JOURNAL OF BALTIC SCIENCE EDUCATION

ISSN 1648-3898 /Print/
ISSN 2538-7138 /Online/

SECONDARY SCHOOL PHYSICAL SCIENCE TEACHERS' BELIEFS ON THE PURPOSES AND GOALS OF SCIENCE TEACHING: THE PRESENCE OF CULTURAL MYTHS

Ramon L. Sanchez III,
Sheryl Lyn C. Monterola

Abstract. *Understanding why teachers teach the way they do is important especially in a time of curriculum reforms. Hence, the aim of this research is to unpack the secondary school physical science teachers' beliefs on the purposes and goals of science teaching (PGST) and to check the alignment of their beliefs on PGST with constructivism. A convergent parallel mixed method design was employed. Scale and checklist were used to collect data on the teachers' beliefs. Thematic analysis of semi-structured interviews was used to explore the teachers' implementation of the science curriculum. Results revealed that while teachers agree with the basic tenet of constructivism, their beliefs on the PGST were traditional. Difficulties of implementing their constructivist ideas on teaching and learning reinforced the cultural myths. Length of teaching experience and actual classroom teaching hours were seen as significant factors in the development of beliefs, whereas familiarity of curriculum intentions correlate negatively with the development of constructivist beliefs.*

Keywords: *constructivist physical science education, purposes and goals of science teaching, teachers' beliefs, cultural myths in physical science education*

Ramon L. Sanchez III,
Sheryl Lyn C. Monterola
University of the Philippines, Philippines

Introduction

Constructivism has been the dominant philosophy in science education for decades. The heart of the constructivist movement in education can be encapsulated in the statement, "Knowledge is constructed in the mind of the learner" (Shiland, 1999, p. 107). Learners are viewed as active participants in the construction of knowledge, which implies that knowledge construction is personal but socially mediated (Llewellyn, 2013). This view of learning contrasts greatly from the knowledge transmission model, which is a characteristic of traditional methods (Tobin, 1993). Several studies have already documented the effectiveness of teaching practices based on the constructivist principles (e.g., Marušić & Sliško, 2011). These studies suggest that the assumptions on constructivist epistemology are consistent. In fact, modern science curricula are based on constructivism (Ulukütük, 2022). An example is the move in Slovakia to transition to a "participatory framework" (Demkanin & Kováč, 2021, p. 8705) in physics education. In this framework, learners are involved to some degree in the design of the teaching and learning process. In the field of neuroscience, a similar suggestion has been made to improve learning by utilising activities where learners actively engage with the material and by designing instruction that takes into consideration the students' "developmental trajectories and individual differences" (Tokuhama-Espinosa & Borja, 2023, p. 19). These examples agree with Shiland's (1999) and Llewellyn's (2013) description that learning in the constructivist paradigm necessitates the learners' active participation. In the Philippines, the Department of Education (DepEd) (2024a) has placed constructivism at the forefront of the "universally recognized theories of learning" (p. 4) that support the science curriculum. Implementing a constructivist curriculum can be shaped by the teachers' beliefs (Akin-Sabuncu & Cali, 2023; van Driel et al., 2008).

Classroom management and teaching are a few areas where teachers' beliefs play an important role (Luft & Zhang, 2014). When teachers are faced with an uncompromising educational dilemma, their actions will be guided by their beliefs (Campbell et al., 2014; Pajares, 1992). However, teachers find it hard to implement a curriculum that does not agree with their beliefs system (Harris & Graham, 2019). Thus, the current research posits that the

https://doi.org/10.33225/jbse/24.23.931

ISSN 1648-3898 /Print/
ISSN 2538-7138 /Online/

framework of the science curriculum (see DepEd 2016, 2024a) sets certain expectations for the alignment of the teachers' beliefs with constructivism. It is expected that such alignment would result in better student performance. For instance, teachers' modelling of students' thinking, based on the current constructivism, can raise the quality of the new curriculum guides, as well as the new curriculum implementation (Demkanin, 2020).

The physical science teachers' beliefs system is a complex topic. One such preliminary study that aims to uncover teachers' beliefs is Novotná and Demkanin's (2024) proposal to create a typology of physics teachers by soliciting their ideas on the biological, psychological, and social views of physics education. Some of the teachers' beliefs can also be uncovered through their ideas or views on the purposes and goals of science teaching (PGST, the *why* of teaching), the nature of teaching and learning (NTL, the *how* of teaching), and the nature of science (NOS, the *what* of teaching) (Friedrichsen et al., 2010). Timostsuk's (2015) survey has shown that the science teachers' main concern is on teaching strategies. This may explain the plethora of studies on the NTL and NOS. In the context of the Philippines, this is illustrated in the content- and instruction-focused teacher training programs conducted throughout the country in accordance with the new curriculum (e.g., DepEd, 2017). On the other hand, Schneider and Plasman (2011) have noted that studies have interchanged the use of *purposes* or *goals*, or that *goals* have been used to refer to both ideas. Moreover, the PGST has been subsumed in the studies of the NTL and NOS. The treatment of the PGST relays a message that this topic is secondary only to the NTL and NOS. This agrees with Tokuhama-Espinosa and Borja's (2023) observation that the *why* of teaching needs more exploration. Furthermore, this concurs with Roberts' (1982) earlier argument that it is important to unpack the teachers' reasons for the way they teach science.

Hence, the current research addresses the gaps in studies by focusing on the PGST (the *why* of science teaching). It expands its literature through the presentation of possible sub-dimensions and through the checking of the alignment of the physical science teachers' beliefs with constructivism. The results may be used to inform designs of teacher professional development programs and policies on school administration.

Theoretical Framework

Science Teaching Orientations

The defining characteristic of a teacher can be encapsulated in the concept of pedagogical content knowledge (PCK) (Shulman, 1987). PCK is the brand of "professional understanding" (p.8) that is unique to teachers. Paraphrasing Shulman's explanation, PCK answers the question *What can a teacher do that a person of another profession, no matter how intelligent he/she is, cannot do?* (Friedrichsen et al., 2010). A teacher's PCK impacts his/her implementation of the curriculum (Pajares, 1992). The importance of PCK, hence, cannot be understated as it is considered a prime venue of research to improve teacher quality (Park & Choi, 2020). For example, Demkanin's (2024) use of PCK for preservice physics teacher education has enhanced the teachers' views on "holistic teaching" (p. 1) and on the building of integrated knowledge of principles of human learning in the context of physics contents.

In the area of science education, a framework of PCK has been proposed comprising of five domains, one of which is "orientations to science teaching" (Magnusson et al., 1999, p. 97). This domain encompasses the teachers' beliefs about science teaching, and these beliefs were posited to influence the other four domains. However, teachers' beliefs are not well-defined. To give clarity, a review of literature has been undertaken by Friedrichsen et al. (2010). The review relabels this domain as "science teaching orientations" (STO) and explicitly identifies its sub-dimensions as the teachers' beliefs on the "goals or purposes of science teaching, (the nature of) science, and science teaching and learning," (p. 372). As a sub-dimension of STO, the purposes or goals of science teaching forms part of the teachers' beliefs system. Pajares (1992) has described belief as the "individual's judgment of the truth or falsity of a proposition" (p. 316) and a referent of actions. It is connected with the other beliefs and its formation is influenced by the teachers' personal experiences. In this regard, the current research also includes other areas of teachers' beliefs to enrich the discussions.

