Transitions and transformations in Philippine physics education curriculum: A case research

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Curriculum, curricular transition and reform define transformational outcome-based education (OBE) in the Philippine education system. This study explores how alignment may be done with a special physics education program to suit the OBE curricular agenda for pre-service physics education, known as an outcome-based teacher education curriculum (OBTEC). A comparison of the program's intended curriculum and enacted curriculum initiated a retrospective evaluation with purposively selected cases of physics teachers in the country's National Center for Teacher Education (NCTE). Insights in the match between the intended transition curriculum and the teachers' enacted curriculum likewise determined the congruence and gaps in these two curricula deduced from the analysis of the comparison. Accordingly, significant congruence observed in each of the three matched domains (lesson design and implementation, content, and classroom culture), as confirmed by well-satisfied students' communicative behaviour and high student engagement (received curriculum), may prove that the special physics education program transformed into the transition curriculum adheres to the traits of transformational OBTEC. Accordingly, teachers' sustained the match while enacting the transition physics education program that visibly confirmed a successful enacting of transition curriculum. Full assessment can provide an entire landscape of operationalising the transition program, which may lead to refinement of the transition program to produce better curriculum outcomes. These outcomes may deliver a strong human capital to help build and sustain the country's economic growth through knowledge-based means.

Introduction

Knowledge-based society highly influences the country's journey to economic growth and development. A former Philippine president emphasised knowledge-based economic growth when he stated, "The most important wars of the 21st century will be fought no longer on the physical battlefield, but in corporate boardrooms, laboratories, stock exchanges, classrooms, and shop floors" (Asian Development Bank [ADB], 2007; Lane, 2014; Singapore Economic Development Board [EDB], 2016). Thus, this journey to a knowledge-based society requires additional and appropriate skills to meet the growing global and economic developments. As the world moves towards an era of globalisation where knowledge foundation is inevitably the country's passport to economic growth and development, new learning outcomes may be needed to keep abreast of these developments, which call for quality learning and education to provide the country with good manpower and human capital (ADB, 2007; Blankley & Booyens, 2010; EDB, 2016; Knowledge Economy Indicators, 2008; Lane, 2014).

Most first-world countries adhere to the concept that STEM-driven human capital and resource (National Governors Association [NGA], 2011; Donovan, Mateos, Osborne & Bisaccio, 2014; Sahin, 2015) pushes their economies to a technology-driven state and sustainable growth of resources such as economy-driven biodiversity and ecosystem restoration, enhanced biocapacity and functionality (Donovan, Mateos, Osborne & Bisaccio, 2014); and STEM-triggered research and innovations for improved and probably increased production of goods. In the Philippines, STEM education could influence the journey of Filipinos' quality of life, which will eventually establish higher economic growth for the country. Thus, quality on this aspect may enable the country to achieve its knowledge-based economic goals.

Quality STEM education may be fostered as a multi-level endeavour involving the institutional, program, and individual levels. Henard and Roseveare (2012) emphasised that quality teaching at the program level ensures improvement in institutional quality outcomes, which most higher education institutions seek in many countries including the Philippines. In fact, Philippine universities are directed by the Philippine Commission on Higher Education (CHED, 2014) through its Commission Memorandum Order No. 46 (CHED, 2012), promoting outcomes-based education and typology-based quality assurance, to define their curricular programs through their expected program outcomes to pronounce how they will contribute to building quality workforce. This demand is instituted in the mandates of *Philippine Qualifications Framework* (PQF, 2012) that defines how each Philippine agency should contribute to building a quality nation with respect to human development, productivity, and global competitiveness.

In detail, CHED's efforts to promote outcome-based education (OBE) included competency-based learning standards (CHED, 2014). Pursuant to this program, the Philippine NCTE initiated *outcome-based teaching and learning* (OBTL), which starts with clearly stating the outcomes of teaching, learners' tasks, and standards. In a report, *Manila Bulletin* (2014) described how the premier teacher-training institution of the country pioneered the *outcome-based teacher education curriculum* (OBTEC) by introducing the concept of envisioning innovative, humane teachers, competent educational leaders, and proficient research scholars. However, transforming curricular programs to OBTEC may require several phases. The transformational process may commence with clearly identified curricular gaps, through comparison of the curricular content in terms of the intended and enacted curriculum. Congruence and gaps identified in this evaluation process defined valuable inputs of the curricular alignment to OBTEC to craft the transition physics education program and attain its avowed goal of producing exemplary teacher education graduates.

Thus, this study focuses on curricular content evaluation of a special physics education curriculum (Bachelor of Science in Physics for Teachers), transformed into the transition program. Analysis of the intended and enacted curriculum determines the curricular congruence and gaps and traces the program alignment, transition, and transformations in the OBTEC program. This process leads to crafting the transition physics program. Additionally, as a longitudinal effort, this study is particularly necessary for science programs which may provide sufficient manpower to answer the current need to fill in about 28,000 science teaching posts and uplift the country's human resource index (Malipot, 2015).

Purpose of the research

Primarily, this study seeks to provide evaluation of the physics education curriculum through cases of graduates of the program holding teaching positions at the University. Specifically, the study attempts to shed light on these objectives:

1. Determine to what extent the *intended curriculum* matches the *enacted curriculum.*
2. Identify probable congruence and gaps between the intended and the lived teaching experiences, which served as bases for aligning the enacted and intended curriculum to OBTEC.
3. Describe the transitions and transformations that have been implemented in the special physics education curriculum to align with OBTEC.

