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Teachers' and Students' Assessment on the Extent of Constructivism in the Senior High School Physics Learning Environment in Benguet, Philippines

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Abstract

The education literature recognizes constructivism as the most appropriate pedagogical and philosophical approach in any field of science. This study aimed to determine the assessment of teachers and students on the extent of constructivism of the physics learning environment senior high school STEM-strand. Students' assessments were also compared according to the type of senior high school (public and private). The study used a descriptive survey design using the Constructivist Learning Environment Survey (CLES) tool administered to 12 STEM-strand teachers and 520 students from different private and public senior high schools in Benguet. Results revealed that students and teachers assessed the physics learning environment as very constructivist and mostly constructivist, respectively. When compared according to the type of school, public high school students have slightly higher assessments than students coming from private high schools, although both overall mean scores are classified as very constructivist. The results suggest enriching the different dimensions of constructivism is still needed to achieve a holistic constructivist classroom in the STEM curriculum. Future studies using qualitative research design and other survey instruments or tools are recommended to confirm results.

KEYWORDS

Constructivist Learning Environment
STEM Education
Physics

Introduction

Science is a vital subject in the educational growth of every learner for many reasons. It is a universal concept that is indispensable for man's existence and the improvement of human life. Physics, in particular, has always played a crucial role in the development of society, particularly in terms of technological advances (Ben, 2010). However, most students often perceive that physics is difficult to learn because it involves experiments, formulas, computations, graphs, conceptual explanations, and transformations (Ornek et al., 2008). It primarily deals more with quantitative skills and connections or relationships between concepts. Like any other field of science, its empirical nature entails the importance of observation, measurement, and experimentation in its development (Ocampo et al., 2015). This nature of physics may have led to the decline in students' interest in the subject and to their perceived extreme level of difficulty they associate with physics. This perceived difficulty of physics in particular and in science, in general, is manifested by students' performance in national and international assessments. Also, from the teachers' perspective, they feel that physics seems difficult and abstract to students (Oon & Subramaniam, 2010).

The present state of basic science education in the Philippines falls behind other countries. Results of the 2018 Programme for International Student Assessment (PISA) show that the average score of Filipino students in scientific literacy is significantly lower than the average of all participating countries (Department of Education [DepEd], 2019). Consistently, the country ranks lowest among the participating ASEAN countries. The low performance of Filipino students in the recently concluded international assessment echoes results of prior assessments such as the Second International Science Study (SISS) and Third International Mathematics and Science Study (TIMSS). Also, data from the World Economic Forum's "Global Competitive Index" on the quality of science education reveal that the Philippines ranked 76th in 2017-2018, a drop from the 2015-2016 ranking of 67th place (World Economic Forum [WEF], 2019). These poor performances of students in basic science resonate at the tertiary level, as shown by the data from the Commission on Higher Education [CHED] (2019) for SY 2017-2018. Of the total number of enrollees, only 1.66 % of students enrolled in science-related courses. The dismal status of science education in the country can be attributed to certain factors. Some of these factors are shortage of qualified science teachers, incongruent teaching assignments with teachers' educational background, lack of quality textbooks, unclear and undefined philosophy of science education at the basic education and teacher education curriculum, and lastly, the predominance of teacher-centered classrooms and teaching practices (Science Education Institute, Department of Science and Technology [SEI-DOST] & University of the Philippines National Institute for Science and Mathematics Education Development [UP NISMED], 2011). These factors can be generally categorized as teacher-related and school-related factors, as classified by Orleans (2007) when he assessed the condition of physics education in secondary schools. These "problems and issues necessitate educational reforms and actions that will address the compelling need for students and the larger Philippine society to be influenced strongly by science and technology" (SEI-DOST & UP NISMED, 2011).

One of the critical problems or factors attributed to Filipino students' low performance in science, particularly in physics, is the teaching-learning process taking place in the classroom (Abdulrachman, 2018; Orleans, 2007). The teacher-centered classroom still dominates the learning environment in science classes. SEI-DOST and UP NISMED (2011) stressed that "lacking in content and pedagogical skills suitable for science teaching, many science teachers turn to lecture instead of providing students with engaging and challenging activities that enable the latter to develop creative ideas" (p. 6). As a response, the K to 12 curriculum promotes different approaches in facilitating the acquisition of the three domains of learning (i.e., cognitive, affective, and psychomotor). These approaches include inquiry-based approach, multi/interdisciplinary approach, science-technology-society approach, contextual learning, and problem/issue-based learning, all primarily driven by established educational pedagogies, one of which is constructivism. Dudduan et al. (2015) accentuated that science is a critical subject that regularly involves experimentation and practice; it is also a subject most in need of adding methodologies of critical thinking. In essence, the theoretical and philosophical foundation of science education is constructivism. It is thus the most appropriate pedagogical approach in any field of science and even in other subject areas for reasons that it has been recognized to improve the quality of teaching and ensure a positive contribution to the development of scientific thinking skills (Altun & Yücel-Toy, 2015).

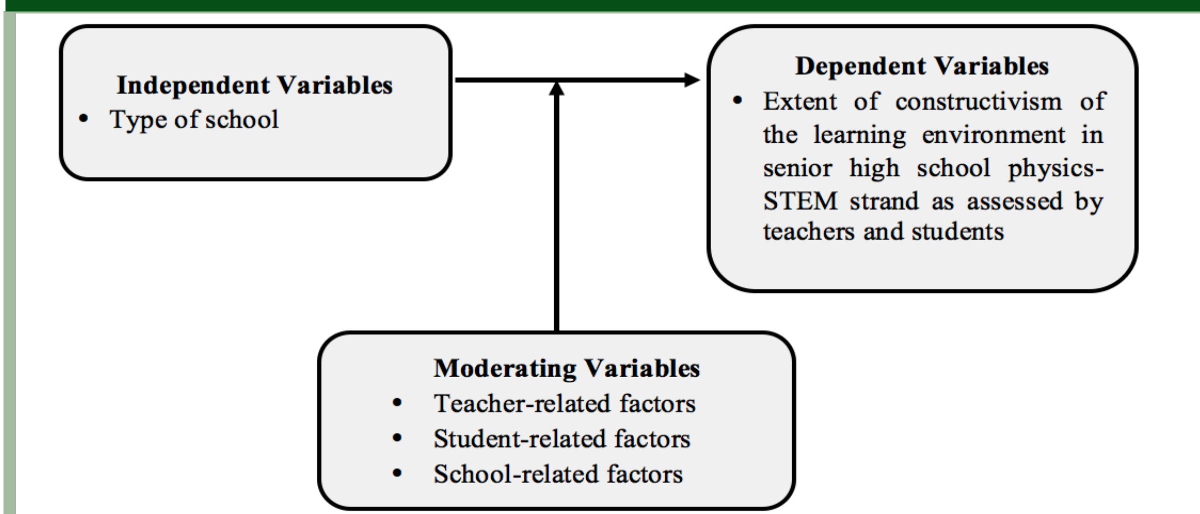
Constructivism inspires a nurturing classroom environment by redefining the roles of students and teachers. In teaching physics and other related fields, several domestic studies focused on exploiting different approaches and strategies consistent with constructivist learning principles. Tabago (2011) utilized constructivist approach experiments in teaching selected topics in physics. Results disclosed that these activities effectively improve students' achievement and develop a more positive attitude towards physics. These findings were later established by Obrero and Obrero (2015) when they utilized a constructivist small-group learning intervention in thermodynamics and found that it was effective in promoting students' conceptual change. Students also exhibited positive attitudes towards constructivism, small-group learning, and physics, which prompted the researchers to recommend this intervention and any similar constructivist interventions in physics teaching. On the other hand, Pondevida et al. (2009) determined the level of accomplishment of faculty in teaching earth science through constructivists' approach. Based on students' assessment, teachers still need to show substantial improvements in some of the themes as indicated by indicators in realizing a successful shift towards constructivism.