Redefining Purposes and Goals of Science Teaching as a Single Construct

This sub-domain of STO—the teacher's views or ideas on the *why* of science teaching—has been expressed in two ways: one expressing exclusivity of definitions (i.e., purposes *or* goals; P/GST) and another one expressing inclusivity (i.e., purposes *and* goals; PGST). In response to Schneider and Plasman's (2011) observations of the vagueness in the use of this sub-domain, the current research adapts the *purposes and goals of science teaching*

https://doi.org/10.33225/jbse/24.23.931

ISSN 1648–3898 /Print/
ISSN 2538–7138 /Online/

(PGST) as a single construct to indicate the inclusion of the definitions used in the different studies. This agrees with Magnusson et al.'s (1999) original proposition when they discussed STO. They described PGST as a "general way of viewing or conceptualizing science teaching" (p. 97). However, Friedrichsen et al.'s (2010) concluding statements in their literature review have expressed this sub-domain as the P/GST instead, although it can be noted that they have used Magnusson et al.'s (1999) original inclusive expression (i.e., PGST) at the start of their paper. The explanation to the change is not explicit, but it may be deduced that it is to give future researchers options to focus on—functions for using a specific strategy for *purposes*, or a general view of science teaching for *goals*. Schneider and Plasman (2011) have also described the teachers' learning progressions for purposes *separately* from the goals. They have noticed that a variety of educational objectives was referred to as goals, whereas purposes cover the teachers' reasons for their way of teaching. Nonetheless, Schneider and Plasman have used the inclusive expression to state the teachers' beliefs on the *why* of science teaching. As a way to present the different ideas into learning progressions, the following statements have guided their analyses: "why science is taught", "what was important about teaching science", and "why it was important to teach science" (p. 541). Consequentially, these statements can be viewed as alternative ways to describe the teachers' beliefs on the *why* of science teaching. The same approach has been used by Maseko and Khoza (2021) in exploring in-service science teachers' beliefs. Although their paper has used the exclusive expression (i.e., P/GST), they united the definitions of purposes and goals through Roberts' (1982) curriculum emphases. The curriculum emphases are messages about science that are implicitly or explicitly relayed to the students through the wordings of the curriculum guide, designs of curriculum materials, or the approaches used by the teachers. The curriculum emphases answer the student's question "Why am I learning this?" (p. 245). The description of curriculum emphases resonates with Magnusson et al.'s original description of PGST. In doing so, it can be said that Maseko and Khoza (2021) may have inadvertently agreed with the inclusive expression, thus considering *purposes and goals* as a single construct. Other works that have used the inclusive expression are Timostsuk's (2015) survey on pre-service teachers' main concerns, and Campbell et al. (2014) and Ueda and Isozaki (2016)—both have described PGST as the function of science teaching.

Taking these into consideration, the current research uses the inclusive expression—PGST—to encompass the teachers' beliefs on the aims, intentions, functions, objectives, importance, and reasons for science teaching. To make the description more compact, the current research posits that the PGST answers the teacher's question "*Why do I teach science the way I do?*" This is similar to the way Roberts (1982) has defined curriculum emphases and reflects Tokuhama-Espinosa and Borja's (2023) call to explore the *why* of science teaching. From here on, this question is referred to as the PGST guide question.

Cultural Myths in Physical Science Education

Cultural myths are beliefs about science teaching that were identified by Tobin and McRobbie (1996) to be deterrents of a constructivist science curriculum. The underlying assumption is that the traditional paradigm of science teaching and learning (i.e., objectivism, behaviourism, positivism)—before the widespread acknowledgement of constructivism as a more effective paradigm of teaching and learning—has shaped the beliefs system of the stakeholders in the education system. This includes the school administrators, teachers, students, and parents. Tobin and McRobbie have identified the cultural myths by asking a science teacher and his students to answer the "Classroom Environment Survey" (CES) (p. 227), which is followed by interviews exploring their ideas on the five dimensions of the CES: "involvement of the students in discussion, autonomy of students in making decision about learning; relevance of the science topic studied; commitment of students to learning; and inhibitors of learning" (p. 227). The interviews have prompted the respondents to describe the events in the classroom, to provide probable explanations of why the class events occurred the way they did, to describe what they would have preferred to happen, and to explain their preferred class occurrences. The analysis and cross-referencing of the results of the CES and interviews have resulted in four themes considered to be the beliefs that stakeholders accept as the truth behind science teaching and learning. For example, the Transmission Myth is described as the idea that the teachers are the main source of information in the classroom whereas the students are the receivers of the information. Scientific knowledge is considered independent from the scientific processes and, thus, can be obtained by mere lecturing. As such, memorisation is a key aspect of teaching and learning. Deviation of student's knowledge from what was lectured by the teacher is considered the student's shortcoming. Considerations of students' individuality (Tokuhama-Espinosa & Borja, 2023) are put aside.

These beliefs are aptly labelled *cultural myths* because they are deeply ingrained in the mindset of the stakeholders through the historical/traditional view that scientific knowledge is an object that exists in nature and can

https://doi.org/10.33225/jbse/24.23.931

ISSN 1648-3898 /Print/
ISSN 2538-7138 /Online/

be obtained by logical methods irrespective of the person doing the exploration, and that the teacher is the only authority in the classroom. Nasri et al. (2020) have utilised the cultural myths in establishing the Physics teachers' perceptions on physics education in relation to the sustainable development goals. In another study, Morris and Chi (2020) have solicited teachers' "naïve conceptions about learning" (p. 5) using the cultural myths. They are presented as antitheses to constructivism as part of a professional development program designed to improve teacher questioning. From the perspective of Tobin and McRobbie (1996), the cultural myths are referents to the teachers' actions. They have emphasised that identifying the presence of cultural myths in the beliefs system of the stakeholders will give the school administrators, researchers, and educators a better understanding of why teachers teach the way they do and will serve as "foci for reflection" (p. 226) to improve the implementation of the science curriculum. Akin to Roberts' (1982) claim on the importance of curriculum emphases, Tobin and McRobbie have asserted that neglecting to investigate the teachers' reasons for the way they teach would put any reforms pushed forth in jeopardy.

Hence, the current research considers the cultural myths as answers to the PGST guide question. In a similar fashion to how Morris and Chi (2020) have used them as antitheses to constructivism, they will be utilised as bases to develop statements expressing teachers' traditional and constructivist beliefs on the PGST. Furthermore, being identified as traditional beliefs, they can be used to determine the alignment of teachers' beliefs with constructivism. Agreement indicates traditional beliefs, whereas disagreement indicates constructivist beliefs.

Table 1 shows the different cultural myths. The Transmission Myth exemplifies the objectivist view that knowledge can be achieved devoid of human experiences (Davis et al., 1993). The Myth of Efficiency and Myth of Rigor are cases of behaviourist views where the teacher sets the pacing of the lesson and learning is just a matter of conditioning the students to respond to a certain stimulus (Hinduja, 2011; Seker, 2008). The Myth of Preparing Students for Examinations emphasises logical, empirical, and inductive approaches to learning, which is a characteristic of the positivist view (Peca, 2000). In this regard, the traditional beliefs being referred to in the current research cover the objectivist, behaviourist, and positivist beliefs on teaching and learning.