Literature review

As defined by Davis (2003) an *outcome* is a culminating demonstration of learning or what the student should be able to do at the end of the course. Outcome-based education is an approach to education in which decisions about the curriculum are driven by the exit learning outcomes that the student should display at the end of the course. It is a result-oriented thinking where the product defines the process (Butler, 2004). Tracing back, Spady (1994) noted that reform advocacies can be written with traditional, transitional or transformational goals. He even asserted that transformational OBE is the "highest evaluation of the OBE concepts where central to the idea of transformational reform is the notion of outcomes of significance." Furthermore, he averred that transformational outcomes are future-oriented, based on descriptions of future conditions that he felt should serve as starting points for OBE design.

Transformational outcome-based education

The works of famous pioneers (Brady, 1995; Oliver, 2001; Hejazi, 2011; Spady & Marshall, 1994; Spady, 1994) showed that OBE design comes in three forms: traditional, transitional, and transformational. Though all these forms seek to obtain "outcomes," there are basic differences in the perceived educative process. It turns out that transformational OBE, as Oliver (2001) argued, focuses on the idea that the learner and the curriculum should integrate totally with a view to giving meaning to the latter. Transformational OBE underscores a strong humanistic and social adaptation, as well as a high level of involvement by both the teacher and the learner (Akhmadeeva, Hindy & Sparrey, 2013; Hejazi, 2011; Hughes, 2013*).* Accordingly, the learning outcomes include knowledge, skills, and attitudes that citizens need to function as critical citizens (Kaliannan & Chandran, 2012; Spady, 1994; Tshai, Ho, Yap & Ng, 2014). In order to do so, this design permits schools to select any content and use a wide range of teaching methods to develop citizens who display the envisioned outcomes including life-role responsibilities.

Retrospective evaluation of the curricular program through teachers' beliefs

A necessary paradigm shift may influence the designs of curricular programs in OBE context. Accordingly, retrospective evaluation may be a way to identify congruence and gaps in the curricular programs, which may serve as inputs to a probable curricular shift to accommodate OBE principles. This retrospection may be conducted with participating individuals who are classified as either having some outcome (cases) or lacking it (controls). Kuzborska (2011) presented other ways of retrospective evaluation through the teacher's beliefs, which he reported to have a profound influence on classroom practices (e.g., procedures, goals, and classroom interaction patterns) and tagged as essential for the enhancement of teachers' professional growth for the successful implementation of new curricula. Teachers' beliefs about learning appear to rely on much visible, behavioural evidence rather than on assessment of student meaning-making (Turner, Christensen & Meyer, 2009). Also importantly, Richards et al. (2001) presented that teachers' beliefs form part of the processes of understanding how teachers conceptualise their work, including how they provide new instructional practices (Carney, Brendefur, Thiede, Hughes & Sutton, 2016); deeper constructs of implementation; and how to enact their classrooms for better student achievement and outcomes (Bray, 2011; Gabriele & Joram, 2007; Sherman, 1995; Swan, 2006; Turner, Warzon & Christensen, 2011; Wilkins, 2008).Thus, the success of educational reforms depends heavily on the match between teachers' belief systems and the constructs and contents of the intended curriculum (Handal & Herrington, 2003), for effective implementation. In turn, knowledge about congruence and gaps of the intended and the lived curriculum through teachers' belief system may provide valuable inputs to better curricular reform - outcomes-based education.

Framework for this study

The Philippine CHED's *Typology of Quality Assurance and Outcome-Based Education* (CMO no. 46, s. 2012) spells out competency-based learning standards and outcome-based quality assurance monitoring and evaluation. As the country's premier teacher education institution, the NCTE modelled a three circle schemes representing its programs' educational outcomes. The general outcomes are shown in three broad points: knowledge, attributes, and practices, collectively envisioned to a commitment of producing innovative teachers, educational leaders, and research scholars. These outcomes define the goal of producing teachers who are: 1. discipline grounded; 2. professionally competent; 3. innovative practitioner; 4. reflective specialist; 5. humane, ethical, and moral person; 6. transformative educator; and 7. critical, creative and responsible educational expert. This modelling scheme spurred efforts to align existing programs to the curricular standards dictated by OBTEC, presented in Figure 1.

Varied definitions of curriculum are available in literature. Tracing back, Marsh and Willins (2003) provided several definitions and types. Kabiri and Tabatabaei (2013) defined curriculum as the most important element for formulating educational experiences. Collectively, the definitions provided by literature focus on the totality of the learning experiences of the child, which led Billett (2006) to conceptualise the curricular