Numerous studies in science education concerning the implementation of constructivist pedagogical approach or a constructivist learning environment have shown to cause a positive significant effect on improving students' cognitive or academic performance (Jack, 2017; Pandey & Ameta, 2017; Qarareh, 2016; Wilson & Zoellner, 2016), development of skills on critical thinking, problem-solving, basic science process, 21st century skills (Dudduan et al., 2015; Ozfidan et al., 2017), and positive attitude towards science (Alt, 2015; Ilhan et al., 2016; Qarareh, 2016). The existing literature has not explicitly focused on the learning environment that transpires in physics classes of senior high school students in the Science, Technology, Engineering, and Mathematics (STEM) strand of the K to 12 curriculum. Also, no published studies on assessments were made concerning the variations on the extent of the constructivist learning environment in public, private, regular, and science senior high schools. Thus, evaluating a learning environment's uniformity with the principles of constructivism is a primary concern for enhancing students' creativity and meta-cognitive skills (Cirik et al., 2015). Consistently, this study is anchored to the framework of basic science education that requires the use of sound pedagogical approaches such as constructivism (DepEd, 2016). Hence, there is a need to assess whether a constructivist learning environment exists in the physics classroom of senior high schools-STEM strand as embodied in the K to 12 science framework.

This study aims to assess whether the learning environment in physics classes of the senior high schools-STEM strand is a constructivist classroom or not. A survey was administered to teachers and students from private and public secondary schools offering the STEM strand. Differences in each dimension and overall assessment of students and teachers were determined. Also, comparisons were made between the assessments of private and public senior high school students on the extent of constructivism of their physics classroom learning environment. Figure 1 shows the relationships between the variables.

Figure 1

Paradigm of the Study



One of the most important tasks of a good teacher is to provide learning experiences that will allow students to critically evaluate the quality of their background knowledge (Churach & Fisher, 2001). In this regard, the type of learning environment provided by the teacher plays an important role for students in gaining these experiences. A learning environment, as defined by Keser and Akdeniz (2010), is a place where learning is fostered and supported. Learning environments can be used to improve instructional models and pedagogy in certain scientific subjects taught in schools (Hofstein et al., 2001). Perkins (1991) introduced the five facets of a learning environment. These are information banks, symbol pads, construction kits, phenomenaria, and task managers. These facets "offer a general perspective on the general structure and its underlying assumptions about the nature of teaching and learning" (Perkins, 1991, p. 18). At the same time, they also offer a grid of how information processing technologies can figure in the instructional process. Wilson (1996) differentiated learning environments from instructional environments. Accordingly, a learning environment is "meaningful, authentic, intentional, complex, cooperative, and reflective learning activities that help the learner construct and develop skills relevant to problem-solving" (p.3). A constructivist learning environment is "a place where learners may work together and support each other as they use a variety of tools and information resources in their guided pursuit of learning goals and problem-solving activities" (p. 5).

According to Cirik et al. (2015), one way to evaluate learning environments according to constructivism's principles is to use instruments designed specifically for a constructivist approach. One of the main instruments is the revised Constructivist Learning Environment Survey (CLES) by Johnson and McClure (2004), with four (4) items in each of the five (5) scales. The five (5) scales are personal relevance, uncertainty, critical voice, shared control, and student negotiation. In this study, the term dimension was instead used to avoid misperception of the technical term "scale." The Table 1 shows the different dimensions and their corresponding descriptions.

Secondary schools in the Philippines are generally classified into public or private and regular and science. The national and local government funds public schools, while the finances of private schools come from students' fees, capital investments, loans, grants, and other financial sources allowed by current legislation (Ben, 2010). In terms of the curriculum, private schools are given flexibility if they want to implement the prescribed curriculum or offer a modified or enhanced curriculum for as long as they inform the Department of Education. As such, there are differences regarding the grading system, contact hours, subjects offered, pedagogical approaches, the medium of instruction, and many more. Private schools are typically perceived to provide a better quality of education than public

Table 1

Dimensions of the Constructivist Learning Environment Survey (CLES)

Dimension (Scale)	Description
Personal relevance	The extent to which school physics is relevant to students' everyday out-of-school experiences.
Uncertainty	The extent to which opportunities are provided for students to experience that scientific/ mathematical knowledge is evolving and culturally and socially determined.
Critical voice	The extent to which students feel that it is legitimate and beneficial to question the teachers' pedagogical plans and methods.
Shared control	The extent to which students share with the teacher control for the design and management of learning activities, assessment criteria, and social norms of the classroom.
Student negotiation	The extent to which students have opportunities to explain and justify their ideas, and to test the viability of their own and other students' ideas.

Note: All descriptions are taken and adapted from Taylor et al. (1997)

schools (Ben, 2010). Like in other developing countries, public high school students in the Philippines have lower achievement levels than private school students (Bernardo et al., 2015). Their study showed that "public school students reported less support for schooling from their social groups, lower academic-related self-concept, and lower achievement goals than private school students" (p.657).

This study assesses the extent of constructivism of the physics classroom learning environment of the senior high school-STEM strand. Specifically, it aims to determine the extent of constructivism of the physics classroom learning environment as assessed by STEM students and teachers and determine the significant difference between the assessments of public and private senior high school students.

Methodology

This study utilized a cross-sectional survey research design in determining the extent of constructivism of the learning environment in senior high school physics of the STEM strand. Participants answered questions administered through a questionnaire.

