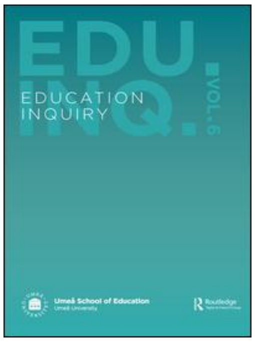

Education Inquiry

ISSN: (Print) 2000-4508 (Online) Journal homepage: http://www.tandfonline.com/loi/zedu20

Teaching and learning physics using technology: Making a case for the affective domain

Yashwantrao Ramma, Ajeevsing Bholoa, Mike Watts & Pascal Sylvain Nadal

To cite this article: Yashwantrao Ramma, Ajeevsing Bholoa, Mike Watts & Pascal Sylvain Nadal (2017): Teaching and learning physics using technology: Making a case for the affective domain, Education Inquiry, DOI: 10.1080/20004508.2017.1343606

To link to this article: http://dx.doi.org/10.1080/20004508.2017.1343606

Published online: 29 Jun 2017.

EDUCATION INQUIRY, 2017
https://doi.org/10.1080/20004508.2017.1343606

Routledge
Taylor & Francis Group

OPEN ACCESS Check for updates

Teaching and learning physics using technology: Making a case for the affective domain

Yashwantrao Ramma [a], Ajeevsing Bholoa [a], Mike Watts [b] and Pascal Sylvain Nadal [a]

[a]Mauritius Institute of Education, Reduit, Mauritius; [b]Brunel University, London, United Kingdom

ABSTRACT

Even though its importance is underscored in many research pursuits, attention to the affective domain in learning is often neglected at the expense of the cognitive development of students studying science, in particular physics. In this paper we propose a framework, the pedagogical technological integrated medium (PTIM) founded on the TPACK model, that builds on the existing premises of pedagogy, content and technology to make space for the affective domain where these three premises intersect with each other. We operationalize the PTIM framework through a multi-loop model that explores the affective dimension as an overarching space for interaction among learners, teachers and parents through a series of stages encompassing home tasks, as well as classroom and out-of-school activities. Within the qualitative paradigm, we substantiate from two case studies, an exploratory and an evaluative one in two different schools, that a succinct synchronisation of these various interactive elements promotes knowledge construction springing from the affective domain in terms of motivation, interest and values and also from their inter-relationships.

KEYWORDS

Motivation; interest; value; pedagogical technological integrated medium; multi-loop model

Introduction

Technology has permeated all the spheres of human life, including most of our educational undertakings. It is commonly construed that its non-use is tantamount to a regressive attitude towards the 21st century (Cuban, 2001). Mobile tablet devices and smartphones provide users with continuous and ubiquitous access to the Internet with the emphasis being on finding information efficiently and ensuring constant social presence with other people (Pachler, Bachmair, & Cook, 2011; Rosen, 2011). Instilling mobile learning (Crompton, 2013) transformation in schools is not simply about delivering content to mobile devices. It is the process of coming to know and being able to operate successfully within and across new and ever-changing contexts and learning spaces (Pachler et al., 2011) to deepen student learning. Mauritius is investing massively in the use of technology in teaching and learning in primary and secondary schools altogether. However, until now technology is used as a means for teacher's demonstration rather than as a pedagogical tool that is guided by means of a framework for integration.

CONTACT Yashwantrao Ramma y.ramma@mieonline.org Mauritius Institute of Education, Reduit, Mauritius

Technology can provide the appropriate medium for teachers to nurture higher-level thinking in students, a key element of the 21st century skills for learners (Shelly, Gunter & Gunter, 2012), by means of carefully structured activities (Anwaruddin, 2015; Pedrosa-de-Jesus, Moreira, Lopes, & Watts, 2014). However, most of the time, technology in education is used as a source of information rather than as a process-based means for knowledge construction. Innovation in this domain is related mostly to hardware and software (Lim et al., 2013) and consequently, research has focused principally on matters of practical implementation and design. The innovation is largely driven by *common-sense* assumptions about what technology can achieve, or by hype and excitement, rather than by evidential theory. In such cases, the innovation encompasses technological knowledge (Schmidt, et al., 2009), technological skill (the ability to apply acquired technological knowledge to perform specific tasks) and technological will (the readiness to embrace technology to conduct the assigned tasks). It is common practice that the use of technology by teachers in the classroom, in particular the Powerpoint software, is restricted most of the time to presenting information from a one-sided perspective (Isseks, 2011). In such cases, technology is employed as a tool rather than as a pedagogical tool. However, it makes a difference when technology is used as a pedagogical tool for teaching and learning(Westera, 2015) and the pedagogical value of a tool is reflected in the level of student engagement and the nature of participation garnered (Johnson & Golombek, 2016).

Literature on the use of technology in education is mostly directed towards the cognitive domain, as may be evidenced by the TPACK (Mishra & Koehler, 2006; Mishra & Koehler, 2007) and the ICT-TPCK (Angeli & Valanides, 2009) exemplar frameworks. The TPACK is made up of seven elements: technology knowledge (TK), content knowledge (CK), pedagogical knowledge (PK), pedagogical content knowledge (PCK), technological content knowledge (TCK), technological pedagogical knowledge (TPK), and technological pedagogical content knowledge (TPACK). The latter lies at the intersection of the six elements and teachers can construct their lessons by carefully selecting the appropriate content guided by the framework. On the other hand, in the ICT-TPCK model of Angeli and Valanides (2009), in addition to pedagogy, content and ICT, two additional elements – learners and context – constitute the technology-enhanced learning environment.

These frameworks enunciate the connections between the teacher's understanding of content, pedagogy and technology, thus emphasizing the cognitive domain as an essential construct for knowledge acquisition. However, apart from the cognitive domain, Autio and Hansen (2002) and Autio (2011) point to the significant role of the affective domain which is not brought to light in these frameworks. Moreover, O'Keefe and Linnenbrink-Garcia (2014) highlight the role of affective factors such as motivation, interest and value in relation to social contexts and in bettering students' engagement in learning activities.

In this paper, we propose a framework for integrating technology in teaching and learning, which we call the Pedagogical Technological Integrated Medium (PTIM), a framework adapted from the TPACK (Mishra & Koehler, 2006; Mishra & Koehler, 2007) framework. The PTIM framework also extends our previous research on technology integration in science (Ramma, Tan, & Mariaye, 2009; Alsop & Watts, 2000a; Alsop & Watts, 2000b). This study thus contributes to theory by informing research as well as practice on how to enable technological mediation with a growing perspective on the affective domain.