Table 1
Cultural Myths Described by Tobin and McRobbie (1996)

Cultural Myths	Description	Associated Beliefs
Transmission Myth	Views the teacher as the main source of knowledge and the students are its receivers	Scientific knowledge is an object that can exist outside the scientific process (objectivist view of knowledge; cold reason) Memorisation is the main format for effective teaching and learning
Myth of Efficiency	Emphasises the need to cover a considerable amount of content in a given time	Teacher controls the students Time is a commodity that is in short supply Content coverage is more important than learning with understanding Work program is in control of the teacher's and students' activities
Myth of Rigor	Consistency of student learning must be ensured from one set of students to another and from one year to the next	The prescribed content must be covered High standard of teaching and learning must be maintained Science teaching is for preparing the students for the next educational level Specifications of the curriculum is a prerogative of external agencies
Myth of Preparing Students for Examinations	Emphasis on learning facts and algorithms to obtain correct answers	Science teaching is for preparing the students to succeed in tests and examinations Tests and examinations are the focus of the curriculum

Research Aim and Research Questions

This research aimed at unpacking the secondary school physical science teachers' beliefs on the purposes and goals of science teaching. The following research questions guided this research:

1. What are the beliefs of the secondary school physical science teachers on the purposes and goals of science teaching?
2. What factors affect the beliefs of the secondary school physical science teachers on the purposes and goals of science teaching?

https://doi.org/10.33225/jbse/24.23.931

ISSN 1648–3898 /Print/
ISSN 2538–7138 /Online/

Research Methodology

General Background

This research employed a convergent parallel mixed method design. The rationale behind this choice is that studies on teachers' beliefs necessitate analysis on the teachers' pronouncements, intentions, preferences to actions, and even their behaviours (Pajares, 1992), which could be revealed through a qualitative approach. Maseko and Khoza (2021) utilised a qualitative approach in exploring in-service science teachers' beliefs on the PGST. In the current research, thematic analysis on teachers' responses to the semi-structured interviews was employed. In addition, the quantitative approach gives an overview of the alignment of the teachers' beliefs with constructivism by measuring their agreement to statements expressing beliefs on PGST and establishing significant differences using the teachers' profile. Statistical treatments—independent t-test, one-way ANOVA, measures of central tendency, and correlation—were employed for this. The quantitative and qualitative data were collected and analysed independently, then compared for similarities and differences, and finally were merged during the discussions (Creswell & Plano Clark, 2018). In this way, a fuller view of whether the teachers' beliefs on the PGST were constructivist or traditional was obtained.

The first stage of data collection was conducted through paper questionnaires for three months to the teachers in the Province of Leyte in the Visayas area of the Philippines. The assumption of choosing a small area was that similar beliefs are formed by people who share the same language and move within close proximity to one another (Keane, 2008; McKinley et al., 1992). The results of this stage established the reliability of the initial PGST Scale and the accompanying questionnaires. The second stage of the data collection was opened to a wider group of participants—to the teachers in Luzon and Mindanao areas. The second stage utilised Google Form for the scale while interviews were conducted over the phone. The Google Form was opened for three months, after which, cleaning of data followed. Only the participants with complete information were considered for the final analysis and were invited for interview.

Participants

The sample of the research were secondary school physical science teachers. These teachers were purposely chosen because they were teaching contents in Physics, Chemistry, or Earth and Space Science in the Junior (Grade 7–10; 13–16-year-old students) or Senior (Grade 11–12; 17–18-year-old students) High School (see DepEd 2016, 2024a). The invitation to participate in the study was sent through the principals, school heads, and district offices in the Luzon and Mindanao areas in the Philippines. The returned forms were inspected for completeness. Of the returned forms, only 101 were complete and were considered for final analysis. The assumption of covering a wide choice of participants was to create a better picture of the teachers' beliefs in relation to how the science curriculum is lived by the teachers across different teaching settings. Table 2 shows the profile of the participants.

Table 2
Profile of the Participants (N = 101)

Categories		*f*	%
Gender	Female	71	70.30
	Male	30	29.70
Highest Educational Attainment	Bachelor's Degree	61	60.40
	Master's Degree	35	34.65
	Doctorate Degree	5	4.95
Location of School (by Area)	Luzon	49	48.51
	Mindanao	52	51.49
Location of School	Urban	87	86.14
	Rural	14	13.86

https://doi.org/10.33225/jbse/24.23.931

ISSN 1648–3898 /Print/
ISSN 2538–7138 /Online/

Categories		*f*	%
Length of Teaching Experience*	Novice	13	12.87
	Experienced	55	54.46
	Senior	33	32.67
Daily Average Classroom Teaching Hours	$h_{ave} > 4$	68	67.33
	$h_{ave} \leq 4$	33	32.67

**Novice (1–3 years), Experienced (4–10 years), Senior (≥ 11 years)*

Instruments

Teachers' beliefs on the PGST were determined using three researcher-made instruments: a scale, a checklist, and the interview questions. These instruments were reviewed by field experts to establish validity. The scale and checklist were pilot tested, and results were subjected to statistical treatments—specifically Cronbach-*α*—to establish reliability. The interview questions were pilot tested to physical science teachers who were not part of the batch used for the final data analysis.

Development of the PGST Scale

Using the PGST guide question, a guide statement, from the perspective of the teacher, was developed: *I teach science the way I do because I believe that the aim, intention, function, objective, importance, or reason for science teaching is to* ___________. Literature was reviewed to complete the statement. The main reference for traditional responses were the cultural myths (Tobin & McRobbie, 1996), while Tobin's (1993) *The Practice of Constructivism in Science Education* was used for the constructivist responses. A total of 40 items—21 traditional and 19 constructivist—were created from the iterative review of literature. Paper questionnaires were created for this stage. To pilot test the PGST Scale, permissions from two districts in the Province of Leyte in the Visayas area in the Philippines were secured. After which, invitations were sent to the teachers through the principals and school heads to participate in the pilot testing. A total of 105 in-service physical science teachers returned the questionnaires. Constructivist items were scored on a 5-point Likert scale, 5 "Strongly Agree," to 3 "Undecided," to 1 "Strongly Disagree." Traditional items were reverse scored. The results were subjected to reliability analysis to remove items until an acceptable reliability coefficient (Cronbach-α = .7) was established and constructivist items were preserved. After this stage, only 18 items were retained—13 traditional and 5 constructivist.

The second stage was opened to secondary school physical science teachers nationwide, except from the Visayas area in the Philippines. The remaining 18 items were converted to Google Form and were sent through the school heads, principals, or district offices. A total of 101 in-service physical science teachers with complete responses were secured. Their responses were again subjected to reliability analysis, removing items until an acceptable reliability coefficient (Cronbach-α = .887, M = 2.09, SD = 0.660) was established. This stage left only 11 items after all the five remaining constructivist and two more traditional items were dropped. In addition, the use of Exploratory Factor Analysis (EFA) extracted four factors with a minimum factor load of .3. These factors were considered the sub-dimensions of the PGST Scale. The final PGST Scale had 11 items and four sub-dimensions stated in the traditional perspective.

Development of the Science Curriculum Intention Checklist

The same guide question and statement used in formulating the items of the PGST Scale were used in identifying the purposes and goals of the science curriculum. To differentiate this set of purposes and goals, it was labelled instead as science curriculum intentions (SCI). The labelling was patterned from the curriculum emphasis of Roberts (1982), who underlined the intentions of the curriculum. A total of 23 items were identified for the SCI Checklist. The SCI Checklist was implemented together with the second stage of the PGST Scale. The respondents were *not* informed that the items were taken from the science curriculum. They were asked to identify from the list the intentions of the science curriculum. A satisfactory reliability coefficient was established (Cronbach-*α* = .923). None of the original 23 items were dropped.

https://doi.org/10.33225/jbse/24.23.931

ISSN 1648–3898 /Print/
ISSN 2538–7138 /Online/

Interview

Semi-structured interviews were conducted to unpack the teachers' beliefs on the PGST by asking them to describe and explain their stand on several issues about science teaching. They were also asked to describe what they do in the classroom in relation to the issues. Participants from the second stage of the PGST Scale development who left their contact information were invited for an interview, of which 23 responded. The interviews were conducted individually at the interviewees' most convenient time. The interviews, which lasted for 30 to 60 minutes, were audio-recorded and transcribed.