The study participants were the entire population of students and teachers in the STEM strand of the senior high school curriculum, both from public and private schools of the Department of Education-Benguet Division. There are seven public schools and five private schools offering STEM tracks in the senior high school program. Two public high schools were eliminated as a study site since it was their first year of offering STEM strand; hence, no physics subjects were taken by students in the current school year. Two private schools opted not to participate in the study. Overall, seven public high school teachers, five private school teachers, 248 public school students, and 272 private school students participated in the study. Table 2 shows the distribution of participants from the different participating schools.

Inclusion and Exclusion Criteria

Regardless of specialization, teachers who are currently teaching or have taught physics in the STEM strand were considered respondents. Excluded are physics teachers who are not handling any of the physics subjects offered. On the other hand, STEM students (Grade 11 or 12) who are currently taking or have taken any of the physics subjects (General Physics 1 and 2) under the teacher-respondents are participants of this study. Students who took physics subjects under a teacher who is not part of the group of respondents were excluded from this study.

Instrumentation

The Constructivist Learning Environment

Table 2

Distribution of Participants

School	Teacher/s	Student/s
Ampusongan National High School (ANHS)-Public, Regular	1	9 (1 section)
Loo National High School (LNHS)-Public, Public, Regular	1	48 (2 sections)
Mankayan National High School (MNHS)-Public, Regular	1	49 (2 sections)
Tublay School of Home Industries (TSHI)-Public, Regular	1	62 (2 sections)
Benguet State University-Secondary (BSU-SLS)-Public, Regular	2	43 (2 sections)
King's College of the Philippines (KCP-SLS)-Private, Regular	3	146 (3 sections)
Saint Paul's Academy of Sayanga, Inc (SPA, Inc)-Private, Regular	1	41 (1 section)
Cordillera Career Development College (CCDC)-Private, Regular	1	85 (2 sections)
Cordillera Regional Science High School (CRSHS)-Public, Science	1	37 (2 sections)
Total	12	520 students

Survey (CLES2-20) by Johnson and McClure (2004) was used in this study. This shortened version is the product of the validity and reliability tests performed on the previous version (CLES1-30) that was designed by Taylor et al. (1997). It contains 20 items grouped into blocks of five dimensions, namely, personal relevance (PR), uncertainty (U), critical voice (CV), shared control (SC), and student negotiation (SN). The student form of the instrument used in this study has an alpha reliability coefficient of 0.94, indicating right internal consistency with the same item and scale structure as found in the teacher form. Besides, the instrument was subjected to exploratory factor analysis with factor loading values of greater than 0.6 for all items signifying a strong relationship among the items in each of the dimensions. The CLES-student form is written within the perspective of the students but based primarily on the teacher form. This questionnaire aims to obtain "information about teachers' and students' perceptions of their classroom learning environments" (Johnson & McClure, 2004). The original response choices for all items are almost always, often, sometimes, seldom, and almost never, which are scored 5, 4, 3, 2, and 1. However, for a smoother distribution and variations of responses, a 10-point scoring system was used as response choices with "almost never" as 1-2, "seldom" as 3-4, "sometimes" as 5-6, "often" as 7-8 and "almost always" as 9-10.

Data Gathering Procedure

The researcher determined the number of senior high schools offering academic track-STEM strand in the division of Benguet through the DepEd division website. An informal inquiry was later conducted to determine the initial number of STEM enrollees in each school.

A request letter signed by the dean of the School of Advanced Studies containing the details of the study was then forwarded to the superintendent of the Department of Education-Benguet Division. Upon approval, separate request letters with the attached endorsement from the superintendent were forwarded to the different school heads for their information and guidance.

After the approval of the different school heads to conduct the study, the researcher informed the senior high school physics teachers to schedule the administration of the survey questionnaire properly. At the scheduled time and place, the researcher distributed the informed consent form (ICF) personally to each teacher to read and accomplish before answering the survey questionnaire. The ICF was used to inform them of the study details and their right to decide whether to participate or not, and the right to withdraw at any time without any consequences. Sufficient time was given to the teachers to accomplish the consent form. Teachers who decided to participate were given the questionnaire, and adequate time was allotted for them to answer. The accomplished ICFs and questionnaires were retrieved on-site.

On the approved scheduled date and time, the researcher personally met the students as a class for the orientation and distribution of needed forms. The researcher explained the complete details of the study and the content of the Informed Assent Form, Informed Consent Form (ICF), and survey questionnaire. Students who are above 17 years old were given the ICF and the questionnaire to accomplish on-site or at home. These documents were then collected personally by the researcher. However, students who are minors (below 18 years of age) were given the informed assent form, informed consent form for parents, and the survey questionnaire and were allowed to take these documents home and inform their parents about the study. Students were instructed to let their parents read and sign the ICF before accomplishing the assent form and survey questionnaire. Those parents who are illiterate with the English language were asked to let a literate person translate for them the content of the form and questionnaire. In instances where a literate person was not available, parents were encouraged to be with their child the next school day. The researcher or a person fluent in the local dialect personally translated the necessary information for them. Students whose parents have signed or affixed their thumbmarks in the consent form were asked to accomplish the assent form and questionnaire, which the researcher retrieved on the same day. Students whose parents did not accomplish the consent form were excluded from participating. The data were organized and coded by the researcher to ensure the anonymity of respondents. A statistician then performed the appropriate statistical treatment.

Analysis and Treatment of Data

In determining the extent of constructivism of the learning environment in physics classes of senior high school-STEM strand, frequency and mean were used. The following is the scale for the mean interpretation of the extent of constructivism with the corresponding association based on the response choices found in the questionnaire.

Mean	Descriptive Equivalent	Operational Definition
1.00- 2.79	Least Constructivist (LC)	Almost Never
2.80- 4.59	Slightly Constructivist (SC)	Seldom
4.60- 6.39	Moderately Constructivist (MDC)	Sometimes
6.40- 8.19	Very Constructivist (VC)	Often
8.20-10.00	Mostly Constructivist (MC)	Almost Always

The 10-point scoring range in the questionnaire is grouped into five (5) scales of descriptive interpretations. For example, a rating of 1 and or 2 will be both described as almost never in the respondents' questionnaire but will be interpreted as least constructivist depending on the mean score of all participants. Meanwhile, the t-test for two independent variables was used in comparing the assessment of public and private senior high school students.

Results and Discussion

Extent of Constructivism of the Physics Learning Environment

The study's primary objective is to evaluate the perception of senior high school students and teachers on the extent of constructivism in their physics classroom learning environment. The learning environment is categorized into five dimensions, namely, personal relevance (PR), uncertainty (U), critical voice (CV), shared control (SC), and student negotiation (SN). Table 3 presents itemized mean, dimension means, and overall mean of the ratings given by the participants. The items are grouped into dimensions and are arranged from highest to lowest based on the overall mean score.