The framework: pedagogical technological integrated medium

The present framework is derived from the TPACK framework. Akin to TPACK, our proposed framework also draws on Shulman's (1986) conception of content, pedagogical content knowledge and curricular knowledge. Downplaying the affective domain in teaching and learning makes any subject matter alien to the social milieu, which is fundamentally in line with the strong view that Ryan & Patrick (2001) hold about learning as a social endeavour. In our view, the affective domain should be considered in juxtaposition with the other domains of learning, as the social dimension is influential enough to provide directions for technology integration. Figure 1 depicts the relationships among the social dimension, the affective domain, content, technology and pedagogy.

All the three core elements – content, technology and pedagogy – are interconnected through technological content knowledge, pedagogical content knowledge and technological/pedagogical knowledge, and are directly focused on learning. We strongly emphasise learning and place it at the centre of the various interconnecting elements, in contrast with the model proposed by Mishra and Koehler (2006). We consider these connections to be dynamic and flexible enough to accommodate changes in superimposing layers. Content knowledge, in juxtaposition with topic-specific knowledge, is considered as a single integrated component which has a direct focus on learning (Bell, Maeng, & Binns, 2013). Content and topic-specific knowledge form a singular component, as learning is best sustained when content and topic-specific knowledge, derived

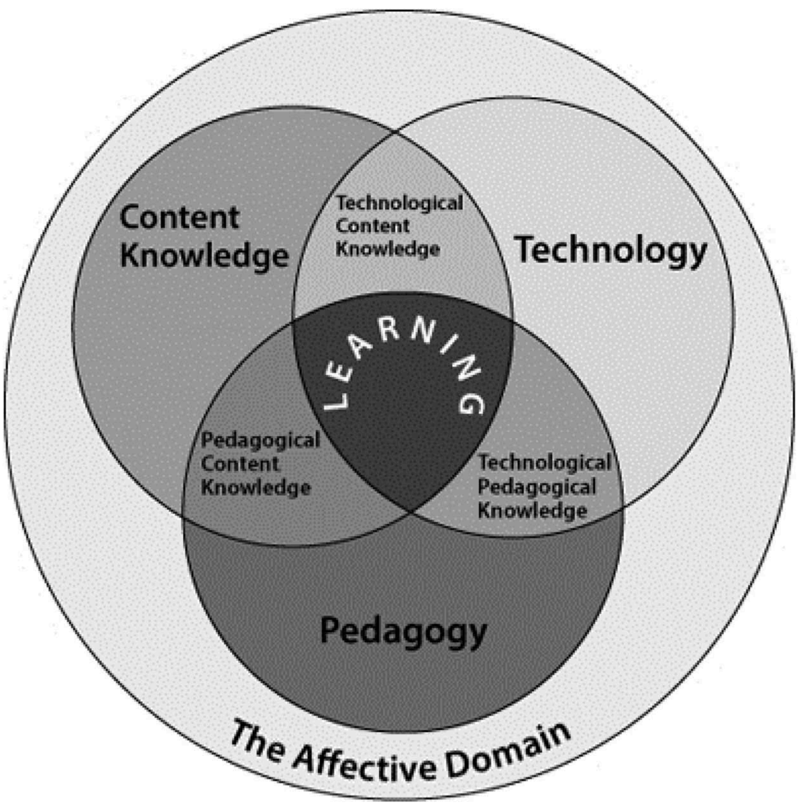

Figure 1. Pedagogical Technological Integrated Medium (PTIM) framework.

from the lived experiences, form an integral configuration (Barab, Hay, Barnett, & Squire, 2001; Barab & Kirshner, 2001; Mishra & Koehler, 2006).

We lay strong emphasis on the need to connect content with lived experiences (Grangeat, 2008), as content should always be related to real life situations, a most important point also highlighted by Cuban (2001) while introducing his second goal, which is to 'transform teaching and learning into an engaging and active process connected to real life' (p. 14) that allows learners to 'come to grip with real world issues' (p. 15). Such a connection between content and context can be a source of motivation for learners when they are required to relate theory and practice with process, thus preparing them for future workplace experience.

The Affect

In this study, the affective element takes into consideration three features, in particular, motivation, interest and value (Wigfield & Cambria, 2010). These are examined through students' lenses as they engage in the tasks and activities and are also observed when students interact with teachers and parents around these key elements:

(i) Contextualised content knowledge in the teaching and learning of physics concepts;
(ii) Technological and pedagogical knowledge focussing on the use of school-based and home-based internet systems;
(iii) School-based pedagogy for the development of classroom teaching and learning skills.

First, cognitive disequilibrium, or 'variance' (Moon, 2005), signals conflicts in knowledge: puzzlement, curiosity, perplexity, doubt, and challenge. Variance of this kind is a form of Piagetian constructivism which is, at the core, driven by the processes of equilibrium and disequilibrium (Piaget, 1971). It is clear that feelings of satisfaction/dissatisfaction, comfort/discomfort about states of thought or others constitute emotional and affective issues rather than cognitive ones. There is no doubt, too, that variation can arouse 'hot' emotions such as frustration, fear, revulsion, pleasure, hope and joy. It is indeed common knowledge that people can object very strongly to what they perceive as unpalatable, insensitive, drastic or offensive ideas that are radically at odds with their own (Pedrosa de Jesus & Watts, 2014).

Second, there is a gap in the literature when it comes to discussing the affective domain in the use of technology in teaching and learning. Exceptions to this observation are the notable works of Shephard (2006), Rovai, Wighting, Baker & Grooms (2009) and Grangeat & Hudson (2015) in discussing values related to technology in teaching and learning. While Cuban (2001) is of the view that 'computers and other technologies have had little tangible effect on either classroom teaching or learning' (p. 105), we subscribe to the view put forward by Roschelle et al. (2010) that a different approach to technology, emphasising active engagement, can produce robust effects on performance. We see the use of technology to transform teaching and create adequate opportunities for learning (Groth, Spickler, Bergner, & Bardzell, 2009; Borko, Whitcomb, & Liston, 2009; Kim, Kim, Lee, Spector, & DeMeester, 2013; Kapon,

2015) when an 'actor-oriented transfer' perspective (Lobato, 2003, p. 17) is adopted. In this study, such a perspective led us to explore ways to generate interest through the engagement of students with their parents and teachers with the help of technology as the pedagogical tool. Although social networks constitute 'platforms for virtual social lives' (Tiryakioglu & Erzurum, 2011, p. 135), learning with technology has somehow downplayed the importance of the affective domain in teaching and learning.

