4.21 | 0.83 | 2.29 | .08 |
| | 6-10 years | 22 | 4.40 | 0.58 | | |
| | 11-15 years | 17 | 4.42 | 0.38 | | |
| | 16 or more | 15 | 4.71 | 0.25 | | |
| Peer Tutoring | 0-5 years | 39 | 3.37 | 1.09 | .06 | .98 |
| | 6-10 years | 22 | 3.38 | 1.14 | | |
| | 11-15 years | 17 | 3.45 | 0.94 | | |
| | 16 or more | 15 | 3.50 | 1.08 | | |

Results from Table 5 indicated no significant differences existed on the extent of use of the different constructivist teaching methods by the teachers considering their years of teaching experience ($p>.05$). This suggests that both the new and the more experienced teachers tend to view constructivist teaching methods as effective methods of teaching, hence, their proliferation of use (Li, Cheng, & Liu, 2013, Fisher & Frey, 2010, Hakverdi-Can & Sonmez, 2012, Hsiung, 2012, Krych, et. al., 2005).

Figure 3 and Table 6 presents the analysis of the effect of highest educational attainment unto the teachers' extent of practice of the constructivist teaching methods. It should be noted that for the purpose of this analysis the doctorate and post-doctorate respondents were grouped into one since there is only one respondent with a post-doctorate degree. In general, trend analysis of the lines in Figure 3 indicated that there is a marked increase in the use of constructivist teaching methods as one progress in their educational qualifications, with the exception of peer tutoring. Furthermore, the graph showed that most teachers tend to use CL or cooperative learning techniques, guided instruction and project-based learning with PT (peer tutoring) as the least used teaching modality. It could also be noted that there is a slight differentiation in the proliferation of use of these teaching techniques when one considers the educational attainment of the respondents. However, to ascertain if these differences were statistically significant, Table 6 presents results of the one-way ANOVA on the effect of educational attainment unto the teachers' extent of practice of the different constructivist teaching methods.




Legend:CL (Cooperative Learning), GI (Guided Instruction), IB (Inquiry-based Learning), PBL (Project-based Learning), PT (Peer Tutoring)

*Figure 3*. Highest Educational Attainment vs. the different Constructivist Teaching Methods

Table 6

*Effect of Highest Educational Attainment on the Practice of the different Constructivist Teaching Methods Using One-way ANOVA*

| Constructivist Teaching Method | Highest Educational Attainment | | | | F | *p*-value |
|---|---|---|---|---|---|---|
| | Groups | n | Mean | SD | | |
| Project-based Learning | Bachelor | 34 | 3.84 | 0.75 | .68 | .51 |
| | Masters | 45 | 3.94 | 0.61 | | |
| | Doctorate and Post-Doctorate | 14 | 4.07 | 0.53 | | |
| Guided Instruction | Bachelor | 34 | 4.08 | 0.77 | 1.98 | .14 |
| | Masters | 45 | 4.34 | 0.54 | | |
| | Doctorate and Post-Doc | 14 | 4.36 | 0.40 | | |
| Inquiry-based Learning | Bachelor | 34 | 3.79 | 0.83 | .83 | .44 |
| | Masters | 45 | 3.91 | 0.64 | | |
| | Doctorate and Post-Doc | 14 | 4.07 | 0.56 | | |
| Cooperative Learning | Bachelor | 34 | 4.17 | 0.83 | 3.22 | .04* |
| | Masters | 45 | 4.44 | 0.54 | | |
| | Doctorate and Post-Doc | 14 | 4.64 | 0.30 | | |
| Peer Tutoring | Bachelor | 34 | 3.46 | 1.04 | .67 | .51 |
| | Masters | 45 | 3.29 | 1.06 | | |
| | Doctorate and Post-Doc | 14 | 3.64 | 1.13 | | |

*Significant at the 0.05 level

In order to see the effect of educational attainment on the proliferation of constructivist teaching practices, one-way ANOVA was used for the data (Table 6). Belief that educational attainment has an effect on the teachers' use of constructivist teaching methods gave contradicting results in project based learning, guided instruction, inquiry-based learning, and peer tutoring. Only in the use of cooperative learning techniques do we find significant differences on their extent of practice of the teaching method between the bachelors' degree holders, masters' degree holders and doctorate to post-doctorate degree holders. However, further scrutiny via pairwise comparison using Games-Howell statistic indicated that only between those who graduated bachelors' degree and doctorate to post-doctorate degree have significant differences on their extent of practice of the cooperative learning techniques ($p$=0.016). This suggests differences in the mastery on the use of the constructivist technique with the neophyte teacher (bachelors' degree) having lesser mastery of the technique (see Figure 4) which might indicate their lesser use of the method.