Based on the data, STEM students' overall perception of their physics learning environment is classified as very constructivist. Precisely, the dimension with the lowest mean is shared control with a descriptive equivalence of moderately constructivist. Personal relevance is the highest, which is designated as very constructivist. Interestingly, it is also in the dimension of shared control where the item relating to students' participation in deciding which activities best work for them has the lowest mean. Meanwhile, the item with the highest mean is within the dimension of student negotiation that describes how students are given opportunities to communicate with other students in solving problems.

On the other hand, the teachers' overall assessment of their own perceived learning environment is mostly constructivist. Critical voice and uncertainty are the highest and lowest evaluated dimensions of constructivism, respectively. In detail, the item concerning teachers providing opportunities for students to participate in the planning of learning activities has the lowest mean but is still classified as very constructivist. Finally, teachers rated themselves as mostly constructivist on the item relating to students' right to ask for clarifications about confusing activities.

The data further suggest that teachers and their respective students have different perceptions of the learning environment in their physics classroom. For students, it is essential to emphasize based on the mean scores that all dimensions are classified as very constructivist except for shared control being considered moderately constructivist. Consistently, all the items in the shared control have lower means than the rest of the items in all the dimensions. This finding suggests that students are rarely involved or not involved in deciding what should they learn, how they should learn, and how they can assess their learning. It also echoed the findings of Pondevida et al. (2009) that students' assessment of their teachers' level of accomplishment through a constructivist approach is satisfactory to very good only. It is also reflected that those students do not take part in designing the learning environment and self-assessment.

Table 3

Summary of Ratings of the Extent of Constructivism of the Learning Environment in Physics

Dimension	Mean					
	Students (N=520)	DE	Teachers (N=12)	DE	Overall	DE
Personal Relevance						
Students learn interesting things about the world inside and outside of school.	8.16	VC	8.91	MC	8.54	MC
Students learn about the world inside and outside of school.	8.07	VC	8.64	MC	8.36	MC
New learning relates to experiences or questions about the world inside and outside of school	7.81	VC	8.45	MC	8.13	VC
Students learn how physics is a part of their inside- and outside-of-school lives.	7.75	VC	8.45	MC	8.10	VC
Mean	7.95	VC	8.55	MC	8.25	MC
Uncertainty						
Students learn that scientific explanations have changed over time.	7.70	VC	8.55	MC	8.13	VC
Students learn that physics is a way to raise questions and seek answers.	7.59	VC	8.00	VC	7.80	VC
Students learn that physics cannot always provide answers to problems.	7.15	VC	7.18	VC	7.16	VC
Students learn that physics is influenced by people's cultural values and opinions.	6.77	VC	7.36	VC	7.07	VC
Mean	7.30	VC	7.73	VC	7.52	VC
Critical Voice						
It is acceptable for students to ask for clarification about activities that are confusing.	8.22	MC	9.82	MC	9.02	MC
It is acceptable for students to express concern about anything that gets in the way of their learning.	7.81	VC	9.36	MC	8.59	MC
I feel students learn better when they are allowed to question what or how they are being taught.	7.78	VC	9.27	MC	8.53	MC
Students feel safe questioning what or how they are being taught.	7.01	VC	8.82	MC	7.92	VC
Mean	7.70	VC	9.36	MC	8.53	MC
Shared Control						
Students let me know if they need more/less time to complete an activity	6.45	VC	8.73	MC	7.59	VC
Students help me to decide how well they are learning.	5.13	MDC	7.91	VC	6.52	VC
Students help me to decide which activities work best for them.	4.77	MDC	7.55	VC	6.16	MDC
Students help me plan what they are going to learn.	4.87	MDC	7.00	VC	5.94	MDC
Mean	5.30	MDC	7.82	VC	6.56	VC

Table 3 *Continuation...*

Dimension	Mean					
	Students (N=520)	DE	Teachers (N=12)	DE	Overall	DE
Student Negotiation						
Students talk with other students about how to solve problems.	8.57	MC	9.09	MC	8.88	MC
Students ask other students to explain their ideas.	8.09	VC	8.55	MC	8.32	MC
Students explain their ideas to other students.	7.26	VC	9.00	MC	8.13	VC
Students are asked by others to explain their ideas.	6.83	VC	8.36	MC	7.60	VC
Mean	7.69	VC	8.73	MC	8.21	MC
Overall Mean	7.18	VC	8.44	MC	7.81	VC

Note: MC= Mostly Constructivist, VC= Very Constructivist, MDC= Moderately Constructivist

Students who assessed their science learning environment agreed to most of the dimensions of constructivism except for shared control, in which students were not invited to share in planning the learning environment (Ahmad et al., 2015).

On the contrary, the highest-rated dimension is personal relevance, to which students believe that physics plays a significant role in their out-of-school experiences. A possible explanation may be the nature of students. Most of them are expected to venture into science-related careers. Logically, the student respondents are likely to quickly grasp the relevance of physics or scientific concepts to their own experiences outside of the school since they are science-oriented students. Correspondingly, students are more motivated to learn science when they are provided with opportunities to link scientific concepts with authentic issues (Çetin-Dindar et al., 2014). Wild (2015) found that those students who are likely to have science careers are those who perceived a more constructivist learning environment. Consequently, modifying a classroom environment where opportunities are provided for students to link concepts to real-world experiences could strengthen physics appreciation (Mistades, 2008). Teachers' self-assessment on the extent of constructivism shows a mostly constructivist overall mean. The most apparent dimension of the classroom learning environment as perceived by teachers is the extent to which students are free to ask questions on how and what they are being taught. It can be assumed that teachers rated themselves as mostly constructivist in all of the items in critical voice since they feel they are providing opportunities for students to ask questions for clarifications and emphasis during their physics classes. This finding is consistent with the study of Savasci and Berlin (2012), when they discovered that teachers' most perceived component or dimension of constructivism is the critical voice.

The uncertainty dimension to which students learn that physics can be used to seek answers but cannot always provide an answer to problems is the dimension with the lowest mean. However, the mean still indicates a very constructivist learning environment. This dimension is also associated with the nature of physics or scientific knowledge as continually evolving and culturally and socially determined. Providing opportunities for students "to experience scientific knowledge as arising from theory-dependent inquiry, involving human experience and values, evolving and non-foundational, and culturally and socially determined" (Taylor et al., 1997, p.6) is the critical requirement of this dimension. This self-assessment of teachers on this dimension can be associated with their educational background and experience. There were few teachers whose specialization is not either physics or physical science. Also, the majority of the teacher-respondents do not have graduate degrees related to physics and, at the same time, are classified as beginning teachers with only a few years of teaching experience. These factors may have caused teachers to rate the uncertainty lowest among the dimensions of the constructivism instrument since their physics content knowledge might be limited in providing learning opportunities for students concerning the uncertainty of physics or scientific knowledge. Garbett (2011) connected pedagogical content knowledge with the use of a constructivist approach in the classroom.