Third, the PTIM framework requires that good pedagogical structures are in place. Lessons to be taught are carefully planned, designed and pitched at the appropriate level so that learners can construct purposeful and misconception-free knowledge structures through argumentation (Osborne, Erduran, & Simon, 2004; Berland & Hammer, 2012; Sampson & Blanchard, 2012; Walker & Sampson, 2013) and through evaluative behaviours. Argumentation offers both teachers and students the opportunity to interact and value shared information and technology can precisely contribute to this role of argumentation in the classroom (Mirza & Perret-Clemont, 2009). Teacher preparation (Lee & Krapfl, 2002; Hudson, English, & Dawe, 2009) and affective commitment (Stanhope & Corn, 2014; Treagust & Duit, 2009) also bring about conceptual change in learners. In addition to prior knowledge, Savard (2014) argues that the contact between the teacher and learners enables the former to capture the mental model of learners and guide them in the construction of cognitive structures. Therefore, it rests upon teachers to guide learners to structure the content into well-organised mental models (Zohar, 2004) or to reformulate the naïve mental models that some learners might have and which would certainly impinge upon their construction of new cognitive structures.

Novelty of the Framework

The novelty of our framework resides in the inclusion of the affective domain – in the form of interest, motivation and value – in the use of technology for teaching and learning, with a view to creating an adequate social learning environment for knowledge construction by learners. All the various components illustrated in Figure 2 focus on the learner for meaningful construction of knowledge.

Borinca and Maliqi (2015) significantly draw attention to the mediating factor of the affective domain as being responsible for the creation of a state of motivation to learn and without which cognitive learning would be comparatively low. Within the constructivist perspective of technology integration (Pope, Hare, & Howard, 2005), the teacher has a facilitating role and is responsible for enabling learners to be engaged in the following relationships: student-student; student-teacher; and teacher-student. The *student-teacher-student* interaction during the science lesson that makes use of technology is facilitated and carefully monitored by the teacher, who also has the responsibility to inculcate values while the interactions are underway. Prior preparation from teachers in content/context knowledge, technology and technological pedagogical content/context knowledge is an essential aspect of technology integration. The teacher conducts *design experiments* and renders the technology science lessons as interactive as possible. Such a situation should eventually result in a *learning ecology* (Cobb, Confrey, diSessa, Lehrer, & Schauble, 2003), which is a sort of multifaceted interconnecting system comprising a combination of various layers within a group of activities. The carefully designed science technology

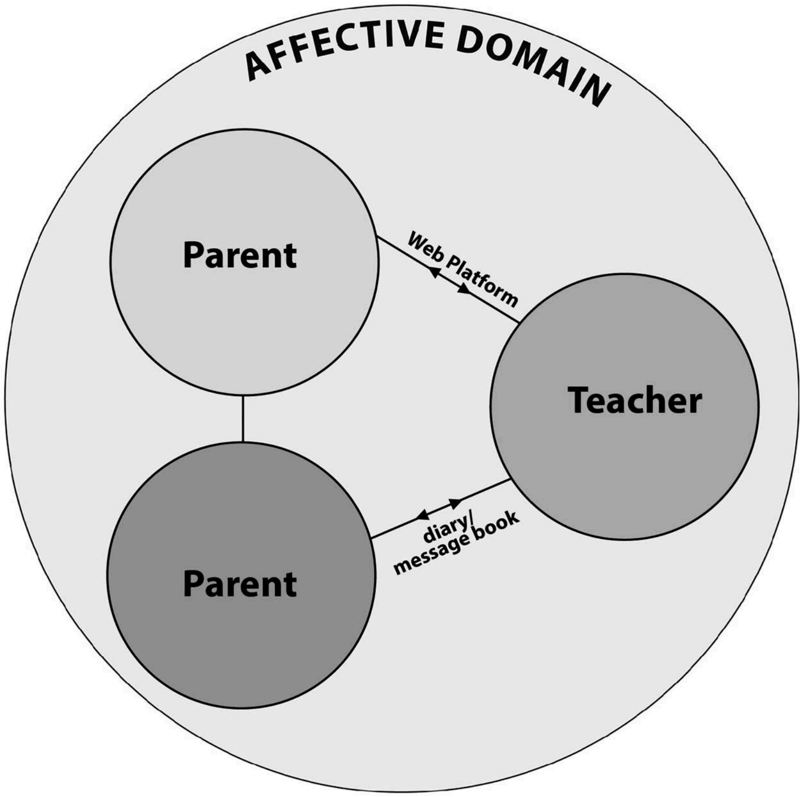

Figure 2. Interaction among different stakeholders.

activity lessons should motivate the learners to display interest in the subject. Some of the pertinent tasks can be extended in the form of homework to elaborate on concepts introduced in the classroom, for if learners find the homework (referred-to as 'home tasks') irrelevant, they soon lose interest in it (Turanli, 2009).

Moreover, teachers should maintain a constant rapport with parents (Mestry & Bennie, 2007), irrespective of whether the web-based platform is available or not to provide and receive feedback to and from parents. Monitoring children in doing their homework (Patall, Cooper & Robinson, 2008), as well as communication, should enable a relationship of trust to develop between school and home (Epstein & Salinas, 2004). Technology-savvy parents will follow the learning of their children at home and report to teachers through an appropriate web platform (Merkley, Schmidt, Dirksen, & Fuhler, 2006). Such a type of communication is twofold: both parents and teachers speak the same language and maintain a capacity-building exercise through the use of technology. The teacher will have the free hand to set a checklist for parents to report whether certain tasks, including problem-solving activities, have been completed by their children at home. Parents who do not possess similar level of technological competence will have the possibility to communicate by phone (Merkley, Schmidt, Dirksen, & Fuhler, 2006) or via a checklist predetermined by the teachers in the learner's diary/message book. It is not required that parents be knowledgeable about the subject, as their role is limited to ensuring that whatever tasks have been assigned or done at school are completed and reflected upon at home. Typically, the reporting to teachers by parents and vice-versa is the missing link that we are presently witnessing in our Mauritian educational system. A significant number of parents are not able to balance work and family life, and tend to shy away from their responsibilities in supporting their children's learning at home for various reasons, among which lack of time is the predominant factor (Baeck, 2010). It is therefore imperative that such a rapport of trust be established by fostering and sustaining parent-teacher collaboration through dialogue. Figure 3 illustrates the collaboration undertaken by parents and the teacher with the use of technology or via other traditional means.