The interview questions were pilot tested to five physical science teachers as part of the first stage of the PGST Scale development. This set of teachers was never shown the PGST Scale. The pilot testing was conducted to check consistency in the interpretations of the questions. The questions were adjusted per recommendation of the teachers.

Research Procedure

Google Form was used to collect data which became part of the final analysis. To ensure the quality of the target participants, the first part of the form verified whether the participants were teaching in either Junior or Senior High School (see DepEd 2016, 2024a) and if they were physical science teachers. The participant should click the "yes" button to both questions, or else they would be sent immediately to the Exit message.

To protect the integrity of the respondents, the Plain Language Statement (PLS) and Consent Form were presented next. The teachers would have to click the "yes" button indicating that they had read the content of the PLS. The PLS contained the declaration of the research objective, what the teachers would be asked to do, the duration of their participation, a guarantee of anonymity, a statement of voluntary involvement, and information that the results will be presented in conferences or submitted as journal articles. Once the teacher had clicked the "yes" button, the Consent Form would appear. It contained their confirmation that they had read the content of the PLS and that they were giving their permission to voluntarily participate in the study. It also assured that they could choose to discontinue their participation without any further explanation or any undue repercussions to their person, career, or school. Only upon clicking "yes" to the Consent Form will the participants be able to access the scale. A "no" answer in either form will automatically send the teacher to the Exit message. The participants were also given the option to leave a contact number. Only those with a contact number were invited for an interview. Pieces of information for profiling were also asked from the participants (see Table 2).

To protect the confidentiality of the participants, the names were replaced by codes and no teacher or school was identified during the data analysis.

Data Analysis

To determine the structure of the PGST Scale at the item level, EFA using the Minimum Residuals extraction method in combination with Oblimin rotation was used. Bartlett's test of sphericity and Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy showed the sample size was adequate for factor analysis (KMO = .862, Barttlet's test $p < .001$). Model fit results (RMSEA = 0.0454) showed the four-factor model is an excellent fit to analyse the data with 65.1% of the total variance explained. Items which loaded in more than one factor were categorised under the higher factor load. Table 3 summarises the reliability of each factor and Table 4 presents the rotated factor matrix.

To determine how the different teachers' profiles and teaching background might show possible differences in the teachers' beliefs on the PGST, independent t-test and one-way ANOVA were conducted on the mean scores of the PGST Scale. Significant results using one-way ANOVA were further subjected to Dwass-Steel-Critchlow-Fligner Pairwise Comparison for finer analysis.

To determine the correlation between the teachers' beliefs on the PGST and the SCI, Pearson's correlation coefficient was used on the mean scores of the PGST Scale and the item frequencies of SCI Checklist.

To attain a fuller view of the teachers' beliefs on the PGST, the participants were invited to semi-structured interviews. Transcripts of the interviews were coded, and themes generated by the first author. The second author reviewed the codes and themes. Disagreements were discussed and resolved through iterative analysis of the transcripts.

https://doi.org/10.33225/jbse/24.23.931

ISSN 1648–3898 /Print/
ISSN 2538–7138 /Online/

Research Results

Underlying Factor Structure of the Teachers' Beliefs on the PGST

Four factors were extracted explaining 65.1% of the total variance of the PGST Scale. The factors were labelled as use of scientific knowledge (USK), use of scientific method (USM), acquisition of scientific knowledge (ASK), and promotion of students (PoS). The labels were adapted from the major goals that had "shaped the content of science curricula" identified by Bybee and De Boer (1994, as cited in Bello et al., 2014, p. 92).

Table 3
Descriptive Results of the PGST Scale

Factors	*n* items	Cronbach-α	*N*	*M*	*SD*
Use of Scientific Knowledge (USK)	3	.792	101	2.83	1.02
Use of Scientific Method (USM)	3	.786	101	1.79	0.671
Acquisition of Scientific Knowledge (ASK)	2	.761	101	1.50	0.667
Promotion of Students (PoS)	3	.790	101	2.04	0.806

Note: $\alpha_{\text{PGST Scale}} = .887$, $M_{\text{PGST Scale}} = 2.09$, $SD = 0.66$

Table 4
Rotated Factor Matrix of the PGST Scale (N = 101)

Scale	Factor			
Items	USK	USM	ASK	PoS
Determine whether a student is intelligent or not	.870			
Avoid concepts that students already know	.702			
Maintain a group of students for interschool competitions at the local, national, or international levels	.529			
Help students follow logic as prescribed by experts		.681		
Prepare students for national exams or college entrance exams		.586		
Familiarise students with scientific symbols, jargon, and instruments		.548		
Provide fun ways to remember information			.988	
Guide students in correctly performing tried-and-tested laboratory activities			.483	
Cover all the different aspects of the curriculum				.883
Cover all the lessons enumerated in the curriculum				.468
Promote students to the next grade level				.348

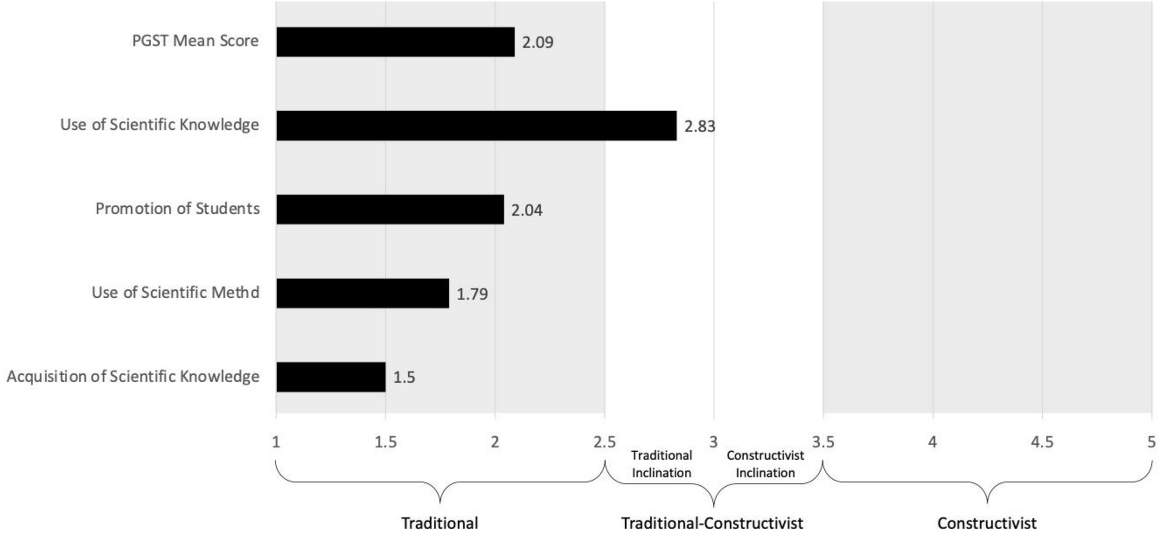
Means and Standard Deviations of the PGST Scale