Another dimension with a nearly equal mean score with uncertainty is shared control, or the degree to which students are involved in planning what they need to learn and how they will learn. In this component, the dimension is "concerned with students being invited to share control with the teacher of the learning environment, including the articulation of their own learning goals, the design and management of their learning activities, and determining and applying assessment criteria (Taylor et al., 1997, p.4). Savasci and Berlin (2012) likewise found in their study that the least preferred components of the classroom learning environment are scientific uncertainty and shared control, as manifested by teachers whom they observed and interviewed. These teachers would ultimately uphold their autonomy in deciding exclusively what they should teach, which activities they do, and how they evaluate learning competencies as mandated by the curriculum. Generally, teachers do not prefer students to share control of the learning environment where students may question their pedagogical plans and methods (Ongowo et al., 2015).

Based on the mean scores, it can be deduced that students and teachers share the same perception on the extent of constructivism along the dimensions of personal relevance and uncertainty. This result can be gleaned when ranking all the dimensions for both students' and teachers' assessments. Uncertainty is the lowest-rated dimension for teachers and the second-lowest for students, while personal relevance is the highest-rated for students and the third-highest for teachers. Among the dimensions of constructivism, uncertainty cannot be readily observed in the classroom setting. Also, teachers have limited options in selecting appropriate learning opportunities suited for this dimension. It is also one of the least preferred, least observed, and least perceived dimensions by teachers of diverse constructivist beliefs (Savasci & Berlin, 2012). Nix et al. (2005), who tested the validity of the CLES instrument to teachers, also discovered that teachers who are trained with the constructivist paradigm might present science in a way that demonstrates the uncertainty of science more often than other teachers. The lower assessment of students in the uncertainty dimension compared to the other dimensions could be influenced mostly by their content knowledge in physics and prior learning experiences. Students who have a weak background in basic and introductory physics may have difficulty inferring the inherent uncertainty and limitations of this knowledge. In the same way, it is possible that the majority of the students rarely experienced or have not experienced the provisional status of physics knowledge in their prior learning experiences. Contrary to the findings of Nix et al. (2005), they discovered that students of teachers exposed to the principles of constructivism had evaluated the uncertainty of science higher than those students of other teachers.

On the dimension of personal relevance, data revealed that both students and teachers have an almost identical perception of the extent of constructivism for this dimension. For teachers, it is assumed that they have adequate experience and pedagogical content knowledge in providing opportunities for students to realize the significance of physics concepts in their out-of-school experiences. Likewise, teachers are also mandated by the curriculum to consistently link scientific concepts to actual or real-life experiences; hence, it is one of the most implemented dimensions of constructivism. Together with critical voice, personal relevance is the most observed and most preferred component by constructivist teachers (Savasci & Berlin, 2012). Nix et al. (2005) have stated that regardless of whether students are exposed to a constructivist paradigm or not, their perception of science is almost the same as manifested by the minimal difference in the mean.

On the dimensions of critical voice, shared control, and student negotiation, the assessment of students could be mostly dependent on what they experienced in the classroom rather than what the teachers alleged to have implemented. Teachers may assert that they have implemented constructivism in their class, but their observed classroom learning environment does not match their perception. However, apart from the type of classroom learning environment that transpired depending on the teachers' choice of instructional practices, students' assessment might be in some way affected by their prior learning experiences, learning styles, and learning approaches. Students who were regularly immersed in a student-centered classroom in their junior years or those who have previously experienced constructivist approaches such as inquiry and problem-based learning may have different discernment on their current learning environment. Gijbels et al. (2006) explained that the difference in the students' and teachers' scores regarding constructivism is the effect of past learning experiences of students. This result explains why the assessment of students for each of the scales differs. Other factors that may promote the different perceptions of students regarding their learning environment are their learning styles and learning approaches. Assimilating learning style is not consistent with constructivism since this type of learner prefers to work independently and favors lectures and reading than any other teaching strategies. Converging, diverging, and accommodating learning styles are consistently aligned with the views of constructivism.

Moreover, students with surface learning approaches may not favor constructivism because they depend on teachers and books as the sources of knowledge. They tend to forget new information quickly, which is contrary to the principles of constructivism. On the other hand, deep learners construct new knowledge through inquiry then transfer this learning to new situations. These characteristics of deep learners are favored to thrive and excel in a constructivist classroom (Cirik et al., 2015). Ozkal et al. (2009) also noted that all constructivist learning environment dimensions predict students' learning approach directly and indirectly through tentative scientific epistemological belief. On the other hand, fixed scientific epistemological beliefs of students were significantly related only with personal relevance.

The lower assessment of teachers in some dimensions compared to the others may be attributed to certain factors such as experience, educational background, epistemological and pedagogical beliefs, and resources. Teachers who experienced a constructivist learning environment and are accustomed to different constructivist strategies may have a different assessment than those who were rarely exposed to this learning environment. Also, the length of teaching experience or prior teaching experience might influence the varied assessment of teachers on the different components of the learning environment. Üredi (2014) reiterated that teachers who are regarded as professional seniors perceived their classroom learning environment as more of a constructivist than teachers with inferior professional experience. However, Çetin-Dindar et al. (2014) explained that the length of teaching experience does not inevitably translate to proficiency in constructivism. Aydoğdu and Ay (2016) further discovered that relatively inexperienced teachers are more constructivist than those veteran or seasoned teachers. Cirik et al. (2015) nevertheless found no significant difference among teachers' assessment of the actual learning environment concerning teaching experience and educational level. However, the educational background of teachers might affect their assessment. Teachers who have completed graduate programs might be more capable of attaining a constructivist classroom since it is probable that they have learned varied constructivist strategies and approaches at the graduate level. Aydoğdu and Ay (2016) revealed that those with graduate degrees are more inclined to exhibit characteristics consistent with constructivism.

Epistemological and pedagogical beliefs of teachers can also be considered as factors that could have possibly influenced their assessment of the extent of constructivism in their physics classroom learning environment. Epistemological beliefs of teachers represent the beliefs concerning the nature of knowledge and how it is acquired. On the other hand, teachers' pedagogical beliefs are described as beliefs about teaching and learning. Teachers who are likely to implement traditional instruction may have assessed some components of the questionnaire differently than those teachers with more sophisticated epistemological beliefs. Traditional instruction believes in the certainty of knowledge and that the only source of knowledge is external authorities. Also, traditional instruction is more likely a teacher-centered learning environment.