Lastly, the social and physical environment in which children are raised influence their educational achievement (Sacker, Schoon, & Bartley, 2002; Jethro & Aina, 2012). Students participate in many social activities on their own, but to what extent are these structured (or unstructured) after-school activities (Dunn, Kinney, & Hofferth, 2003) and experiences ploughed back into the educational system? For instance, students involved in scouting have the opportunity to interact thoroughly with their environment and parents can channel these constructs to teachers so that they are, in turn, infused into the teaching-learning process. When it comes to out-of-school activities, collaboration among teachers of various disciplines represents an added benefit for the children. Figure 3 offers an insight

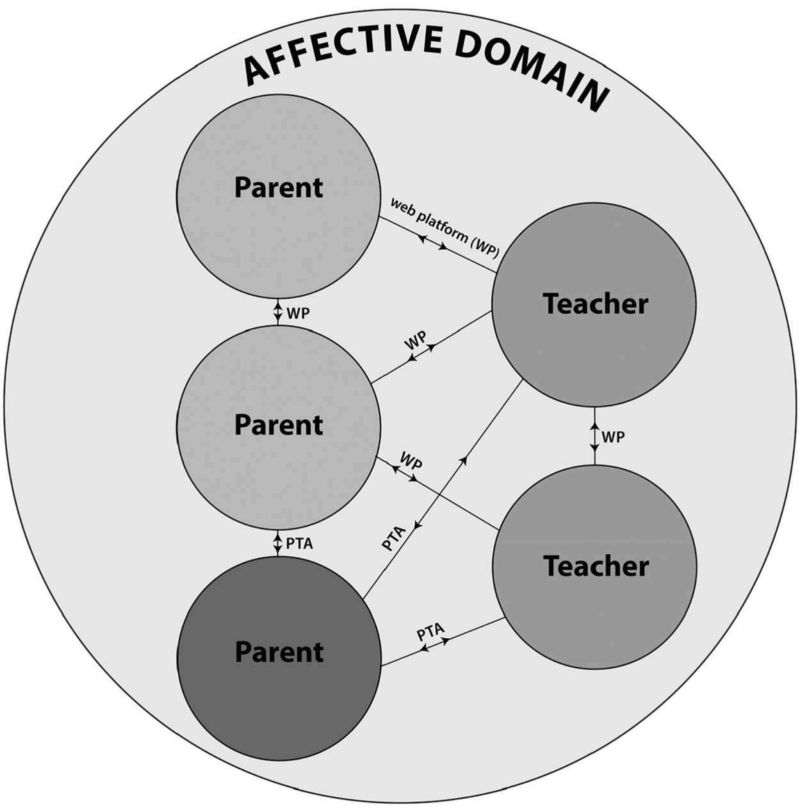

Figure 3. Out-of-school interactions

into the type of collaboration that has to be established, be it with the use of technology or by traditional means. Parents with limited technological expertise are not ignored in this framework and their voices can be heard during regular Parent Teacher Association (PTA) meetings. In this framework, emphasis is laid on the establishment of contacts with parents and also on ensuring that parents who are technology-savvy communicate through the web platform (WP). The other group of parents, in the very first instance, are encouraged to communicate using traditional means during face-to-face PTA meetings. With this type of communication, and via follow-up by teachers, parents will gain growing confidence in the use of the web platform. Provisions have also been made for parents to interact with each other through the web platform in an attempt to model such face-to-face interactions which usually occur during PTA meetings. However, the web-based interactions among parents have yet to be established.

The multi-loop learning model

This work aims at contributing to the improvement of teaching and learning of physics by accommodating the affective domain within a technology-mediated framework (the

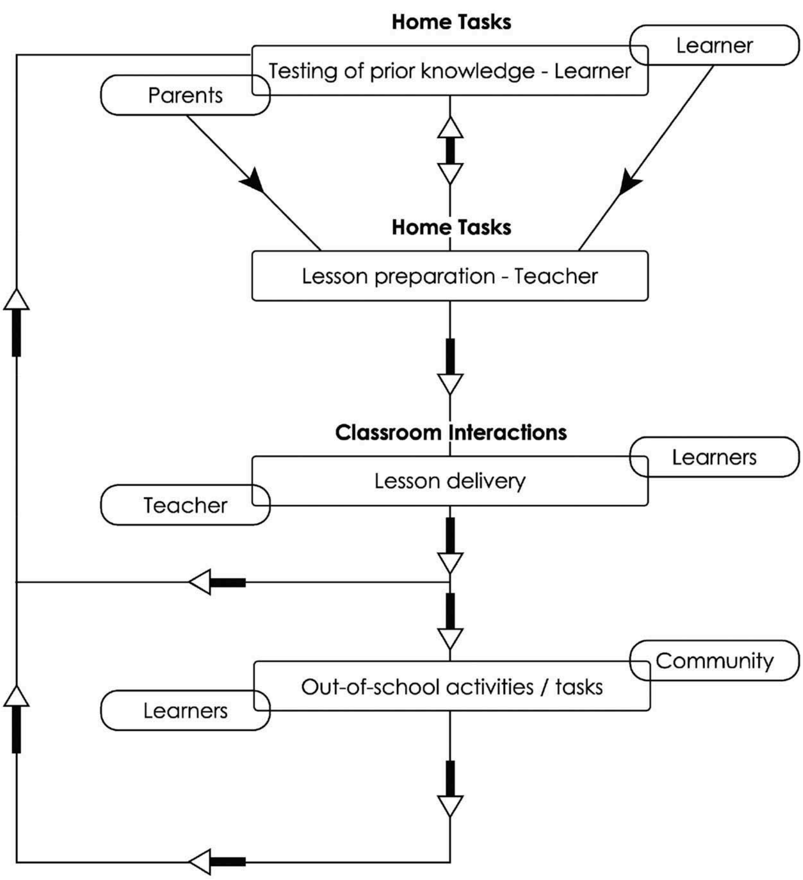

Figure 4. Multi-loop model for conceptualising physics lessons

PTIM). The strategy towards achieving this aim initially consists of conceptualising a research multi-loop learning (Pahl-Wostl, 2009) model (Figure 4) for teaching and learning.

The role of the teacher is very prominent, as physics lessons are constructed through a multiple teaching and learning process so as to engage learners in developing or reviewing their prior knowledge during home tasks in the presence of their parents. In the multi-loop learning model, some of the tasks include elements of formative evaluation which allow the learners to be prepared for the acquisition of new concepts in class.

The teacher, in turn, uses the feedback at the process level (Hattie & Timperley, 2007) available from the home tasks (formative) and the comments submitted by parents to develop the interactive physics lessons for delivery in class. Additionally, the teacher selects out-of-school activities or tasks that learners have to be engaged in for the consolidation of the concepts learnt in class. Feedback obtained from these two levels (class and out-of-school activities) is again considered and infused into the development of subsequent lessons, including testing and reviewing of prior knowledge (home tasks).