Only the traditional items remained after the reliability analysis. To show a preference for the constructivist perspective, the remaining items were reversely scored: 1 = Strongly Agree, 2 = Agree, 3 = Undecided, 4 = Disagree, and 5 = Strongly Disagree. Figure 1 shows that the teachers' beliefs on the PGST ($M = 2.09$) were generally traditional. Only USK ($M = 2.83$) made it to the traditional-constructivist range, but it was still traditionally inclined. ASK ($M = 1.50$) was the category that the teachers strongly agreed with.

https://doi.org/10.33225/jbse/24.23.931

ISSN 1648–3898 /Print/
ISSN 2538–7138 /Online/

Figure 1
Categorisation of Beliefs on PGST and Sub-dimensions According to Mean Score



Analysis of Semi-Structured Interviews

Covering the Curriculum

The teachers had mixed views regarding covering the curriculum. One group did not consider covering the whole curriculum. Most of the reasons given were that they preferred to pace the lesson based on the skills of the students, and to prioritise the mastery of concepts (Teacher 3). One teacher also mentioned choosing the lessons based on what was thought to come out in the college entrance exams (Teacher 1).

> *I cover about 90% of the curriculum. If the students are having difficulties, I just cannot move on to the next lesson. Most of the time, we concentrate on discussing the concepts and computation. For those topics which I think are just extras, I forego them in the classroom. I usually sacrifice the applications. I just lecture the importance or applications of the topic. [Teacher 3]*

> *For General Physics 1, I only cover those that will prepare the students for college entrance exams. [Teacher 1]*

Another group were those who wanted to cover the whole curriculum but were not able to do so. They explained that this all depended on how fast their students could comprehend the topic.

> *As much as I want to cover all the topics in the curriculum, I'd rather make sure that my students understood well the current lesson before I move on to the next. I am "quality-over-quantity" type of teacher. I believe that the quantity of the lessons that I have taught will not matter if my students will not develop appreciation and/or interest to the lesson that I am teaching. [Teacher 19]*

The last group viewed covering the whole curriculum as mandatory. They explained that they needed to follow the budget of work adapted by the school based on the curriculum and to prepare the students for the next grade level.

> *I normally cover everything. I check what the DepEd has provided, then I provide additional topics either to connect to the next grade level or topics that are in preparation for college. [Teacher 6]*

> *I simply follow the budget of work. I do not add anything. [Teacher 10]*

https://doi.org/10.33225/jbse/24.23.931

ISSN 1648–3898 /Print/
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Teachers 3, 1, and 19 appeared to be free from the Myth of Efficiency since covering the whole curriculum was dependent only on the learning of the students. Teacher 1, however, believed that science teaching is for preparing the students for college entrance exams (Myth of Preparing Students for Examinations). The Myth of Rigor was also evident: Teachers 1 and 6 believed science teaching is for preparing the students for the next grade level or college; Teachers 6 and 10 believed in covering the whole curriculum because the budget work is assigned by outside agencies, i.e., the DepEd or Division Office.

Coping with Time Constraints

Although Teachers 6 and 10 initially declared that they were faithful in covering the curriculum, they also admitted that this depended on the grading period. There were grading periods where they could not cover the topics. They explained,

> *The usual reason why there are some topics which we could not cover is time constraints. In our school, the teachers are the ones who transfer to the different grade levels depending on their subject expertise. There are some grading periods which are too short for the number of lessons…That is why the latter lessons are usually the ones not covered. [Teacher 6]*

> *There are some grading periods in which I could not cover all the lessons. For example, there are a lot of topics in [Grade 9] Physics. For two weeks, I only focus on projectile motion…Because of problem solving, the pacing of the lesson is slow. Sometimes, I have to repeat the lesson. [Teacher 10]*

These statements from Teachers 6 and 10 showed that there was a mismatch in the length of the grading period and the number of lessons. Teacher 10 further highlighted that the students had a hard time with problem solving, which led to the slow pacing of the lesson. Teacher 7 gave another reason why this mismatch occurred. The grading period was cut short due to the Christmas break, but the number of modules was not reduced, while Teacher 19 blamed the sudden suspension of classes.

> *Usually in the third grading period, during the [Grade 9] Physics part, there are six modules. The period is cut short because of Christmas break. So, there are some lessons which will not be covered. [Teacher 7]*

> *For the last school year, I taught Science 7. In that class, I wasn't able to cover all the topics under Physics (the last unit in the DepEd curriculum) because there had been delays in the lessons, which I think was mainly caused by the number of class suspensions. In addition to this, like what I have said earlier, I wasn't also able to follow my calendar because I make sure my students have already understood the current lesson before I move to the next. [Teacher 19]*

Other forms of time constraints in the curriculum were expressed by Teachers 2 and 4. They needed to follow the end-of-the-year schedule set by the school. Ancillary tasks, like filling out year-end reports and other paper works, contributed to the constraints of time for classroom instruction. To cover the budget of work, Teachers 2 and 4 resorted to skipping topics or activities, compressing class discussions, or adapting the transmission model of teaching.

> *Usually, we lack time because it is already the cut-off date…We have target dates. So, if the cut-off date is nearing, I lessen the coverage of other topics. Also, when it is almost the end of the school year, when vacation is near, we have a lot of forms to accomplish. During this time, there will be more topics which will not be covered. [Teacher 2]*

> *Because when the school year is almost over, there are a lot of teacher activities. I have difficulty budgeting the lessons because I have to think of how to accomplish the year-end paper works. I have to allot time for the paper works. What I do is to simplify or shorten further the module. For the lessons that were not covered, I provide supplementary reading materials. But since, we need to cover the curriculum, I compress some lessons or simply lecture the lesson. In this way, although this is superficial, I was still able to cover the topics. At least the basics are covered, but the other activities, like experimentation, will be skipped. [Teacher 4]*

The statements under this theme talked about time as a commodity in short supply (Myth of Efficiency). This was brought about by the belief to cover the prescribed content (Myth of Rigor). Furthermore, Teachers 2 and 4 believed that the work program set by the school (Myth of Efficiency) was more important, and in response, resorted

https://doi.org/10.33225/jbse/24.23.931

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to shortcuts and transmission models of teaching. Teacher 4, likewise, believed that providing supplementary materials was equivalent to covering the curriculum (Myth of Efficiency) and assumed the students to read and understand them even though they were not tackled in class. This action was an indication of Teacher 4's belief that knowledge could be simply transferred from the teacher to the student through the supplementary reading materials (Transmission Myth).

Joining Competitions

There is a tradition for the schools to train a select number of students to join competitions. Most teachers had a positive outlook about joining competitions because they believed it developed students' critical thinking skills, competitive skills, time-pressured decision making, camaraderie, motivated the students to learn more, and built confidence. Winning in the contest was seen as a source of pride for the school and one of the ways to evaluate the performance of the student, teacher, or the school as a whole (Teachers 6 and 8).

Of course. Joining competitions can help me evaluate where we are now. I cannot see how my students are good if we do not compete outside. So, competitions act as a litmus test for all teachers to see if we are effective compared to other schools. [Teacher 6]

Just for the teacher to know where the students are compared to other students. And also, for the students to know where they stand compared to their peers or to people their age…It serves as a feedback of how you are as a teacher, as a student, and, of course, as an institution. [Teacher 8]

Coaching for the competition is even part of the teachers' individual performance commitment and review form (IPCRF), the teacher's evaluation. However, Teacher 14 expressed bitterness on the teacher's evaluation because being a coach entailed spending her personal resources including personal time. Furthermore, it appeared that coaching had no clear monetary compensation.