On the contrary, non-traditional instruction allows learners to construct knowledge through active inquiry and accentuates that knowledge is constructed from experience, judgment, and reason. Non-traditional instruction manifests a learner-centered classroom where teachers are more of a facilitator than the only source of knowledge. Both epistemological and pedagogical beliefs have been established to affect teachers' choice of instructional practices, determining the type of learning environment they attained (Kaya, 2017; Saylan et al., 2016; Tondeur et al., 2016). Kablan and Kaya (2014) also pointed out that teachers who prefer active learning methods might have adopted constructivist teaching methods consistent with their learning style. Anagün (2018) also emphasized the relevance of teachers' skills in problem-solving, critical thinking, cooperation, communication, and creativity in implementing a constructivist learning environment. The study highlighted that a teacher who possesses 21st century skills could implement constructivist pedagogical approaches, such as extensive inquiry and investigation that promote students' positive attitudes.

Finally, teachers' choice of classroom practices in attaining a constructivist physics learning environment is perhaps affected by the availability of instructional resources and facilities. These resources include laboratory equipment, audio-visual materials, computer hardware, software, access to the internet, laboratory rooms, and other instructional materials and technologies. Teachers who do not have access to these resources and facilities may consider it as a deterrent in attaining a constructivist learning environment; thus, their assessment may practically differ from those with ample access to these facilities. Temli Durmuş (2016) explicitly stated the importance of educational materials to help learners construct their knowledge. The study found that science teachers cited that some limitations in attaining a constructivist learning environment are the absence of laboratories and lack of materials and equipment, classroom size, and seating arrangements.

Students' Assessment Based on Type of School

Comparing public and private senior high school students' assessments on the extent of constructivism of the learning environment in their physics classes shows an overall highly significant difference. Their overall mean scores are described as very constructivist.

Table 4 compares the extent of constructivism in physics classes as evaluated by students grouped according to the type of school. Based merely on the mean, it appears that students from public high schools indicated a greater extent as compared to their private counterparts. A similar scenario is also observed throughout the different dimensions of constructivism. Also, these means are descriptively interpreted as "moderately constructivist" to "mostly constructivist."

These observed differences were statistically tested to identify whether these marked differences are "significant," indicating that the extent of assessment of public senior high school students is different from private school students. The *p*-values indicate whether significant differences exist in the general assessment as well

Table 4

Students' Assessment Compared According to the Type of School

Dimensions	Mean				*p*-value
	Private (N=272)	DE	Public (N= 248)	DE	
Personal Relevance	7.65	VC	8.24	MC	<0.01**
Uncertainty	7.20	VC	7.37	VC	0.19 ns
Critical Voice	7.48	VC	7.94	VC	<0.01**
Shared Control	5.04	MDC	5.57	MDC	0.01*
Student Negotiation	7.60	VC	7.76	VC	<0.01**
Overall	6.99	VC	7.37	VC	<0.00**

*ns p-values > 0.05 implies that there is NO significant difference, **p-values < 0.01 implies that there is high significant difference, *p-values <0.05 implies that there is significant difference* as on the dimensions. Results reveal that, in a broad sense, a considerable difference exists between the assessments of the two groups. Students from public high schools have a significantly higher perception of the extent of constructivism over their private counterparts. This significant difference is observed in all of the dimensions except for uncertainty ($p>0.05$). Subsequently, the differences in the dimension of personal relevance, critical voice, and student negotiation are all highly significant ($p<0.01$), while shared control is significant ($p<0.05$). The not significant difference in the uncertainty dimension implies that both groups of students are almost the same in their perception of what transpired in their physics classes. As earlier explained, the assessment of students in this dimension is not totally dependent on their experiences in the current learning environment but could also be influenced by their background knowledge in basic or introductory physics and prior learning experiences. Therefore, it is presumed that resemblance of students in these factors exists, resulting in a very constructivist level but no significant difference. This outcome further confirms the findings of Nix et al. (2005) that the perception of private and public students in the uncertainty dimension is classified in the frequency seldom or equivalent to a very constructivist level for this study.

The significant differences in the overall constructivism and on the dimension of personal relevance, critical voice, shared control, and student negotiation signifies that private and public senior high school students have diverse perceptions of their learning environment. Both groups of students regarded personal relevance with the highest mean score. However, public high school students have a higher mean equivalent to mostly constructivist compared to a very constructivist level for private high school students. It indicates that students from public schools seem to have experienced more learning opportunities linking physics to students' experiences outside of the school. On the dimension of shared control, both groups of students have classified it with the lowest mean matching a moderately constructivist classification. Lastly, both are described as very constructivist on critical voice and student negotiation and with highly significant differences between the two groups of students. These differences could be attributed to the classroom learning environment that transpired depending on the teachers' choice of instructional practices. However, these differences might also be affected by students' prior learning experiences (Gijbels et al., 2006), learning styles and learning approaches (Cirik et al., 2015; Ozkal et al., 2009), and some other factors, including school resources and facilities, nature of students, and class size (Savasci & Berlin, 2012).

Conclusions

Based on the results, the students' assessment of their physics learning environment does not entirely reflect teachers' self-assessment of their perceived constructivist classroom. Teachers generally perceived their physics classroom as mostly constructivist, but students' assessment is significantly lower in the dimension of critical voice, student negotiation, and shared control. As such, it can be deduced that the methodologies and strategies employed in the classroom do not fundamentally encourage holistic constructivism as manifested by the inferior rating of the other dimensions of constructivism. These results can be attributed to the different factors presented (teacher, student, and school-related). There is still a need to encourage the use of different constructivist approaches and strengthen its practice as a holistic approach to physics teaching in the senior high school-STEM strand. Using pedagogical approaches and combining them with existing and emerging technologies to develop learning materials grounded by the tenets of constructivism might be one of the numerous processes to further encourage a constructivist learning environment.

Comparing the classroom learning environment of public and private high schools, the extent of constructivism of the learning environment in physics is significantly different, as manifested by the different assessments of students. Regardless of the type of schools, it is apparent, however, that both teachers and students agreed in assessing shared control and uncertainty of physics as the dimensions requiring enrichment in attaining a holistic constructivist classroom. The assessment of students could have been influenced by student-related factors that include content knowledge, prior learning experiences, learning styles, and learning approaches. On the other hand, physics teachers have different assessments of their perceived classroom environment in different dimensions. Their rating is not solely dependent on their choice of instructional practices but could have also been affected by the experience, educational background, teaching styles, learning styles, skills, pedagogical and epistemological beliefs, and school resources.