On the effect of the availability of educational technologies on the respondents' extent of practice of constructivist teaching methods, Table 7 presents the results of analysis using t-test. Mishra and Koehler (2006) argued that in order to realize the full potential of teaching technologies to improve learning and instruction, knowledge pertinent to pedagogy and the constructivist teaching methods are essential components. It could also be argued that the availability of educational technologies creates the possibility of their effective integration into teaching practice (Norris, Sullivan, and Poirot, 2003). It should also be noted, however, that the acquisition of technology and knowledge does not always lead to effective technology integration (Polly, Mims, Shepherd & Inan, 2010). With these findings from previous researchers, analysing the effect of knowledge of availability of the educational technologies (whether the technology is personally available to the respondent, available at school, in the internet vs being not available) unto the teachers' extent of practice of the different constructivist teaching methods indicated that there were no significant differences between those who have knowledge of the availability of the physical technologies and software and programs and those who deemed them not available (Table 7). These results contradict previously held beliefs by Norris, Sullivan, and Poirot (2003) and upheld observations by Polly, Mims, Shepherd and Inan (2010).

Table 7

*Comparison of Extent of Practice on the different Constructivist Teaching Methods considering Knowledge of Availability of Educational Technologies*

| Constructivist Teaching Methods | Knowledge of Availability of Ed-Tech | n | Mean | SD | t | df | *p* - value |
|---|---|---|---|---|---|---|---|
| **PHYSICAL TECHNOLOGIES** | | | | | | | |
| Project-based Learning | AVAILABLE | 85 | 3.92 | .67 | -.123 | 91 | .902 |
| | NOT AVAILABLE | 8 | 3.95 | .49 | | | |
| Guided Instruction | AVAILABLE | 85 | 4.25 | .65 | .004 | 91 | .997 |
| | NOT AVAILABLE | 8 | 4.25 | .36 | | | |
| Inquiry-based Learning | AVAILABLE | 85 | 3.87 | .72 | -.782 | 91 | .436 |
| | NOT AVAILABLE | 8 | 4.07 | .44 | | | |
| Cooperative Learning | AVAILABLE | 85 | 4.37 | .68 | -.194 | 91 | .846 |
| | NOT AVAILABLE | 8 | 4.42 | .33 | | | |
| Peer Tutoring | AVAILABLE | 85 | 3.38 | 1.07 | -.677 | 91 | .500 |
| | NOT AVAILABLE | 8 | 3.65 | .94 | | | |
| **SOFTWARE AND PROGRAMS** | | | | | | | |
| Project-based Learning | AVAILABLE | 89 | 3.91 | .66 | -.553 | 91 | .582 |
| | NOT AVAILABLE | 4 | 4.10 | .38 | | | |
| Guided Instruction | AVAILABLE | 89 | 4.26 | .63 | .959 | 91 | .340 |
| | NOT AVAILABLE | 4 | 3.96 | .28 | | | |
| Inquiry-based Learning | AVAILABLE | 89 | 3.87 | .71 | -1.197 | 91 | .234 |
| | NOT AVAILABLE | 4 | 4.30 | .26 | | | |
| Cooperative Learning | AVAILABLE | 89 | 4.37 | .66 | -.259 | 91 | .796 |
| | NOT AVAILABLE | 4 | 4.46 | .37 | | | |
| Peer Tutoring | AVAILABLE | 89 | 3.39 | 1.06 | -.757 | 91 | .451 |
| | NOT AVAILABLE | 4 | 3.80 | 1.12 | | | |

The extent use of educational technologies was also investigated. Results from Table 8 indicated that most of the teachers often use available software and programs (M=3.57, SD=0.79) followed by their use of internet-based technologies (M=3.19, SD=0.92) and last is the physical technologies (M=3.15, SD=0.73). Astonishing to see in this day and age of internet technologies (apps and software), the use of internet-based educational technologies only ranked second. Of the different software and programs, most teachers use word processing programs like MSWord (M=4.52, SD=0.78), spreadsheets like EXCEL (M=4.29, SD=1.01), and presentation programs like Powerpoint (M=4.25, SD=0.98). These results are not surprising due to the fact that much of the work of the teacher aside from classroom teaching involves clerical paperworks, report writing and computing grades which all requires the use of word processors and spreadsheets.