To implement the PTIM framework, the multi-loop model is adopted through a case study methodology used in the naturalistic setting of the participants. As such, our findings are primarily of qualitative nature and the preliminary findings relate to the functionality of the model.

The study

Research Questions

Our aim is to evaluate a new framework of technology integration which encompasses the affective domain, and also to investigate the extent to which the engagement of parents, students and the teacher via the developed pedagogical technological integrated medium (PTIM) has an influence on teaching and learning in Mauritius. We are guided by the following research questions:

(1) How can a new technology-mediated framework accommodate the affective domain in the teaching and learning of physics?
(2) To what extent can this framework mediate the interaction among parents, students and teachers?

Research Design

The case study method is considered as appropriate to study contemporary phenomena within a real world context (Yin, 2003). This study combines an exploratory case study and an evaluative case study to explore the identified research questions. The exploratory case study is often viewed as an initial stage in the developmental process of conducting a research inquiry (Jupp, 2006). To provide more grounded empirical evidence (Baxter & Jack, 2008) of the results obtained from the exploratory case study (from School A), an evaluative case study (from School B) is undertaken. We added our own judgment to the phenomena (that is, making a case for the affective domain) by using the evaluative case study (Zainal, 2007) to augur similar results (Yin, 2003) created from the exploratory one. Our intention is to provide strong and reliable evidence of our results (Baxter & Jack, 2008) and also to avoid the release of premature conclusions.Thus, the present study is a type of a multiple case study design (Yin, 2003) following a three-way schema as shown in Figure 5.

Research Setting

The research study took place in two different secondary schools, namely a co-educational school (School A) and a girl's school (School B). The interventions at the two schools were carried out at different intervals during the academic year in order to avoid disruptions to the teachers' scheme of work. The schools were selected purposively on the basis of (i) availability of Internet facilities and (ii) the successful completion by the physics teachers of a two-day training workshop on the use of the PTIM framework to develop the appropriate knowledge and skills in the use of technology as a pedagogical tool.

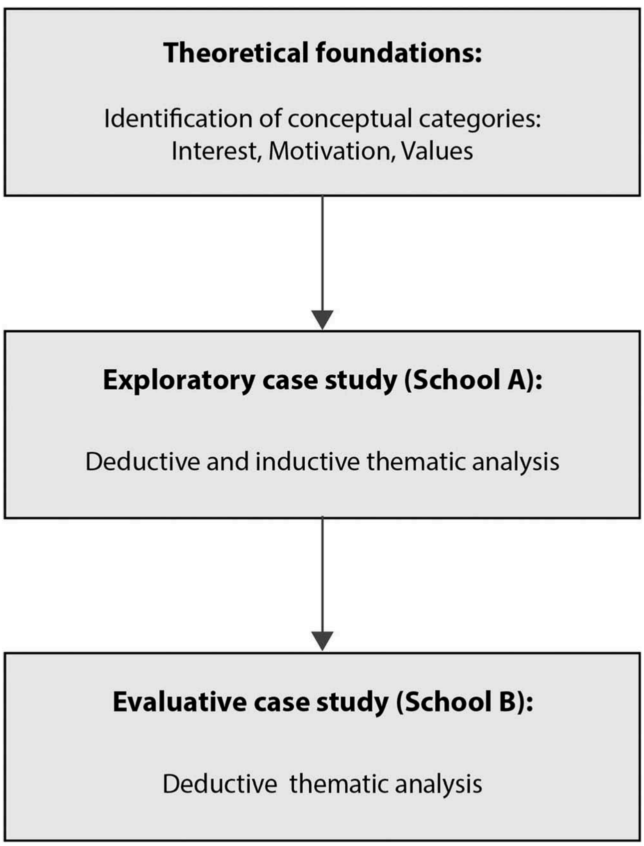

Figure 5. Reseach design of the study

Participants

In the first instance, the exploratory case study was conducted in a class of 22 students aged 13-14 in School A (a co-educational school). The study was based on the concept of 'Measurements' and it spanned over a period of two weeks (1 session of 70 minutes per week) and served as a preliminary set of references in answering our research questions. In the next phase, the evaluative case study was conducted in School B (a girl's school) where the concept of 'Motion' was taught to a class of 31 students of the same age group and over the same period.

Additionally, both physics teachers participated in the study. They were responsible for the teaching of the concepts to students using the web-based lessons in their respective schools during the research period. All parents were invited to participate in the home tasks activities. For school A, 19 parents participated in the home task activities (Measurements) while 15 parents did so for the activity on Motion (School B).

Web-based lessons

The PTIM framework has been used to develop and implement interactive web-based physics lessons (http://science.mie.mu/physics/) on the concept of 'Measurements' and that of 'Motion' within School A and School B respectively. In the exploratory phase of the study, the concepts of 'Measurements' were taught.

Lesson on 'Measurements'

The lesson on measurements is composed of the following (Figure 6a):

- Home task (Diagnostic assessment tasks) – a set of simple activities that review the prior knowledge on the concept of measurement and serve as diagnostic assessment. They also serve as assessment tasks for the psychomotor (measuring length of table using a ruler), cognitive and affective learning domains.
- Formative assessment tasks – A set of five activities (presented in interactive html/ Flash files) give learners the opportunity to explore, explain and deduce the appropriate tools for measurement. Learners also learn to use Vernier calipers with emphasis on scales, accuracy and precision, and precautions to be taken during measurements. They are required to upload their results on the website.
- Summative assessment tasks – A set of multiple choice and structured questions are provided at the end the unit. A summary of the main concepts is presented as well.

A discussion forum is available to support students who are willing to 'think out of the box'.

Lesson on 'Motion'

The lesson on the topic 'Motion' follows a similar design to that of the lesson on the topic 'Measurements'. It contains the following:

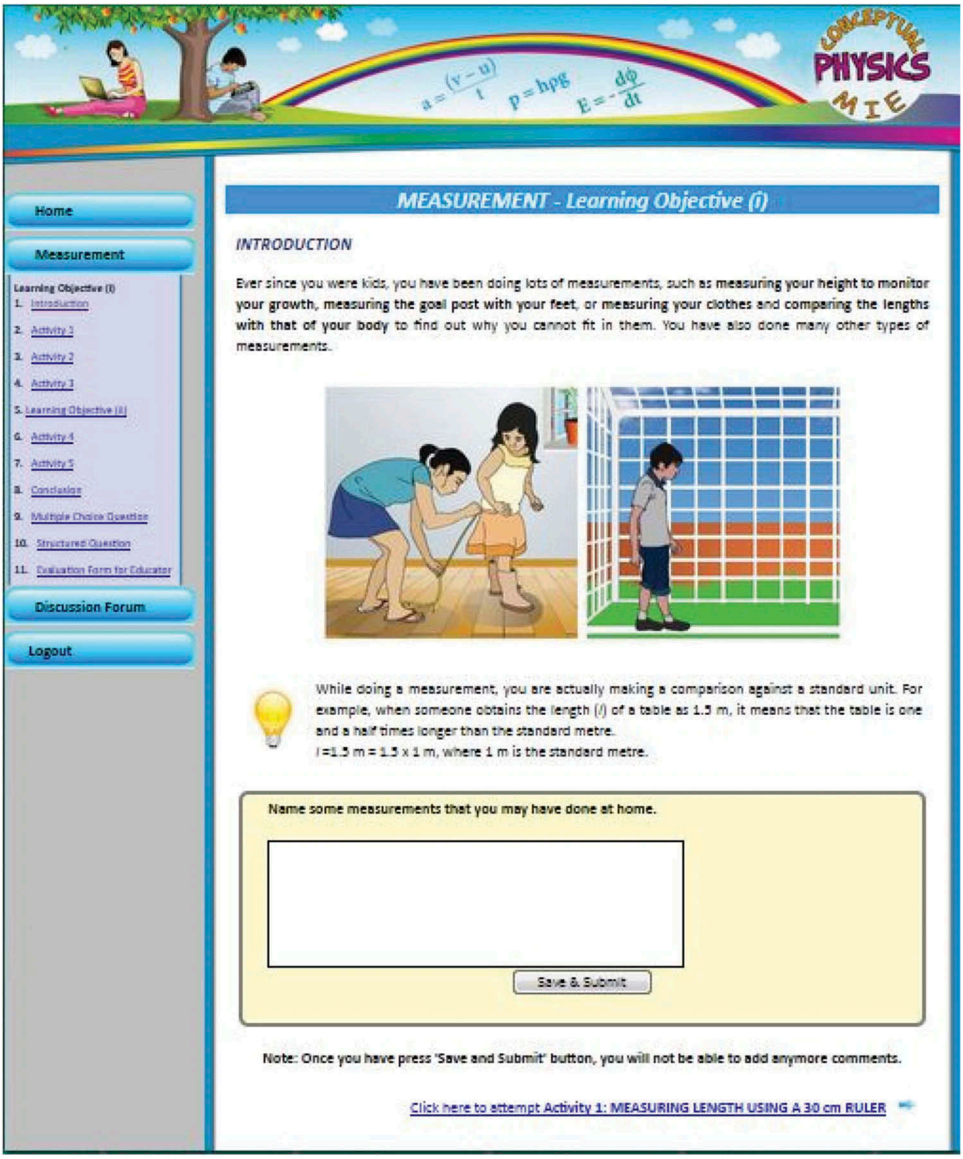

Figure 6a. Snapshot of part of the home-task for acquisition/testing of prior knowledge

- Home task: Learners have the opportunity to interact with an interactive diagram on the motion of a ball on ice and on a rough table.
- Formative assessment tasks: Four more activities (including an interactive worksheet) which relate to the concept of a point of reference (or origin), direction of motion, distance and displacement, speed, velocity and units.
- Summative assessment tasks: The evaluation comprises multiple choice questions and structured questions.
- Discussion forum.

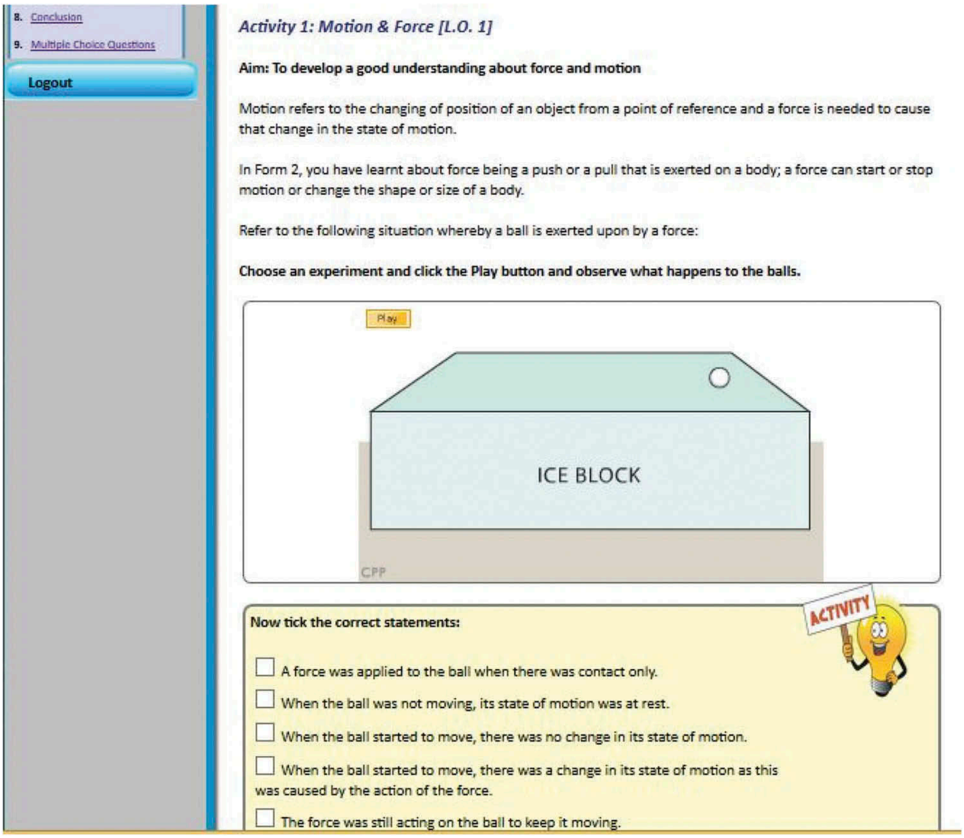

Figure 6b. Snapshot of the web-based lesson on 'Motion'

Data collection and analysis

In order not to disrupt the normal schedule of the class teachers, student interviews were conducted in the morning in the physics laboratories, that is, in their natural settings (Yin, 2003), where they usually have their physics classes. Two focus group interviews lasting for about fifty minutes each were conducted with students, while the ten selected parents were interviewed via phone, pursuant to their requests. The phone interviews with the parents were conducted from the office of the first author in the presence of the second author as from 17:00 hours. A phone interview typically lasted for about 20 minutes.

The two teachers agreed to be interviewed in the physics laboratories, where they felt more comfortable. The interviews took place in the absence of the students and lasted for half an hour in each case.