Recommendations

The result of this study may contribute to the improvement of physics instruction in general. Curricular reforms may be needed to advance the extent of constructivism in the physics classroom of the senior high school STEM-strand. Teachers and administrators from different school types may also realize the need to benchmark their best practices from one another in implementing and achieving a well-rounded constructivist physics learning environment. The need for teachers to advance their technological, pedagogical, and content knowledge (TPACK) may also be needed as part of their continuing professional development. Teachers should also be encouraged to utilize the different learning models and integrate contemporary instructional materials in attaining a constructivist classroom in all dimensions.

This study mainly focused on assessing STEM teachers and students of their physics learning environment using a survey questionnaire that has its restrictions. It is not reflective of the perceptions of all other physics teachers and students in the same condition. Nevertheless, this study reveals a significant issue in the current curriculum that can be further investigated. Future studies may use a qualitative research design and other survey instruments or tools in extracting more data to derive more conclusive results.

References

Abdulrachman, N.M. (2018). A benchmarking of the status of science instruction between two selected secondary schools in Philippines and Malaysia: A case study. *International Journal of Humanities and Social Sciences,* 10(3): 31-34. https://ijhss.net/index.php/ijhss/article/view/450

Ahmad, C.N., Ching, W.C., Yahaya, A., & Abdullah, M.F. (2015). Relationship between constructivist learning environments and educational facility in science classrooms. *Procedia - Social and Behavioral Sciences*, 191: 1952-1957. https://doi.org/10.1016/j.sbspro.2015.04.672

Alt, D. (2015). Assessing the contribution of a constructivist learning environment to academic self-efficacy in higher education. *Learning Environments Research,* 18(1): 47-67. https://doi.org/10.1007/s10984-015-9174-5

Altun, S., & Yücel-Toy, B. (2015). The methods of teaching course based on constructivist learning approach: An action research. *Journal of Education and Training Studies*, 3(6). https://doi.org/10.11114/jets.v3i6.1047

Anagün, Ş.S. (2018). Teachers' perceptions about the relationship between 21st century skills and managing constructivist learning environments. *International Journal of Instruction*, 11(4): 825-840. https://doi.org/10.12973/iji.2018.11452a

Aydoğdu, B., & Ay, T.S. (2016). Determination of teacher characteristics which support constructivist learning environments. *Eurasian Journal of Educational Research,* 16(63): 293-310. https://doi.org/10.14689/ejer.2016.63.17

Ben, F. (2010). *Students' uptake of physics: A study of South Australian and Filipino physics students* [Doctoral dissertation]. http://hdl.handle.net/2440/62384

Bernardo, A.B., Ganotice, F.A., & King, R.B. (2015). Motivation gap and achievement gap between public and private high schools in the Philippines. *The Asia-Pacific Education Researcher,* 24(4): 657-667. http://doi.org/10.1007/s40299-014-0213-2

Çetin-Dindar, A., Kırbulut, Z.D., & Boz, Y. (2014). Modelling between epistemological beliefs and constructivist learning environment. *European Journal of Teacher Education,* 37(4): 479-496. https://doi.org/10.1080/02619768.2014.944614

Cetin, P.S., Kaya, E., & Geban, 0. (2014). Students', pre-service teachers', and in-service teachers' views about constructivist implementations. *Necatibey Faculty of Education Electronic Journal of Science and Mathematics Education*, 8(2): 143-163. https://doi.org/10.12973/nefmed.2014.8.2.a7

Churach, D., & Fisher, D. (2001). Science students surf the web: Effects on constructivist classroom environments. *Journal of Computers in Mathematics and Science Teaching,* 20(2): 221-221. https://www.learntechlib.org/primary/p/8474/

Cirik, I., Çolak, E., & Kaya, D. (2015). Constructivist learning environments: The teachers' and students' perspectives. *International Journal on New Trends in Education and Their Implications,* 6(2): 30-44. http://www.ijonte.org/FileUpload/ks63207/File/03.cirik.pdf

Commission on Higher Education. (2019). *2018 higher education facts and figures*. https://ched.gov.ph/2018-higher-education-facts-and-figures/

Department of Education. (2019). *PISA 2018 National Report of the Philippines. Philippine National Report*. https://www.deped.gov.ph/wp-content/uploads/2019/12/PISA-2018-Philippine-National-Report.pdf

Dudduan, C., Nirat, J., & Sumalee, C. (2015). Development of learning management model based on constructivist theory and reasoning strategies for enhancing the critical thinking of secondary students. *Educational Research and Reviews,* 10(16): 2324-2330. https://doi.org/10.5897/err2015.2193

Garbett, D. (2011). Constructivism deconstructed in science teacher education. *Australian Journal of Teacher Education,* 36(6). https://doi.org/10.14221/ajte.2011v36n6.5

Gijbels, D., Van de Watering, G., Dochy, F., & Van den Bossche, P. (2006). New learning environments and constructivism: The students' perspective. *Instructional Science*, 34(3): 213-226. https://doi.org/10.1007/s11251-005-3347-z

Hofstein, A., Nahum, T.L., & Shore, R. (2001). Assessment of the learning environment of inquiry-type laboratories in high school chemistry. *Learning environments research*, 4(2), 193-207. http://doi.org/10.1023/A:1012467417645

Ilhan, N., Yildirim, A., & Yilmaz, S.S. (2016). The effect of context-based chemical equilibrium on grade 11 students' learning, motivation and constructivist learning environment. *International Journal of Environmental and Science Education,* 11(9): 3117-3137. https://doi.org/10.12973/ijese.2016.919a

Jack, G.U. (2017). The effect of learning cycle constructivist-based approach on students' academic achievement and attitude towards chemistry in secondary schools in north-eastern part of Nigeria. *Educational Research and Reviews,* 12(7): 456-466. https://doi.org/10.5897/ERR2016.3095

Johnson, B., & McClure, R. (2004). Validity and reliability of a shortened, revised version of the constructivist learning environment survey (CLES). *Learning Environments Research,*7(1): 65-80. https://doi.org/10.1023/b:leri.0000022279.89075.9f

Kablan, Z., & Kaya, S. (2014). Preservice teachers' constructivist teaching scores based on their learning styles. *Australian Journal of Teacher Education*, 39(39). https://doi.org/10.14221/ajte.2014v39n12.5

Kaya, G. I. (2017). The relations between scientific epistemological beliefs and goal orientations of pre-service teachers. *Journal of Education and Training Studies,* 5(10): 33. https://doi.org/10.11114/jets.v5i10.2547