The ideal answer is Yes, because it trains the [students'] scientific minds, and semi-practically, Yes, because of the impractical IPCRF…But I am supposed to answer honestly, right? Then my [honest] answer is No, because it consumes so much of my personal time and money. When preparing for competition, I am busy while the other teachers are not…When I have the same teaching and advisory loads as other teachers, then it is totally not fair, in my opinion, to have the same salary. When I have less teaching loads or no advisory assignment, they are busy with their advisory tasks while I am supposed to be relaxed. But in the end, I still receive new [coaching] tasks because I am the one that is "not busy" anymore. [Teacher 14]

Teacher 11 expressed a lukewarm attitude toward competition. She believed that recall type of competitions, like quiz bee, do not develop the students' thinking skills; hence, joining such contests is a low priority for her. However, if the contest was about research, then she would be more likely to have her students participate.

It could be, but it is not my priority. Why? Because, in my experience with competitions, these events are minor. If the questions are all trivia, the students will not develop their scientific skills. Ok, so for the contest, the student might become more familiar with symbols…but so what?...This is too shallow. But if the competition is about research or innovation, then that would be better. But if the contest is in a quiz bee format, for me joining is not that important. Because I know a lot of people who are good with trivia, but what can trivia do, right? Can the student [develop] problem solving skills with the knowledge of trivia? [Quiz bee] does not have much impact. The students may be able to memorise a lot of facts, but for what purpose? So, for me, it is nonsense to join quiz bee type of competitions. [Teacher 11]

Furthermore, a requirement for a student to be able to join the contests was that they should be intelligent. Teacher 8 stated that students should be innately intelligent, whereas Teacher 12 cautioned against letting low achieving students join competitions on the belief that this might be detrimental for their well-being.

In the six years I have been coaching for competitions, I do not teach for the competitions. Students [should be] innately intelligent. Then you pull them out [of their class] and train them. [Teacher 8]

https://doi.org/10.33225/jbse/24.23.931

ISSN 1648–3898 /Print/
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Ahhmmm…for some students, I think…if they can. Because if the student has low achievement, and if you expose them to contest, I think they would feel more…degraded. [Teacher 12]

The belief in maintaining the school's high standards (Myth of Rigor) was revealed in the statements of Teachers 6, 8, and 12. Teachers 6 and 8 believed that joining competitions was a way to evaluate the students by comparing them with other students, to determine the effectiveness of the teaching strategy, and, as a whole, to infer the standards of the school. Teachers 8 and 12 used the competitions as a way of identifying the high- and low-achieving students. Teacher 14's case was different because the evaluation program of the school compelled her to take on the task of coaching. Nonetheless, the teachers' evaluation was an indication of the school's belief that the work program is in control of science teaching (Myth of Efficiency). On the other hand, Teacher 11 was an antithesis to the Transmission Myth. She emphasised that memorisation was not the way to maintain the high standards of the school, but to keep the students engaged in activities that target the higher order thinking skills that could be achieved through research and innovation.

Mastering Scientific Concepts

There are two views regarding concept mastery. One side viewed it in high regard because learning the concepts was seen as a key to learning and relearning the skills. Teacher 11 had this to say,

Mastery of scientific concepts is very important. The skills can be learned by the students, but learning the concepts is like the heart. If you know the big picture, even if you forgot the skills, you can relearn them because you have the concept…I could compare it with the heart of science teaching. [Teacher 11]

There were also teachers who preferred the development of scientific attitudes, values, and skills since mastery of the higher order thinking skills was viewed as developing students who could survive on their own. This is exemplified by Teacher 13.

Mastery, for me, is more than memorisation of the concepts. It is being able to tackle … higher order thinking skills. I believe that the mastery of scientific concepts is pretty important in achieving the curricular goal; but not necessary… I like to see myself as a humanistic and constructivist teacher who takes importance on values formation and creation of meaning through science. With this philosophy, the mastery of all science concepts is not the objective of the implemented curriculum. What matters most is what I would try to impart on them that shall affect their lives furthermore. I would like to teach more on the skill and the attitude towards the subject, since it means I am teaching the students how to fish for themselves, and master other scientific concepts by themselves. [Teacher 13]

Students' mastery of scientific concepts was also used as a measure of the effectiveness of the teacher (Teacher 4) and was even included in their evaluation (Teacher 10).

Yes, we are assessed based on the mastery level [of our students]. Our percentage of mastery should be high…That is included in the reports. It's like this, we are evaluated…So let's say that this school year, the school targets 5% increase in mastery…Let's say last year the students' mastery is only 60%, this year, it should be 65%. The teacher and the school are evaluated in terms of the acquired [mastery]. That is why mastery is so important. [Teacher 4]

Yes, mastery is so important because if they cannot master [the current concepts], what will they do in the next grade level? Because our curriculum is spiral, right? So, if they do not have a solid foundation, the basic topics, then when they move to the next grade level, but they have not mastered [the basics], so at the end, in every grade level, the teacher will keep on reviewing the past topics. This is one of the dilemmas…one of the reasons why we cannot cover the whole curriculum. Because the teacher spent more time on reviewing the past concepts, we cannot cover the intended topics for our grade level…In the first place, we, the teachers, are assessed. [Our performance] is evaluated through the IPCRF. Mastery is a key indicator in the teachers' assessment. That is why mastery is very important. [Teacher 10]

https://doi.org/10.33225/jbse/24.23.931

ISSN 1648–3898 /Print/
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The statements of Teachers 11 and 13 might initially appear as mere expressions of preference; however, they were manifestations of the Transmission Myth. Scientific concepts were viewed as objects separate from the skills associated with scientific thinking, and vice-versa. The statements of Teachers 4 and 10 echoed close to the statement of Teacher 11 but were indications of the belief of maintaining the high standards of science teaching through teacher's evaluation (Myth of Rigor). Teacher 10 might have described that some students were being promoted to the next grade level without being able to master the concepts of the present grade level. This might be an antithesis of the belief of maintaining the high standards of science teaching (Myth of Rigor) but was a clear demonstration of the belief that science teaching is for the promotion of the students to the next grade level (Myth of Rigor).

Assessing Teaching and Learning

Teacher 10 described that one of the ways to measure students' mastery was through a long test that was given by the Division Office (DO). Teacher 10 claimed that even the lessons that were not discussed in class were included in the test, and that there was a misalignment between the division test and the lessons discussed.

> *There are topics not discussed in class but are included in the division test…It's like this, there are people in the DO who are assigned to create the test items. The test items are based on whatever budget of work was submitted…This is frustrating because when the students fail, it is because there are test items which we were not able to discuss in class…Based on personal observation, the people from the DO made the exam without checking if [the items] are part of the module given by the DepEd…because if the exam is matched with the contents of the module, I think the students will be able to answer them. It will be easy for the students…What is more frustrating is that there are some basic topics in Physics which were not included but are essential in problem solving, like significant figures and scientific notation. [Teacher 10]*

There were more assessment tools available. Teacher 12 stated that these tools were somehow overwhelming.

> *Actually, the [assessment tools] given by DepEd are too broad. There are a lot of things to do in terms of assessment. [DepEd] wants to assess a lot of things to the point that we no longer have time. There are a lot of outputs. Then you have to score them. Then there are also exams. [Teacher 12]*

Yet, amidst the availability of these assessment tools, Teacher 7 found it difficult to implement formative assessments.