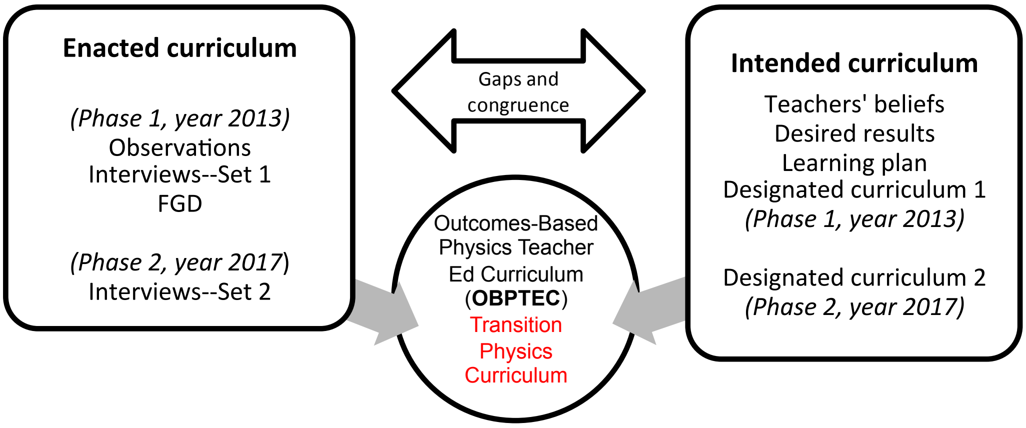

Figure 1: Framework of the study

elements as: the written (intended), enacted, and received curriculum. Apparently, the enacted curriculum (Billett, 2006; Bouck, 2008; Nolet & McLaughlin, 2000) operationalises the intended curriculum and reflects the teachers' decisions and interpretation of the curriculum during implementation. In a broader perspective, the Center for Study of Mathematics Curriculum (CSMC, 2010) delineated the *official curriculum* (designated curriculum, curricular goals, curricular assessment and the teacher intended curriculum) from the *operational curriculum* (the teacher intended, enacted curriculum and received curriculum). Intended curriculum includes interpretation and decisions by the teacher to project and plan for instruction, and is created as the teacher draws on the designated curriculum. Assessment of this curriculum may include the teacher's belief system (Carney, Brendefur, Thiede, Hughes & Sutton, 2016) and artifacts (e.g. lesson plans, instructional materials, course syllabi and session plans). The enacted curriculum (Carney, Brendefur, Thiede, Hughes & Sutton, 2016) refers to the classroom interactions specifically between the teacher and the students, which may be influenced by factors such as teacher and student knowledge, beliefs, practices, access to resources and contextual opportunities.

Thus, this study explored the different teaching artifacts such as course syllabi and session plans to present and describe content; the plan of learning that showcase fusion of several teaching strategies, activities, assessment; and other related factors like beliefs to describe and assess the *intended curriculum*. Probing into the actual teaching practices of the University's physics education faculty qualitatively described the *enacted curriculum* that requires a close look at the pre-service physics teachers' pedagogical competencies as well as their beliefs and attitudes towards physics education and learning. The same process conducted years after the initial exploration (year 2013) provided a longitudinal aspect of the retrospective analysis. Extracted congruence and gaps between the intended and the enacted curriculum served as inputs to aligning the physics education curriculum to the curricular reform in transformational OBTEC, to craft the transitional physics education curriculum. The alignment of the physics education curriculum to OBTEC defines the transition process of the curriculum to transformational OBTEC. This newly defined

OBTEC physics education curriculum spells outs the transformation in the Philippine physics education curriculum.

Method

This longitudinal research utilised a descriptive-analytical design (quantitative and qualitative approaches in data collection and analysis) to come up with answers to the research problems presented. Table 1 presents the summary of the entire process of study.

Table 1: Summary

Focus of the study	Participants	Data collection/instruments	Data analysis
Intended curriculum	• 5 scholar graduates with teaching post at the premier teaching institution.	• Content analysis of: - Designated curriculum 1 (physics curriculum used until year 2012-2013) - Designated curriculum 2 (physics curriculum from year 2013 onwards) - Course syllabi - Session plans - Instructional materials • Interview for beliefs on strategies, pedagogy, assessment	• Content and document analysis. • Transcriptions and coding.
Enacted curriculum	• 5 scholar graduates with teaching post at the premier teaching institution. • 10 teachers teaching in designated curriculum 2 (phase 2, year 2017).	• Classroom observation - phase 1, year 2013 (Class observation protocol) • Interview 1 (Interview guide 1, phase 1, year 2013) • Interview 2 (Interview guide 2, phase 2, year 2017)	• Free-listing • Pile-sorting • Categorising • Transcriptions • Coding

Participants

The study involved physics and professional education teachers of the Bachelor of Science in Physics for Teachers (BSPT) program. A total of five purposely selected faculty members (three females and two males) from the University comprised the participants of the first phase of the study (June to October, 2013), three of whom are graduates of the aforementioned program. Primarily, the participants' engagement as subject teachers in the special physics program qualified them to be the participants in the study.

In the second phase (January to April, 2017) of the investigation conducted three years after the initial phase (June to October, 2013), three of the five aforementioned participants were still able to join this phase. Two others had transferred to new workplaces and are not available for further interviews. Additionally, seven other teachers (new recruits and science teachers teaching for the transition physics education curriculum) participated in the second phase of the study.

Instruments

Classroom observation protocols
The researcher utilised the *Reformed Teacher Observation Protocol* (RTOP) (DRSC, 2011). The protocol (alpha = 0.954) uses a Likert style rating scheme, including a capsule description of the quality of the lesson based on the following categories: (1) lesson design and implementation; (2) content (propositional and procedural knowledge); and (3) classroom culture (communicative and student-teacher relationships).

Interview protocols
These protocols are a set of questions used to infer from the teacher-participants their teaching beliefs and practices. The first protocol (Appendix A) focused on probing details of the special physics education program (Bachelor of Science in Physics for Teachers, year 2013). The second protocol (Appendix A) emphasised exploring details on the changes instituted in the original program to align to the OBTEC program (year 2017).

Data collection and analysis

Data collection for this study started in year 2013 with the last group of enrollees for the special program. The research sourced all relevant data and vital information on the *intended curriculum* from available documents such as designated curriculum, course syllabi, session plans, instructional materials; and an interview on beliefs on strategies, pedagogy, and assessment. Consequently, the second phase (year 2017) of document analysis commenced with the curricular alignment of the said program, which started in the same year and became fully implemented in its third year (year 2017).