Keser, O.F., & Akdeniz, A.R. (2010). Assessment of the constructivist physics learning environments. In *Asia-Pacific Forum on Science Learning & Teaching*, 11(1). https://www.eduhk.hk/apfslt/v11_issue1/keser/

Mistades, V.M. (2008). High school physics teachers' attitudes and beliefs about physics and learning physics. *Journal of Research in Science, Computing and Engineering,* 3(3). https://doi.org/10.3860/jrsce.v3i3.100

Nix, R.K., Fraser, B.J., & Ledbetter, C.E. (2005). Evaluating an integrated science learning environment using the constructivist learning environment survey. *Learning Environments Research,* 8(2): 109-133. https://doi.org/10.1007/s10984-005-7251-x

Obrero, M.M., & Obrero, M.P. (2015). A constructivist small-group learning intervention in thermodynamics: Effects on students' conceptual change and attitudes. *Iamure International Journal of Social Sciences,* 14(1). https://doi.org/10.7718/ijss.v14i1.1037

Ocampo, C.A., de Mesa, D.M.B., Ole, A.F., Auditor, E., Morales, M.P.E., Sia, S.R.D., & Palomar, B.C. (2015). Development and evaluation of physics microlab (P6-Î¼Lab) kit. *The Normal Lights,* 9(1). http://po.pnuresearchportal.org/ejournal/index.php/normallights/article/view/11

Ongowo, R., Indoshi, F., & Ayere, M. (2015). Perception of constructivist learning environment: Gender and school type differences in Siaya County, Kenya. *Advances in Research,* 4(1): 15-26. https://doi.org/10.9734/air/2015/13843

Oon, P., & Subramaniam, R. (2010). On the declining interest in physics among students—From the perspective of teachers. I*nternational Journal of Science Education*, 33(5): 727-746. https://doi.org/10.1080/09500693.2010.500338

Orleans, A.V. (2007). The condition of secondary school physics education in the Philippines: Recent developments and remaining challenges for substantive improvements. *The Australian Educational Researcher,* 34(1): 33-54. https://doi.org/10.1007/bf03216849

Ornek, F., Robinson, W.R., & Haugan, M.P. (2008). What makes physics difficult? *International Journal of Environmental and Science Education,* 3(1): 30-34. https://files.eric.ed.gov/fulltext/EJ894842.pdf

Ozfidan, B., Cavlazoglu, B., Burlbaw, L., & Aydin, H. (2017). Reformed teaching and learning in science education: A comparative study of Turkish and US teachers. *Journal of Education and Learning*, 6(3), 23. https://doi.org/10.5539/jel.v6n3p23

Ozkal, K., Tekkaya, C., Cakiroglu, J., & Sungur, S. (2009). A conceptual model of relationships among constructivist learning environment perceptions, epistemological beliefs, and learning approaches. *Learning and Individual Differences*, 19(1): 71-79. https://doi.org/10.1016/j.lindif.2008.05.005

Pandey, L., & Ameta, D. (2017). Effect of constructivist-based training on learning and teaching: An experiment in classroom. *Journal of Education and Practice*, 8(13), 67-72. https://eric.ed.gov/contentdelivery/servlet/ERICServlet?accno=EJ1143831

Perkins, D.N. (1991). Technology meets constructivism: Do they make a marriage?. *Educational technology*, 31(5): 18-23. https://www.learntechlib.org/p/170731/

Pondevida, H.B., Gonzales, C.C., & Sonico, M.M. (2009). The teaching of earth science: A shift towards constructivism. *Southeastern Philippines Journal of Research and Development,* 18(2). http://ejournals.ph/form/cite.php?id=9056

Qarareh, A.O. (2016). The effect of using the constructivist learning model in teaching science on the achievement and scientific thinking of 8th grade students. *International Education Studies*, 9(7): 178. https://doi.org/10.5539/ies.v9n7p178

Savasci, F., & Berlin, D.F. (2012). Science teacher beliefs and classroom practice related to constructivism in different school settings. *Journal of Science Teacher Education,* 23(1): 65-86. https://doi.org/10.1007/s10972-011-9262-z

Saylan, A., Armagan, F.O., & Bektas, O. (2016). The relationship between pre-service science teachers' epistemological beliefs and preferences for creating a constructivist learning environment. European *Journal of Science and Mathematics Education*, 4(2), 251–267. https://eric.ed.gov/?id=EJ1107826

Science Education Institute, Department of Science and Technology & University of the Philippines National Institute for Science and Mathematics Education Development. (2011). *Science framework for Philippine basic education*. Manila: SEI-DOST & UP NISMED. https://sei.dost.gov.ph/images/downloads/publ/sei_scibasic.pdf

Tabago, L.C. (2012). Effectiveness of constructivist approach experiments in teaching selected physics concepts. *IAMURE International Journal of Multidisciplinary Research,* 2(1). https://doi.org/10.7718/iamure.v2i1.64

Taylor, P.C., Fraser, B.J., & Fisher, D.L. (1997). Monitoring constructivist classroom learning environments. *International Journal of Educational Research,* 27(4): 293-302. https://doi.org/10.1016/s0883-0355(97)90011-2

Temli Durmuş, Y. (2016). Effective learning environment characteristics as a requirement of constructivist curricula: Teachers' needs and school principals' views. *International Journal of Instruction,* 9(2): 183-198. https://doi.org/10.12973/iji.2016.9213a

Tondeur, J., Van Braak, J., Ertmer, P.A., & Ottenbreit-Leftwich, A. (2016). Understanding the relationship between teachers' pedagogical beliefs and technology use in education: A systematic review of qualitative evidence. *Educational Technology Research and Development,* 65(3): 555-575. https://doi.org/10.1007/s11423-016-9481-2

Üredi, R. (2014). Analyzing the classroom teachers' levels of creating a constructivist learning environment in terms of various variables: A Mersin case. *Educational Research and Reviews,* 9(8): 227-236. https://doi.org/10.5897/err2014.1750

Wild, A. (2015). Relationships between high school chemistry students' perceptions of a constructivist learning environment and their STEM career expectations. *International Journal of Science Education*, 37(14): 2284-2305. https://doi.org/10.1080/09500693.2015.1076951

Wilson, H.E., & Zoellner, B. (2016). Effectiveness of a constructivist-based science camp for gifted secondary students. *Journal of Research in Education*, 26(1): 76-108. https://eric.ed.gov/contentdelivery/servlet ERICServlet?accno=EJ1118479

Wilson, B.G. (1996). *Constructivist learning environments: Case studies in instructional design*. Educational Technology.

World Economic Forum. (2019). *The global competitiveness report 2017-2018.* https://www.weforum.org/reports/the-global-competitiveness-report-2017-2018