Data analysis

The interviews were audio recorded and transcribed. The analysis of the transcripts captured both inductive and deductive approaches. The three elements of the affective domain, namely interest, motivation and values, formed the basis of deductive analysis, while additional categories emerged inductively from the data. For the exploratory phase of the study, we carried out the thematic networks analysis (Attride-Stirling, 2001), adopting an inductive-deductive approach in the data analysis process, as outlined by Fereday & Muir-Cochrame (2006). The themes generated from the grounded data formed the conceptual categories of the deductive analysis in the evaluative phase of the study.

Ethics

Informed consent to participate in the study was obtained from schools, parents and students. The participation of teachers, parents and students was voluntary. All initial communications with the parents were done by the class teachers after approval was obtained from the rectors, as per the established procedure.

With the respondents' permission, each interview was audio recorded and subsequently transcribed. Once the interviews were transcribed by the researchers and found to be accurate, the recordings were erased. Respondents were assured of confidentiality during the whole process of data collection, analysis and reporting.

Results & Discussions

We carried out the thematic networks analysis (Attride-Stirling, 2001), adopting a hybrid inductive-deductive approach in the data analysis process, as outlined by Fereday & Muir-Cochrame (2006). The *a-priori* themes 'interest', 'motivation' and 'value' were derived from the literature review, but after the inductive analysis of the data, four overarching categories emerged, that is, i) interest, ii) interest and motivation, iii) motivation and value, and iv) interest and value.

Exploratory Case Study (School A)

The home tasks have served a dual purpose: to engage learners in collaboration with their parents (affective dimension – interest, motivation and values) and also to help them gain relevant prior knowledge so that learning new concepts at school becomes enjoyable and meaningful (Campbell & Campbell, 2008).

19 of the 22 parents participated in the web-based activity on the topic 'Measurements'. Students had the opportunity to carry out the activities after logging on the web platform in the presence of their parents. They were required to engage in a prior knowledge acquisition exercise using a 30 cm ruler to measure the length of a table at home while reflecting on the various precautionary measures. The activities (Figure 6a) were aimed at developing (or reinforcing) students' prior knowledge and understanding before they come to school, about the fact that (i) the concept of measurement is related to a comparison against a standard quantity (to be learned later as the SI unit), (ii) the length of an object can be related in a mathematical relationship (links with physics) which captures a physical quantity, a magnitude and a unit; and (iii) some elementary precautions must be taken during measurement.

Interest

During the group interviews, students acknowledged that doing some work prior to coming to class was a new learning experience for them. They claimed that the prior work was interesting and it motivated them to learn the concept in class.

One student expressed her cognitive interest in the web-based tasks (testing of prior knowledge) as follows:

> *I think it is good because we have a foretaste of the subject.*

The teacher also displayed her personal interest in the multi-loop interactive web-based lessons:

> *I understand that it's a long term process and that I need to maintain this momentum.*

One parent expressed some form of situational interest in the novel task in the following terms:

> *I'm aware of a project in Physics for my daughter. She told me about it, but although I find it interesting, I could not find time to get involved.*

This situation is not isolated, as generally many parents find it difficult to sustain their full involvement in the education of their children, which they claim to be due to their professional obligations (Harris & Goodall, 2008).

Even though our PTIM framework aims at fostering this parent-child-parent relationship, yet we acknowledge that time is a non-negligible factor which influences parental engagement in monitoring children's learning. In our Mauritian context, parents are fully involved in the education of their children at the primary level (Bahlalya, 2006), but this parental engagement fades progressively at the secondary level. Thus, teaching and learning within the PTIM is a means to reconnect students, parents and teachers as part of a collaborative endeavour and with the expectation that it will 'drive knowledge sharing behaviour among students' (Ghadirian, Ayub, Siling, Bakar, & Zabeh, 2014, p. 39) and lead to arousal of motivation, interest or changed students' behaviour, as highlighted by a parent:

> *My daughter displayed sustained interest during the time she had to carry out the tasks at home.*

The need for sustained interest among students has been recognised by Harackiewicz, Barron, Tauer, Carter & Elliot (2000) as an essential factor for students selecting a topic for further study. In particular, physics has always been considered a tough discipline, being abstract and remote from learners' everyday life experiences. Ostensibly, there is a gradual decline in the intake of physics students for higher level studies in schools and, conjointly, the mode of teaching has not changed, with the teacher-centered approach still prevailing in our Mauritian schools (Ramma, Bholoa, Watts, & Ramasawmy, 2014). Thus, the PTIM platform offers a mode for encouraging students' interest.

However, some high ability students emphasised that some of the questions were not challenging enough, showing a lack of situational interest.

> *There are questions that are sometimes too easy.*

In contrast with this view, researches (Blickenstaff, 2010; Roth, 2013) show that when students are engaged in a process of knowledge construction through conceptual understanding, their ability to reason critically is enhanced and they perform better in tests and examinations than students who learn in a procedurally-oriented class. However, one student also claimed that she would need time to adapt and adjust to this mode of teaching and learning:

... I must also confess that it's hard to work this way.

Interest and Motivation

During the group interview, most of the students acknowledged that doing some work prior to coming to class was a new learning experience for them and they were interested and motivated to learn the concept in class, as illustrated by the following comment:

... we don't have to wait for the teacher's explanation of the chapter.

In this case, the student has indicated that autonomy in learning has not only brought about an intrinsic interest, but also an intrinsic motivation for learning (Muller & Palekcic, 2005).

In addition, during the interview with the teacher, the latter explained that before proceeding with the lesson development, she displayed the students' online exercises on testing of prior knowledge and praised them for their commitment in undertaking the tasks in collaboration with their parents. She added that she further congratulated the students for coming up with new ideas, which she explained would be picked up during the lesson. This attitude by the teacher – that is the offer of teacher praise – has been reported in the literature (Henderlong & Lepper, 2002) as an affective factor that contributes positively to students' achievement, interest and motivational behaviour. In addition, Stanhope & Corn (2014) add that teacher's commitment can prove to be an important affective factor, as illustrated by the teacher's comment:

Usually, I have to speed up to teach a concept so as to complete the syllabus, but by using this approach, I believe that the students will benefit the most. This way of doing things enables students to carry out certain activities and be prepared for learning the concept in class.

During the group interview with students, some highlighted that they felt uncomfortable in carrying out the tasks on the platform in the presence of their parents. Such an attitude on the part of students is unfortunately becoming increasingly common in our Mauritian society, as students are inclined to study in isolation and refrain from sharing knowledge, which they think is something personal (Ramma, Samy, & Gopee, 2015; Seebaluck & Seegum, 2012), as evidenced by the following student's comment:

I don't like my parents interfering in my studies at school.