The researcher deduced all pertinent data on the enacted curriculum for the special program (BSPT) through class observations focused on lesson design and implementation, content, and classroom culture. Observations lasted for eight weeks (June-July, year 2013). The information extracted for the enacted curriculum of the special physics education program and mapped with the vital data on the intended curriculum identified the gaps and congruence of the special program which served as inputs to curricular alignment in the OBTEC program. Validation interviews (phase 2, year 2017) conducted with 10 teachers in the newly aligned curriculum provided information on lesson design and implementation, content, and classroom culture.

The researcher also conducted random classroom observations upon the teacher-participants who taught courses in the special physics education curriculum in the first phase (year 2013) of data collection. A total of 56 observations for the first phase (year 2013) defined the enacted curriculum of the special physics education program.

Table 2: Observation data (first phase, year 2013; names are pseudonyms)

Participants	No. of physics classes in the Special Physics Program	Contact hours	Number of observations
Juan	2	96	16
Ally	1*	48	8
Chriz	1*	48	8
Jose	1	24	8
Jazzy	2	48	16
Total			56

* with laboratory credit unit

Interviews and focus group discussions conducted after the eight-week period verified and confirmed recorded observations. All conducted interviews and focus groups lasted for 1.5 to 2 hours. Audio recording of these interviews and focus groups helped in the accurate transcription and analysis of data. Another set of validation interviews conducted with 10 teacher-participants who were teaching courses in the transition physics education curriculum (year 2017) provided significant data and information on the major changes instituted in the special physics education program to align to the OBTEC program. Vital information on teachers' belief systems that influence how they envision operationalising the intended curriculum and classroom interactions specifically between the teacher and the students, which may be influenced by factors such as teacher and student knowledge, beliefs, practices, access to resources, and contextual opportunities, defined the enacted curriculum of the transition physics education program. Significant information in both the intended and enacted curriculum in the initial special physics education program (year 2013) and the transition physics education program (year 2017) provided valuable insights on the transition of the program to transformational OBTEC.

Data analysis included document analysis and mapping; coding and transcriptions; frequency count on each of lesson design and implementation, content, and classroom culture; and transcriptions of class observations and interviews. These transcripts were coded to extract the participants' beliefs and detect congruence and gaps in the intended and enacted curriculum, and transitions (program alignment to OBTEC) and transformations (change instituted in the special physics education program) of the aforementioned special program to the transition physics education program (OBTEC aligned curriculum).

Results and discussion

The research has three primary goals: 1. match the intended and enacted curriculum of the special program and the transition program; 2. distinguish congruence and gaps between the intended and enacted curriculum as reflected in the teaching artifacts, teachers' beliefs, and practices; and 3. describe the transition and transformations of the special physics education program to a newly OBTEC aligned program (transition physics education program).

Intended curriculum

Philippine teacher education curricula are intended to develop quality teachers to implement quality learning suited to the intended basic education (junior and senior high school curricula). Thus, the premier teaching institution of the country, labelled as the NCTE, is mandated by the state to offer teacher education curriculum geared towards developing Filipino educators for academic excellence, leadership in teacher education, and research scholarship. In order to achieve this goal, all academic activities must emphasise the development of content expertise and pedagogical skills required of a pre-service student. Table 3 compares the inclusion of state mandated physics education program for other teacher education institutions, the NCTE's special physics education program, and the OBTEC aligned physics program.

Table 3: Comparing the number of credit units of the state prescribed program, the special physics education program, and the OBTEC aligned program

Component	State prescribed for other teacher ed institutions (Phase 1, 2013)	Bachelor of Science in Physics for Teachers (Phase 1, 2013)	OBTEC-aligned Physics Education Program (Transition program) (Phase 2, 2017)
Foundational general education	76 (39.6%)	69 (35.8%)	36 (17.9%)
Professional education	51(26.6%)	33 (17.1%)	36 (17.9%)
Field Study			12 (6.0%)
Subject matter knowledge	65 (33.8%)	79 (40.9%)	87 (43.3%)
Pedagogical content knowledge (PCK)			24 (11.9%)
Foreign language			6 (3.0%)
National Service Training Program and Personal Development		12 (6.2%)	
Total	192	193	201

The special program has 193 credit-units equivalent to 65 courses and is almost basically equivalent to the state prescribed teacher education curriculum with 192 credit units. Relatively, the special program transitioned to a 201-credit unit with special curricular components: a 12-unit Field Study, 24-unit Pedagogical Content Knowledge (PCK), and 6-unit foreign language. The Field Study component underscores the pre-service teacher training in the intended work environment of the future physics teachers. Additionally, these new components provided in the new curriculum an avenue for teachers to blend the content (foundational general and subject matter) and pedagogy (PCK and Field Study) to grasp an understanding of how topics in physics, problems or issues may be organised, presented, represented, and adapted to diverse learners' interests and abilities (Koehler & Mishra, 2009; Shulman, 1997). Furthermore, the transition physics education program provides an aspect of internationalisation through the foreign language component. The subject matter content courses also transitioned from purely physics courses to an increased number of related science courses from which the future physics teachers will source context in teaching physics. The level and intensity of physics courses in the initial program (year 2013) is comparably equivalent to that of the transition program (year 2017), however, the latter placed more emphasis on contextualising the subject matter content parallel to the curriculum (K to 12 Science) of the work environment for these prospective physics teachers (e.g. teaching inertia using disaster preparedness and concepts of earthquakes, and teaching potential energy using the concept of plate tectonics).