> *Because that is the problem with the curriculum. Frequent quizzes are no longer required. Assessment is more on output- or performance-based. So, we could only cross check the learning of the students from time to time when there is a long test, which is under Written Works. [Teacher 7]*

The Myth of Rigor was demonstrated in the statements. Teacher 10 revealed the belief of the education system that an external agency (i.e., DO) had the prerogative of maintaining the high standard of science teaching implemented through the DO-made long test. Teacher 12 also described the prerogative of the DepEd to require the different forms of assessments. Teacher 7's account, on the other hand, was antithesis to the Myth of Rigor because of his difficulty in implementing formative assessments. On the other hand, his preference for written quizzes might be an indication of the belief that scientific concepts are objects that could exist separately from scientific thinking processes (Transmission Myth).

Length of Teaching Experience

The teachers were grouped according to the length of their teaching experience: *novice* (1–3 years), *experienced* (4–10 years), and *senior* (≥ 11 years). Table 5 shows a significant difference between the experienced teachers with both the novice and the senior teachers. In both cases, the experienced teachers had higher mean scores indicating less traditional beliefs. Being an experienced teacher has moderate and positive effects (experienced-novice, $d_s = 0.747$; experienced-senior, $d_s = 0.601$). There was no significant difference between novice and senior teachers.

https://doi.org/10.33225/jbse/24.23.931

ISSN 1648–3898 /Print/
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Table 5
One-way ANOVA on PGST Mean Score and Length of Teaching Experience

Teaching Experience	*M*	*p*	Effect Size
Experienced	2.28	.018*	0.747
Novice	1.80		
Experienced	2.28	.008*	0.601
Senior	1.88		

*Note: Novice (1–3 years), Experienced (4–10 years), Senior (≥ 11 years), *p<.05*

Daily Average Classroom Teaching Hours

The teachers were grouped according to their average hours (h_{ave}) of actual classroom teaching per day: more than four hours ($h_{ave} > 4$), and equal or less than four hours ($h_{ave} \leq 4$). Table 6 shows a significant difference in the PGST mean score. Teachers with $h_{ave} > 4$ of actual classroom teaching per day showed lower mean scores, indicating more traditional beliefs. Teaching more than four hours every day had a high and negative effect ($d_s = -0.867$).

Table 6
Independent Samples t-test on PG Mean Score and Average Hours of Actual Classroom Teaching Per Day

Teaching Hours	*df*	*M*	*SD*	*p*	Effect Size
$h_{ave} > 4$	99	1.91	0.591	<.001*	-0.867
$h_{ave} \leq 4$		2.45	0.657		

**p<.05*

Correlation Between Teachers' Beliefs on the PGST and SCI

Pearson's correlation coefficient was determined between the PGST Scale mean score and the number of identified curriculum intentions in the SCI Checklist. The correlation was small, negative but significant ($r = -.318$, $p = .001$). Teachers who were able to identify more SCI had more traditional beliefs.

Discussion

The teachers' beliefs on the PGST as a sub-domain of STO were described in the current research through the teacher question: *Why do I teach science the way I do?* This question was answered using a scale developed from statements expressing PGST from literature, the science curriculum intentions, and semi-structured interviews.

The internal structure of the PGST Scale (Table 3) shows that the teachers' beliefs on the PGST can be categorised under Use of Scientific Knowledge (USK), Use of Scientific Method (USM), Acquisition of Scientific Knowledge (ASK), and Promotion of Students (PoS). The 11 items which were retained after the reliability analysis can be directly linked to the cultural myths (Tobin & McRobbie, 1996). The PGST Scale mean score showed that teachers "Agree" with these statements, hence revealed their traditional beliefs (see Figure 1). The results of the interviews were also consistent with this finding. Cultural myths were abundant in the teachers' responses. However, there were instances where teachers demonstrated constructivist beliefs on the PGST. Their explanations, nonetheless, revealed the circumstances that prevented them from practicing their constructivist beliefs. The current research posits this is the reason for the development of their traditional beliefs.

Most teachers expressed belief on pacing the lesson based on the students' abilities instead of covering the whole curriculum no matter what. However, there was a mismatch between the number of lessons and the length of the grading period. Class suspensions and teachers' year-end ancillary tasks further contributed to this mismatch by taking time away from instruction. Coupled with the need to follow the cut-off dates established by the school, the teachers believed in the use of the transmission models of teaching—including arbitrarily

https://doi.org/10.33225/jbse/24.23.931

ISSN 1648-3898 /Print/
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choosing the lessons to pursue or forego (i.e., to choose the lessons that will most likely come out in college entrance exams). With the intention to cover the curriculum and cope with the time constraints, the ASK and PoS perpetuated the Transmission Myth.

Joining competitions was believed to positively motivate the students, teachers, and the school. The teachers were able to articulate which type of contest could foster students' scientific thinking; hence, they preferred joining research- and innovation-based contests. However, the inclusion of winning in competitions in the teachers' evaluation converted this activity into a means of tagging the high- and the low-achieving students. Winning the contest became the teachers' concern; hence, they opted to select the students that were more likely to win. Teacher 8 and 12's beliefs revealed how competitions pushed low-achieving students further into the sidelines. In addition, Teacher 14's complaints brought to question the teachers' compensation as coach but was required to coach because it was part of the teacher's evaluation. As a result, the USK perpetuated the Myths of Rigor and Efficiency.

Mastering the scientific concepts was also believed as the heart of science teaching. Nonetheless, there were teachers who preferred developing scientific attitude, values, and skills. This preference either for concept mastery or developing of a scientific attitude is an indication of the teachers' belief in the objectivity of scientific knowledge—that it could be attained or discovered by the students independent of their mastery of scientific processes. In direct disagreement to the constructivist perspective that knowledge and process are inseparable (Tobin & Tippins, 1993), the USK and USM perpetuated the Transmission Myth.

Furthermore, the statement of Teacher 4 showed that mastery was attached to a numerical value, and this value was part of their evaluation. Teacher 10 confirmed this as a key indicator of the teachers' evaluation. One of the ways students were assessed was through an external exam which, as claimed by Teacher 10, might not be representative of the lessons discussed in the class. Amidst all the overwhelming number of assessments to be done, there was still a lack of formative assessment in the classroom. Thus, the USK, USM, and PoS perpetuated the Myth of Rigor, and indirectly, the Myth on Preparing Students for Examinations.

The instances where teachers expressed constructivist beliefs were overshadowed by the contextual factors that prevented the proper implementation of the science curriculum. This is supported by the negative correlation between the teachers' beliefs on the PGST and the number of identified SCIs. Familiarity with the curriculum did not promote the development of constructivist beliefs on the PGST. As revealed by the qualitative and quantitative data, the teachers might be implementing the SCIs, but they were implementing them through the traditional perspective, perhaps not out of their own volition but by the demand of the education system. As Fazio et al. (2022) posited, repetitive actions influence beliefs. In the case of the participants of the current research, they developed the traditional beliefs on the PGST.