Table 8

*Teachers' Extent of Use of Educational Technologies*

| Type of Educational Technologies | n | Mean | Std. Deviation | Descriptive Interpretation* |
|---|---|---|---|---|
| **PHYSICAL TECHNOLOGIES** | | | | |
| 1. Printer | 83 | 3.98 | 1.14 | OU |
| 2. Scanner | 83 | 3.01 | 1.19 | NSU |
| 3. Projector | 83 | 3.87 | 1.04 | OU |
| 4. Digital Cameras | 83 | 2.34 | 1.29 | RU |
| 5. Smartboard | 83 | 1.82 | 1.33 | RU |
| 6. Computer | 83 | 4.07 | 1.12 | OU |
| 7. Internet | 83 | 3.86 | 1.11 | OU |
| 8. Wifi | 83 | 3.71 | 1.25 | OU |
| 9. Subject specific 3D models (viewing models) | 83 | 2.36 | 1.25 | RU |
| 10. Subject specific equipment and facilities (ie. Laboratory equipment) | 83 | 3.12 | 1.45 | NSU |
| 11. Subject specific manipulative models (ie. test dummies) | 83 | 2.45 | 1.39 | RU |
| **Average Extent of Use of Physical Technologies:** | | **3.15** | **.73** | **NSU** |
| **SOFTWARE AND PROGRAMS** | | | | |
| 1. Word Processing programs (ie. Microsoft Word) | 89 | 4.52 | .78 | AU |
| 2. Spreadsheet (ie. EXCEL) | 89 | 4.29 | 1.01 | OU |

| | | | | |
|---|---|---|---|---|
| 3. Subject specific programs/software (ie. MathLab, SPSS, Java) | 89 | 3.00 | 1.45 | NSU |
| 4. Presentation programs/softwares (ie. MS Powerpoint) | 89 | 4.25 | .98 | OU |
| 5. Evaluation editing software (ie. GoogleDocs, Grammarly) | 89 | 3.28 | 1.31 | NSU |
| 6. Picture editing tools (ie. Photoshop, Paint) | 89 | 3.08 | 1.17 | NSU |
| 7. Non-internet based Mobile apps (ie. MathCalc) | 89 | 2.58 | 1.42 | NSU |
| **Average Extent of Use of Software and Programs:** | | **3.57** | **.79** | **OU** |
| **INTERNET-BASED EDUCATIONAL TECHNOLOGIES** | | | | |
| 1. E-mail | 93 | 4.05 | 1.14 | OU |
| 2. Social Learning Networks (ie. Google Classroom, Facebook) | 93 | 3.94 | 1.22 | OU |
| 3. Learning Management Systems (ie. Google Classroom, MOODLE) | 93 | 3.25 | 1.47 | NSU |
| 4. MOOCs (Massive Open Online Courses) (ie. Coursiera) | 93 | 2.02 | 1.27 | RU |
| 5. Internet based mobile apps | 93 | 3.22 | 1.45 | NSU |
| 6. Communication Tools (ie. Facebook, Viber, Twitter) | 93 | 3.97 | 1.27 | OU |
| 7. Subscription to Interest Groups/ discussion groups (ie. Facebook Groups) | 93 | 3.70 | 1.37 | OU |
| 8. Cloud storage (ie. Icloud) | 93 | 2.48 | 1.50 | RU |
| 9. E-books | 93 | 3.11 | 1.55 | NSU |
| 10. E-movies/podcasts (ie. In Youtube) | 93 | 3.24 | 1.46 | NSU |
| 11. Audio books | 93 | 2.19 | 1.30 | RU |
| **Average Extent of Use of Internet-based Educational Technologies:** | | **3.19** | **.92** | **NSU** |

* NU-Never used (did not use at all), RU-Rarely used (used maybe once or twice in my subjects), NSU-Not so often used (used more than two times in my subjects), OU-Often used (most of the time when I teach my subjects), AU-Always used (used every time I teach in most of my subjects)

Of their least used ed-tech among the physical technologies, smartboard tops the list (M=1.82, SD=1.33) indicating that not all teachers use this technology. It should also be taken in consideration that a smartboard is not available in every classroom thereby hampering the proliferation of its use.