Additionally, the framework of the transition curriculum, which is highly influenced by the science teacher education framework (Science Education Institute [SEI] and University of the Philippines National Institute of Science and Mathematics Education [UPNISMED], 2011) and K to 12 framework of the basic education (*K to 12 Curriculum Guide*, 2016), aims to develop an empowered science and technology teacher who will be able to holistically develop scientific, environmentally, and technologically literate citizens of the country (*K to 12 Curriculum Guide*, 2016) to meet the necessary demands of the country for better science and technology human capital. Accordingly, the learning goals and assessment schemes (Appendix B) spelt out in the course syllabus of the different courses, direct the training of the pre-service physics teachers to help them acquire the essence of the course (Erickson & Strommer, 2005) and to achieve the curricular goals. As decoded from available documents (e.g. syllabus), varied teaching and learning strategies dominate the envisioned teaching and learning process in the different courses of the special physics curriculum (year 2013) and the transition physics education program (year 2017). However, the major difference lays in the recipient basic education curriculum (K to 12 Science) to which the outcomes of the previously cited pre-service programs (physics teachers) will serve. The former caters to a competency-based basic education curriculum, while the latter serves the new K to 12 curriculum. Apparently, both pre-service physics education programs strive to provide a holistic development of physics teachers to address the needs of the recipient basic education program. However, necessary alignments in content, pedagogy, and assessment aspects are clearly stipulated to address the curricular demands of the shift from the competency-based curriculum to K to 12 program (junior high school science curriculum), which requires an inquiry-based learning paradigm, highlighting a spiral progression and interdisciplinary visions of the core science concepts. These steps to alignment (transition) provided more room for courses that will better prepare the teachers to teach in this K to 12 curriculum. In fact, teachers in the transition curriculum believed that the transition program appreciates the paradigm of K to 12 curriculum as expressed in their responses in the interview (names are pseudonyms):

> Jany: The transition curriculum subjects bridge the gap between the competency-based curriculum and the K to 12 curriculum in the basic education.
>
> Rey: One feature of the transition curriculum is the inclusion of the summer internship program, a 3-unit course to provide pre-service students with an experience on instrumentation, pedagogy, assessment and other aspects of the curriculum through apprenticeship program.
>
> Jazzy: The transition curriculum mimics the spiraling progression of science topics in the K to 12 curriculum.
>
> Chriz: The transition curriculum emphasises blended learning with 12 weeks of face to face sessions and 6 weeks of flexible delivery mode.

Syllabi in both curricula (special program and transition curriculum) exemplify wide ranges of pedagogical approaches and assessment schemes, from the traditional scheme (interactive lecture-discussion and paper and pencil tests) to interdisciplinary, collaborative, and project-based approaches, output-based assessments and collaborative testing (see Appendix A). In fact, teachers believed that these arrays of strategies provide meaningful learning experiences to pre-service physics teachers. Hence, leading to developing outcomes required to revolutionise the Philippine's campaign for scientifically, environmentally, and technologically literate citizens through quality science teaching contributory to the envisioned STEM-driven human capital (Knowledge Economy Indicators, 2008; Lane, 2014; National Governors Association [NGA], 2011; Donovan, Mateos, Osborne & Bisaccio, 2014; Sahin, 2015) for the country's economic growth.

Enacted curriculum

Lesson design and implementation

Predominantly, this section presents the transition situations of lesson designs and implementations conducted by the participants, as physics teachers of the aforementioned special pre-service physics education program and the transition program. Table 4 presents the frequency of observation (phase 1, 2013) of the different aforementioned constructs.

Table 4: Lesson design and implementation, classroom culture (DRSC, 2011)

Items (class observations = 56)	Frequency of observation					Weighted average
	4	3	2	1	0	
The instructional strategies and activities respected students' prior knowledge and the pre-conceptions inherent therein.	40	16	0	0	0	3.71
The lesson was designed to engage students as members of a learning community.	40	16	0	0	0	3.71
In this lesson, exploration preceded formal presentation.	20	25	10	0	0	3.1
This lesson encouraged students to seek and value alternative modes of investigation/problem solving.	20	22	14	0	0	3.0
The forms and directions of the lesson were often determined by ideas originating with students.	40	16	0	0	0	3.71
Communicative interactions	40	16	0	0	0	3.7
Student-teacher relationship	40	16	0	0	0	3.7

Apparently, most frequently occurring in the participants' classes are efforts to attain a learner-centred paradigm (DeHaan, 2009), e.g. sensitivity to prior knowledge, student engagement, and lessons are directed by ideas originating from students. In fact, the participants claimed and verified the same observations as being conducted and implemented in their respective classes. Chriz (pseudonym) mentioned:

> What I usually do is inquiry-based learning, where meanings and concepts are derived from activities that students perform. There are guide questions that extract students' concepts which are even applied to everyday life.

However, most observed classes show an intermediate student content exploration and no formal discussion of content prior to student exploration, which may be attributed to the students' inclination to guided inquiry, claimed to the match the young learners (Hakkarainen, 2003; Moscovici, 2003; Song & Looi, 2012) rather than open inquiry (Colburn, 2000), which is often equated to more mature learners. The same trend existed in the transition physics education program. The participants claimed to provide more guided inquiry learning in their lesson implementation, for example the following responses (names are pseudonyms):

> Chriz: I lecture less and provide more activities for my students.
> Leigh: I really plan and prepare for an interdisciplinary lesson.
> Ben: In this transition curriculum I make sure to maximise the use of technology.
> Jazzy: I don't skip from asking my students to reflect on the things they have learned.

Consequently, communicative interactions among students occurred most in aspects of the climate of respect in the classroom, flourishing communications, and sharing of information generated from divergent thinking initiated through teacher-triggered questions. Significant student talk occurred between and among them using more than one mode (online or social media, face to face, paper). Ben and Rey (pseudonyms) confirmed these observations in their responses:

> Ben: Students tend to provide a lot of ideas when you start to ask them why's and how's, rather convergent questions.
> Rey: I often focus on higher order thinking skills questions as diagnostic activity with my students.