Another interesting result is the effect of the length of teaching experience in the formation of beliefs on the PGST. Table 5 shows that there is an increase of constructivist beliefs on the PGST among teachers after the third year, but it dropped after the tenth year. This observation is similar to Feyzioğlu's (2012) study, where there was a decrease in the number of teachers holding constructivist beliefs on other areas of teachers' beliefs after the tenth year of teaching. Feyzioğlu explained that teachers' beliefs are built during their preservice training, and as the teacher moves farther from the time of his/her preservice training, he/she develops traditional beliefs. The current research partially agrees with this explanation because Feyzioğlu's study lumped the novice and experienced teachers in one category. Buehl and Fives (2009) also agreed that preservice training helped develop teachers' beliefs, but the current research is more inclined to agree with their other propositions—actual teaching experience and participation in a community of teachers—as the sources of constructivist teachers' beliefs on the PGST. The results of the interview showed that the cultural myths might be ubiquitous in all the themes, but there were a number of instances where teachers expressed constructivist beliefs—like avoiding memorisation and preference for research- or innovation-oriented activities (anti-Transmission Myth), joining competitions to motivate the students (anti-Myth of Rigor), and to pace the lessons based on the understandings of the students (anti-Myth of Efficiency). Considering that the first three years is the time of rapid change in a novice teacher's beliefs (Luft & Zhang, 2014), the interactions with the teachers who held these constructivist beliefs might have helped the novice teachers improve their understandings of the constructivist intentions of the science curriculum. Buehl and Fives further claimed that after the third year of teaching, teachers have had deeper collaboration with fellow teachers, more engagement with the students, thus creating meaningful insights out of their experiences. These experiences are integral parts of helping teachers reflect on their beliefs. This supports Shulman's (1987) description of teaching as a "learned profession" (p. 9). On the other hand, the tenth year drop on constructivist beliefs on science teaching may be attributed to the lack of updating

https://doi.org/10.33225/jbse/24.23.931

ISSN 1648–3898 /Print/
ISSN 2538–7138 /Online/

on the recent trends and findings in the science education (Feyzioğlu, 2012). The interviews, in particular the theme on Assessing Teaching and Learning, also provided another probable cause for this—the frustrations of teachers. The senior teachers' frustrations might have led them to cling to their experiences with the traditional curriculum, which could prevent them from learning and developing the constructivist beliefs necessary for the new curriculum (Akin-Sabuncu & Calik, 2023). An example of this is the Myth on Preparing the Students for Examinations. Of all the cultural myths, this was the only one not directly challenged by the constructivist ideas of the teachers during the interviews. This agrees with Tobin and McRobbie's (1996) observation that the belief in examinations is deeply ingrained in the education system.

The length of teaching hours (see Table 6) was also found to be a significant factor for the development of constructivist beliefs on PGST. Less actual classroom teaching hours means more time for the teachers to plan for constructivist strategies. Beck et al. (2000) observed that teachers needed time to plan, meet with other teachers, and reflect on their students' output as part of the task of creating constructivist activities. In the current research, the interviews revealed a recurring complaint on time constraints (Myth of Rigor). Coaching assignments and year-end ancillary tasks took time from the teachers. Without the needed time, teachers no longer have time to reflect, which more likely leads them to implement what is easiest to do based on "impulse or intuition" (Pajares, 1992, p. 312). This is exacerbated by the need to cover the whole curriculum due to the external exam (Myth of Preparing Students for Examinations) used to measure the students' mastery of concepts, which in turn was a key indicator in the teachers' evaluation (Myths of Rigor and Efficiency). To meet the requirements, teachers resorted to traditional methods of teaching (Transmission Myth) which the teachers might have experienced as students (Demkanin, 2018) or during the past curriculum.

Conclusions and Implications

This research posits that for the successful implementation of a constructivist science curriculum, the teachers' beliefs on the purposes and goals of science teaching (PGST) must be aligned with constructivism. Hence, this research aims to unpack the secondary school physical science teachers' beliefs on the PGST, check the alignment of their beliefs on the PGST with constructivism, and explore the factors that might have affected the development of their beliefs. As revealed by the quantitative results, the teachers hold traditional beliefs (Figure 1) on the PGST which can be directly linked to the cultural myths. The qualitative results, however, revealed two sides. On one side, the teachers could articulate the basic tenet of constructivism but, on the other side, contextual factors prevented them from practicing the constructivist principles on teaching and learning, thus reinforcing their traditional beliefs on the PGST. These have implications on the support that the teachers need to develop a constructivist beliefs system.

First, the moderate but positive effect of being an experienced teacher (Table 6) implies that experienced teachers should mentor the novice teachers as they develop their personal philosophy in teaching and learning through practice. The senior teachers also need support as they navigate the new curriculum, which will hopefully overcome career burnout. For school administrators, this may imply inclusion, if not prioritisation, of novice and senior teachers in teacher professional development programs.

Second, the negative but significant correlation between the teachers' beliefs and the number of identified curriculum intentions questions the perspective from which the teachers implement the curriculum. This calls for teachers' active engagement in reflective activities with their peers, or participation in professional development programs that centre on reflecting whether their beliefs and practices are still aligned with constructivism. Needless to say, this urges for a school-based discussion on the meaning and implementation of constructivism as a learner-centred philosophy on teaching and learning.

Third, the strong and negative effect of teaching for more than four hours per day (Table 5) and the often-repeated complaints on time constraints imply consideration for the teachers' tasks other than teaching. More than checking students' outputs, the teachers' *free time* is also utilised to analyse the results of the activities or the events of the classroom encounters. In doing so, the teachers may be able to design constructivist lessons or to tailor fit their instructional materials to their students. In addition, the teachers' time may also be spent for students' individual consultations, meeting with parents and other stake holders, peer mentoring, and the teacher professional development programs described above. Hence, the school administration may need to consider all these out-of-classroom tasks when planning for the teachers' load and the support that the teachers need.

https://doi.org/10.33225/jbse/24.23.931

ISSN 1648–3898 /Print/
ISSN 2538–7138 /Online/

In the time of curriculum change, it is essential to model students' thinking; that is why the presence of the cultural myths in the beliefs system of the teachers curtails the learning of the students and prevents this group of physical science teachers from implementing successfully the constructivist curriculum. The physical science teachers' agreement with the cultural myths might explain the low results of the Philippines in the PISA 2022. On a wider scope, addressing the oppressive cultural myths in the physical science education needs a whole system approach. To perform well in a constructivist curriculum, students are given the time to reflect on their learning. The same consideration should also be afforded to the teachers. They should also be given time to reflect on their teaching. Lastly, *safe space* is the catchphrase used to assure the students to freely explore their ideas. It is also time to implement this catchphrase to become a lived experience for teachers so that they can freely identify and address the niches of their practice.

Declaration of Interest

The authors declare no competing interest.

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ISSN 1648–3898 /Print/
ISSN 2538–7138 /Online/

Received: *August 22, 2024* Revised: *September 06, 2024* Accepted: *September 24, 2024*

Cite as: Sanchez, R. L., & Monterola, S. L. C. (2024). Secondary school physical science teachers' beliefs on the purposes and goals of science teaching: The presence of cultural myths. *Journal of Baltic Science Education*, *23*(5), 931–949. https://doi.org/10.33225/jbse/24.23.931

Ramon L. Sanchez III
(Corresponding author)
Master of Arts in Education (Physics Education)
Assistant Professor, College of Education
University of the Philippines, Diliman, Quezon City 1101, Metro Manila, Philippines
E-mail: rlsanchez1@up.edu.ph
ORCID: https://orcid.org/0009-0000-6375-8992

Sheryl Lyn C. Monterola
Doctor of Philosophy in Education (Physics Education)
Professor, College of Education
Director, National Institute for Science and Mathematics Education Development
University of the Philippines, Diliman, Quezon City 1101, Metro Manila, Philippines
E-mail: scmonterola@up.edu.ph
ORCID: https://orcid.org/0000-0002-7979-4522