This is followed by digital cameras (M=2.34, SD=1.29) which indicates the fact that because of the availability of cameraphones and smartphones, most teachers do not even bother to use this device. Subject specific 3D models follows the list (M=2.36, SD=1.25) which indicates that not all subjects taught by a teacher needs a 3D model and this hampers their increased usage. On the other hand, among the different physical technologies, the most used are the computer (M=4.07, SD=1.12), the printer (M=3.98, SD=1.14), and the projector (M=3.87, SD=1.04).

A question arises on whether the use of these types of educational technologies affects the teachers' use of constructivist teaching modalities. Is there a correlation between the two variables? Does it necessarily mean that when one uses more of constructivist teaching modalities, their use of and dependence on ed-tech also increases? Table 9 presents the answers to these questions.

Table 9
*Correlation Between Extent of Use of Educational Technologies and the Practice of Constructivist Teaching Practices*

| **Educational Technologies** | **Constructivist Teaching Methods** | | | | |
|---|---|---|---|---|---|
| | PBL | GI | IB | CL | PT |
| Physical Technologies | .37** | .27* | .19 | .29** | .24* |
| Software and Programs | .24* | .33** | .27** | .31** | .18 |
| Internet Based Educational Technologies | .30** | .26* | .24* | .26* | .18 |

* p<.05
**p<.01
^Weak Correlation (WC)=about 0.10, Moderate Correlation (MC)=about 0.30, Strong Correlation (SC)=about 0.50 or higher

Results from Table 9 on the bivariate correlation between the extent of use of ed-tech and the teachers' extent of practice of the different constructivist teaching methods indicated moderate but significant positive correlations between the variables studied with the exception of peer tutoring (PT) which indicated non-significant correlations on the use of software and programs and internet-based technologies. Since this is the least practiced constructivist method by the teachers (see Figure 1), results on this area might not be conclusive. Also, the correlation values are only from weak to moderate correlations (0.19-0.37) indicating that the relationships are not strong enough which hints that while the teachers' do practice constructivist teaching methods, their extent of use educational technologies is situational and not always. This might be due to the fact that some of these technologies are subject- or lesson-specific which dictates the type of ed-tech to be used (see parallel discussions of Table 4) or that other confounding variables might be in play which was not investigated in the study like the type of subject/lesson being taught. For example, Starkey (2010) and Lim and Chai (2008) contended that technological self-efficacy might affect the teachers' extent of use of ed-tech. Also, Aldunate and Nussbaum (2013) suggested that computer anxiety also has a negative effect on the teachers' use of computer-dependent ed-tech. However, generally speaking, there is a marked positive and significant correlation between the teachers' extent of practice of constructivist teaching modalities and their extent of use of ed-tech which validates previous researches in this area (ie. Mishra & Koehler, 2006; Polin & Moe, 2015; Remegio, Simpao, & Cabang, 2017).

## Conclusion

Respondents manifested a proliferation of use of constructivist teaching methods. However, most of the teachers rarely use peer tutoring indicating problems on their familiarity on the method which affects their extent of use of it. Extent of practice of the different constructivist teaching methods was not affected by the respondents' teaching experience and knowledge of availability of ed-tech corroborating earlier findings. On the other hand, statistically significant correlations were seen between the respondents' extent of use of ed-tech and their extent of practice of the different constructivist teaching methods. This suggests that the incorporating constructivist teaching in one's teaching pedagogy is significantly affected by his extent of use of educational technologies such as internet-based applications and software (ie. word processing software, social learning networks) and physical technologies (ie. 3D models and manipulatives). However, results for peer tutoring were found to be inconclusive in this area due to the fact that only a few among the respondents practice this method suggesting low statistical power to detect conclusive correlations. While there were no significant differences seen on the respondents' extent of practice of project-based learning, inquiry based learning, guided instruction and peer tutoring considering the respondents' highest educational attainment, significant differences were, however, noted for cooperative learning. Among the reasons cited by the respondents for using constructivist teaching methods included their desire for student development, better learning and for student motivation and class participation. The respondents noted physical factors, student factors, factors inherent to the method, and teacher factors as the most common challenges they face in implementing constructivist teaching methods.

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