It may be inferred that significant student interactions and communicative interactions dominated the participants' classes (both lecture and laboratory), from which attained a high student engagement (Shahrill, 2013; Critelli & Tritapoe, 2010) and a learner-centred approach (Brown, 2008; DeHaan, 2009; Weimer, 2012). As observed, the participants spent the first 30 minutes with knowledge, comprehension and analysis questions, while application, synthesis, analysis, and evaluation questions dominated the next 30-90 minutes of their lessons, which may be inferred to promote high student engagement in their classes.

Content and culture

The learner-centred paradigm also considers the content knowledge (phase 1, year 2013) of the participants. Table 5 presents the observed occurrence of these forms of knowledge.

Most of the observed characteristics of propositional knowledge occurring in the participants' classes included coherence of concept understanding, and sound grasp of the concept. These domains consequently provided means for the participants to also exhibit capabilities for using elements of abstraction and interlinking with other concepts and with real life contexts or applications. Accordingly, the participants who deliver

Table 5: Content: Propositional and procedural knowledge (DRSC, 2011)

Knowledge	Items (class observations = 56)	Frequency of occurrence					Weighted average
		4	3	2	1	0	
Propositional knowledge	The lesson involved fundamental concepts of the subject.	40	16	0	0	0	3.7
	The lesson promoted strongly coherent conceptual understanding.	56	0	0	0	0	4.0
	The teacher had a solid grasp of the subject matter content inherent in the lesson.	56	0	0	0	0	4.0
	Elements of abstraction (i.e. symbolic representations, theory building) were used.	56	0	0	0	0	4.0
	Connection with other content discipline and/or real-world phenomena were explored and valued.	56	0	0	0	0	4.0
Procedural knowledge	Students used a variety of means (models, drawings, graphs, concrete materials, etc.) to represent phenomena.	23	23	10	0	0	3.3
	Students were actively engaged in thought-provoking activities that often involve the initial assessment of procedures.	56	0	0	0	0	4.0
	Students were reflective about their learning.	56	0	0	0	0	4.0
	Intellectual sign, constructive criticisms, and the challenging of ideas were valued.	20	25	10	0	0	3.1

propositional knowledge are likely to provide students with new learning and new conceptual frameworks to which they can anchor the new concepts to form holistic (not bits of pieces of) information (Bernardo, 2008; NAGT, 2015; Department of Education and Training [DET], 2005; Zirbel, 2006). Apparently, in the transition program, collaborative teaching and use of technology highlighted the provision for propositional knowledge.

Additionally, most observed cases of procedural knowledge highlighted active engagement of students in thought-provoking activities and student reflection on their learning. Participants confirmed these observations based on their responses, for example:

> Juan: I usually ask lots of higher order thinking skills questions and I also ask them to report some applications of physics.
>
> Ally: I ask them to have reflections, they have portfolio in which they collect all their requirements, which includes not just academic matters but their reflections.

These attributes of the curriculum have not changed in the transition program. In fact, enhancement in student engagement was observed in cases where laboratory equipment and technology were used in their classes. However, models, drawings, and value of criticisms acquired an average count of occurrences. It may be inferred that these attributes of procedural knowledge ranked least in the participants' consideration, due to the influence of several factors such as time, pre-service experiences, inability of students, lack of pre-requisite training, and learning styles of students (Ambrose, 2004; Bishop, Clark, Corrigan & Gunstone, 2006; Hill & Ball, 2004).

Gaps, congruence and transition

In the aforementioned intended and enacted curricula, certain congruence and gaps (see Appendix C) may be identified for valuable insights into curricular reform.

The enacted curriculum manifested skills envisioned by the teachers' intended curriculum as deduced from the designated curricular goals. Proficiency in communicating physics theories and concepts surfaced in their manifested skills, such as respect for students' prior knowledge and their expressed ability to obtain high student engagement and exploration. Accordingly, the Boards of Studies Teaching and Educational Standards (BOSTES, 2015) identified these skills in the enacted curriculum as skills of a proficient teacher underscored in standard 1 (know students and how they learn), which significantly operationalises the designated curriculum. In fact, teachers' capabilities for providing coherence of concept understanding, sound grasp of concepts, use of elements of abstraction, and providing connections of concepts to content and the real-world applications are implications of the teachers' capability to translate the intentions of the different components of the curriculum into realistic outcomes in the paradigm of learner centredness.

These characteristics (Brown, 2008; Weimer, 2012) are also spelt out in transformational outcome-based education (Brandt, 1998; Oliver, 2001). Markedly, the transition physics education program exuded enhanced teacher capabilities (interdisciplinary teaching, spiraling progression, technology-influenced classrooms, collaborative teaching of content, context-based physics content lessons, provisions to influence and develop students' PCK, and time-based lesson delivery) to provide students with the needed skills to face the recipients in the new K to 12 curriculum. Noticeably, students showcased procedural knowledge as their in-class behaviour referred to as received curriculum. This connection may mean that what teachers exhibited in class, proved to be the traits they also envision. Thus, it may be inferred that the interweaving nature of the three curricular components: lesson design and implementation, content, and classroom culture; provided the necessary tools, training and venue for an outstanding received curriculum mediated by the transitioning of teachers (of the special physics education program) from the intended (beliefs and official curriculum) to the enacted (lived) curriculum.

In effect, the intended curriculum, dominated by teacher-prepared course syllabi as influenced by their beliefs system (pedagogy, assessment, and practice) is operationalised in both the communicative interactions and student-teacher relationships. Additionally, the product of this interlink is an interconnected chain of events observed in lesson design and implementation, content, and classroom culture, which may be classified as quality pre-service physics education. Moreover, the transition program provided an avenue for teachers to intertwine the three key areas. The framework of teacher transition from intended to enacted curriculum in the special physics education program is carried over as a culture and teacher belief that highly influenced the intended-to-enacted curriculum shift to transition curriculum. As enhanced by inclusions of other science fields in the transition curriculum, outcomes (physics teachers in the transition program) may better deliver STEM education and produce STEM-influenced, scientifically, technologically, and environmentally literate Filipino citizens.

Conclusion and recommendations

Transition (program alignment to OBTEC) and transformation (curricular changes in special program) dominated the focus of this study. Particularly, the study aimed to describe these transitions and transformations in special physics education program to the OBTEC-aligned curriculum through analysis of the intended and enacted curriculum of both programs.

Content in the intended curriculum of the special program emphasised three constructs: foundational general education, professional education, and subject matter knowledge enacted through a learner-centred paradigm, using guided inquiry approaches where divergent thinking is initiated by teacher-triggered questions (67% higher order thinking skills), resulting in higher student achievement. Teachers' skills developed while enacting the special program, included proficiency in communicating physics concepts, respect for prior knowledge, high student engagement and concepts of exploration, and abilities in connecting concepts to content and real-world applications, which led the teachers to translate their intentions (intended curriculum) to live experiences (enacted curriculum). Comparably, the transition program includes PCK, Field Study and related science courses, enacted in the same way as the special program, with differences such as collaborative teaching, use of technology and tools, use of social media and interdisciplinary and contextual teaching of content.

Significant changes that surfaced in teachers while enacting the intended OBTEC curriculum included technology and tools used in their classes, content and delivery of content, pedagogical strategies used, and student assessment. Specifically, these teachers used smartphones and the social media to aid their classes. Collaborative teaching emphasised interdisciplinary delivery of physics courses, with spiral progression of physics content within the realms of other science contexts (biology, chemistry, earth and space). Authentic and alternative assessments such as problem-based and project-based assessments dominated. These kinds of assessment processes match recipients' assessment experiences in their basic education. The differences in the intended curriculum in this transition program led teachers to transition themselves and develop additional skills, such as interdisciplinary teaching, spiraling progression, technology-influenced classrooms, use of social media, collaborative teaching of content, modelling of PCK, and time-based lesson delivery, to adapt to the these changes (transformation) in the program. Collectively, while program transition and transformations occurred, adaptive changes also transpired that led the teachers to acquire innate values of progressive development to successfully live (enact) the intended curriculum (transition program).

Transitions in the special physics education program in terms of content, underscore the inclusions of new sets of credit units corresponding to new sets of courses, presumed as needed in training a new breed of high school physics teachers who will be immersed in the K to 12 curriculum. This transformation of the content structure of the special physics education program exuded the characteristics of transformational OBE reform which emphasise the "notion of outcomes of significance" (Spady, 1994). Additionally, teachers' enactment of the transition program accentuated the use of varied teaching approaches and assessment styles, highlighting transformational OBE in the form of high levels of involvement of both teachers and students, where both exhibit a strong humanistic and social adaptation (Akhmadeeva, Hindy & Sparrey, 013; Hejazi, 2011; Hughes, 2013).

The teachers' success in enacting the OBTEC-aligned physics education program (transition curriculum) exhibited their capability for developing a culture of adaptive capacity to new situations. Enacting the OBTEC curriculum projected a concrete framework of triangulated intended-enacted-received curriculum, which expresses core values of commitment to develop innovative teachers, researcher scholars, and instructional leaders for the country. These teacher-developed framework and core values showed concretely a successful transition and transformation from the special physics education program to the OBTEC curriculum in terms of knowledge, attributes, and practices that may highly influence success of the K to12 recipient program when graduates from the OBTEC curriculum take the stage as physics teachers. Furthermore, the received curriculum (student engagement) validates the success of transformation and transition of the special physics education program to OBTEC curriculum.

The first batch of graduates of this program (OBTEC physics education) will obtain teaching posts early next year (2018), thus, analysis of the received curriculum is limited to the students' immediate responses to teacher-stimulated activities and questions. Evaluation of the OBTEC curriculum in terms of proficiency of the outcomes may be done as a future research project.

Data collection has concentrated upon document analysis, classroom observations, interviews and focus groups, emphasising data for the intended and enacted curriculum, and has used student engagement only to gauge the received curriculum. Further studies may look into a more detailed representation of the received curriculum through analysis of formative progress and development of students, using both numerical achievements and behavioural changes in students. Subsequent curriculum analysis using the triangulated intended-enacted-received curriculum may be used to provide connections of the pre-service training and in-service training as brought about by the analysis of the recipient (K to 12 curriculum) and the contributor (OBTEC curriculum), to better achieve the curricular goal of providing strong, human STEM-influenced capital for the Philippine knowledge-based economy.

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Appendix A: Interview protocol

First interview protocol

1. How do you describe learning?
2. How does learning occur in the class?
3. What strategies do you normally or usually use in your physics classes?
4. How do you assess our pre-service physics teachers?
5. How would you describe the culture or scenario in your physics classes in the pre-service program (BSPT Program)?
6. What can you say about the curriculum (BSPT Program)?
7. What do you think are the features of the program?

Second interview protocol

1. Do we still have the BSPT curriculum in the OBTEC Program/Framework?
2. If yes, how would you compare the old BSPT curriculum with the new one?
3. If not, then what transformations were instituted in the new curriculum?
4. How would you compare the new and the old BSPT curriculum?
5. What bold changes did you institute in your teaching strategies?
6. What bold changes did you institute in your assessment schemes?
7. How would you describe learning in the new curriculum?
8. How does learning occur in your classes?
9. How would you describe the culture or scenario in your physics classes in the pre-service program?
10. What do you think are the significant features of the new program as compared to the BSPT program?
11. What outcomes do we envision in the new curriculum?

Appendix B: Teaching strategies and assessment schemes in the Special Physics curriculum

Curricular component	Teaching strategies	Assessment schemes	
		Traditional	Alternative/authentic
Foundational general knowledge	Lecture discussion; Use of cooperative learning; Class activity; Class demonstration; Film viewing; Field trip.	*Paper-and-pencil test* • Essay; • Multiple-choice; • Matching type and identification; • True-false test.	Practical tests; Problem/product-based learning; Webquest; Performance-based learning.
Professional education	Reporting; Class discussion; Lecture discussion; Role playing; Symposium; Use of ICT.	*Paper-and-pencil test* • Essay; • Lesson planning; • Observation checklist.	Lesson planning; Portfolio assessment; Peer teaching or demo teaching; Performance-based learning.
Subject matter knowledge - basic physics courses	Lecture discussion; Use of cooperative learning; Class activity; Class demonstration; Film viewing; Field trip; Role playing and simulation; Use of ICT; Collaborative teaching; Debate; Book reviews.	*Paper-and-pencil test* • Essay; • Multiple-choice; • Matching type and identification; • True-false test; • Problem solving.	Practical tests; Graded recitation; Lesson planning; Problem-based learning; Webquest; Performance-based learning; Book review; Making models, simulations, and circuits; Project-based learning; Mini-research project; GRASPS; Collaborative tests.

Appendix C: Comparing the intended and enacted curricula

	Intended	Enacted
Curricular goals and assessment vs. lesson design and implementation	• Primary goal of the curriculum is to develop quality physics teachers (research scholar, content expert and educational leader). • Intertwine three components: foundational general education, subject matter and professional education for the development of appropriately skilled physics teacher. • Inclusion of other curricular components: PCK and foreign language to meet the current demand in K-12 science education in the basic education levels. • Provisions for face to face and flexible learning delivery. • Certificates in junior and senior secondary education.	Evidently observed in the lesson design and implementation: • Respect for students' prior knowledge. • High student engagement and student exploration. • Sourcing of ideas is highly from students rather than the teacher. • Most of the times, teachers provide formal discussion prior to activity. • Frequent accounts of students engaging in alternative modes of investigation and problem solving. • Greater percentage of contact time with students is used for student activities. • More provisions for technology-assisted learning. • Collaborative teaching. • Engagement to more interdisciplinary lessons and student outputs. • Teachers also provide activities that develop students PCK not only in PCK courses but also in content courses.
Designated curriculum and content background vs. content	• The designated curriculum (Special Physics Program) follows the government mandated teacher education curriculum with modifications in the number of credit units in each of the three components to highlight more credit-units to subject matter focus. • The foundation general education knowledge and skills develop skills and enduring understanding to enhance the pre-service students' scientific inquiry, literacy and appreciation of life. • Professional education knowledge for theories and concepts, methods and strategies, field study courses for practice. • Subject matter knowledge provides the content concepts which comes in two sets: general physics and science concepts and advanced physics and science courses. • Advanced physics courses mold pre-service physics students' specific attributes such as creative and critical thinking, problem-solving nature, process-orientedness, logical reasoning, etc.	*Propositional knowledge* • Inclusion of fundamental concepts. • Teachers' coherence of concept understanding. • Teachers' solid grasp of concepts. • Teachers' use of elements of abstraction. • Teachers exhibit concept connections with other content and real-world. • Teachers use collaborative teaching and use of technology for better content delivery. *Procedural knowledge* • Students exhibit varied means to represent a phenomenon. • Students show active engagement in thought provoking activities. • The class manifest reflective thinking. • Criticisms and challenged ideas are valued. • Enhancement in student engagement is observe in cases where laboratory equipment and technology were used in classes.

	• PCK courses in the transition program highlight emphasis on the interrelations of content, pedagogy, technology, assessment in the teaching and learning process providing better framework for pre-service physics teachers.	
Documents and teachers' beliefs on pedagogy, assessment and practices vs. classroom culture	• Course syllabi communicate how teachers intend to implement the courses. • Each of the courses provides a syllabus that spell out the goal of learning, content, delivery of the content assessment of the learned content and skills. • Teachers intend to provide at least four teaching strategies per course and varied assessment styles ranging from the traditional to alternative and authentic assessments. • In the transition program, learning outcomes and expectations are spelt out anchored on the program outcomes. • Teachers plan for interdisciplinary teaching. • Teachers plan for student engagement through more student activities, utilisation of technology, and more student outputs that target developing skills for students to achieve the intended learning outcomes. • Teachers' beliefs that strategies must match the learning styles of the students. • Teachers' belief in using questions to promote active discussion and student interaction.	*Communicative interaction* • Communication in varied forms, means, and mode. • Teachers' questions trigger divergent thinking. • Significant student talk and climate of respect. *Student-teacher relationship* • Teachers value student active engagement. • Teacher support is very evident. • Teacher as listener. • Teachers provide venues and instances for more student engagement through activities. • Teachers provide instances for student hands-on, minds-on and technology-influenced experiences.

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