Motivation and Value

Upon analysis of the students' home tasks, we could identify adequate evidence of intrinsic motivation (in the form of competence) and attainment value whereby students have used their prior knowledge to connect same with their existing cognitive structures (Guillies, 2011).

> *... hold the ruler tightly so as* [that] *when measuring, the ruler does not move.*
> *I must place the ruler precisely on the border of the table in order to get the correct and accurate length.*
> *Place your eyes perpendicular to the ruler. Place the ruler at the zero mark.*

Most of the students (94.7%) reported that carelessness should be avoided when reading from a ruler, while encouragingly, a few were able to discuss in relation to concepts such as parallax error (5.2%) and zero error (26.3%). Although the concepts of parallax error and zero error had not yet been introduced by the teacher, some students used their prior experiences with experiments to improve the accuracy of their results. However, as confirmed by the teacher during the interview, the students were able to easily receive, respond (Krathwohl, Bloom, & Maisia, 1964) and integrate prior knowledge (Ionas, Cernusca & Collier, 2012) of accuracy into the newly acquired concepts, in this case, parallax and zero errors.

From these students' comments, elements of the affective domain (relation between parent and student, motivation, valuing students' work, respect of authority) can be picked out:

> *If I have any problem I'll call my mom and she will explain it to me. I was very happy to submit my work* [on the platform] *immediately.*
> *They* [parents] *saw that I was doing some homework on the internet and they were satisfied.*
> *She* [mother] *was very happy because except Facebook and YouTube [sic], I had other works, . . . the project, I was involved in that. At first, she thought I was wasting my time, then when she learnt about the project, she encouraged me to do the work.*

These comments illustrate instances of intrinsic motivation in the form of students' relatedness and attainment values. We also found additional scenarios from our discussion with the teacher about her perspective on her intrinsic motivation and utility values:

> *It was easier for the students to follow my class as I knew they already possessed the prior knowledge after going through the home tasks... in class they got a better idea of what I was explaining... I also used what was submitted* [by students and parents] *on the platforms to prepare the introductory part of my lesson. During the lesson, I could identify the learning difficulties of the students and tried to address them... Students do not have to copy notes about what has been explained in class and they have more time to discuss and interact with each other and with me during the inquiry activities. I could see their excitement during that lesson.*

The students acknowledged that this type of teaching catered for their intrinsic motivation (relatedness, competence and autonomy) as well as attainment and utility values, as they had the opportunity to refer, at their own pace, to the variety of the web-content in addition to the hands-on activities conducted in the classroom and on the discussion forum after the lesson.

I enjoyed learning this way [valuing whatever pedagogical approach the teacher was putting in]*… and also collaborating with my friends and have discussion with* [the physics teacher] *which I usually don't do. …there were lots of activities to do and also many challenging questions that made me think. The discussion forum that she* [the physics teacher] *initiated on the website was very helpful to understand* [the concept of measurement].

By doing the tasks I could come up with my own definitions rather than wait for the teacher to give the definitions … when we have already given our answer then at times the correct answer appears soon after… I understand it better.

Interest and value

In 14 of the 19 cases, results of measurements from the students and parents (submitted on their respective platform) were similar. It should be noted that six of the students stated that the lengths were equal due to the fact that the same table was being measured, while the remaining eight students mentioned that the same ruler had been used. Though both answers are correct, it should be clarified that the two explanations are complementary. These examples provided adequate evidence of students' engagement in the thinking processes already emerging while collaborating with their parents (Sapungan & Sapungan, 2014; Brownlee, 2015). In the remaining five cases, the results displayed by the students and their parents were different, as it appeared from the arguments that the use of different rulers ironically yielded different results. These types of engagement between parents and children at home have been acknowledged by Kraft & Dougherty (2013) as fostering, in the long run, positive outcomes on student's performance. However, most parents displayed satisfaction to the fact that, through the activities, they were also engaged in the education of their children, as emphasised by the parents:

Usually this was not the case until now. She was eager to show what activity she was doing at home.

My child was eager to show me the Flash activities on the platform which I myself found to be very interesting.

The eagerness or willingness has been stated by Wigfield & Eccles (2000) as constituting an experience of the affective domain which lays the groundwork for later and deeper understanding. As one parent further mentioned, his daughter's eagerness to learn through technology was comparable to her early childhood's curiosity:

She was keen to carry out the activities in my presence and did not stop bombarding me with questions … I recall such a situation when I was involved in her education when she was in primary school.

However, this relationship between parental engagement and performance has to be taken with caution, as Robinson and Harris (2014) argue that parental involvement may also hinder learners' progress. Our stance in this study is more in line with researchers (Sapungan & Sapungan, 2014; Lau, Li, & Rao, 2011) who hold the view that parental engagement creates productive collaborative learning opportunities for students.

Evaluative Case Study

The rationale behind the consideration of the evaluation case study was to validate the themes which were uncovered in the exploratory case study with the intention to provide a more transferable outlook of the PTIM framework. Thus, we restricted our analysis to the deductive approach.

In this phase, the concept of 'Motion' was considered. 15 of the 31 parents submitted the home task activities. The activities were geared at engaging the students to gain prior knowledge in relation to (i) a force is exerted on an object when there is contact; (ii) frictional force is the force that slows down the ball and (iii) a force is not needed to sustain motion.

The evaluative case study has enabled us to validate the already identified themes from the preliminary exploratory case study as organised in Table 1.

Discussion

The academic lives of our students are often reflected through challenging and complex interactions of the cognitive, affective and behavioural aspects, such as beliefs, values, interest, motivation, engagement and persistence towards learning and performance. Recent developments in the area through theoretical models and empirical studies have

Table 1.

Affective Element	Parents' comments	Students' comments	Teacher's comments
Interest	*I enjoyed watching my daughter perform the activities and talking to me.*	*The notes and videos on the website have helped me to recall what I learnt earlier and I was eager to learn more in class.* *More notes should have been given as for the exams we can't explain what we have seen in the videos.*	*It is easier to get students to learn the concepts as they have just acquired the relevant prior knowledge.*
Interest and Motivation	*I was happy that my daughter was discussing with me and I encouraged her to complete all the tasks and to tell me if you [she] had any difficulty.*	*We have a better idea of the topic when the teacher explains.* *After having done some of the activities on the website, I wanted to ask more questions in the class.*	*With reference to the force-motion misconception, the video coupled with the quiz was a good opportunity for me to build on and to add my own ideas to dispel students' misconceptions.*
Motivation and value	*This way of learning is a good step for my daughter to devlop skills and I would like to carry out some simple activities like this with her.*	*More activites and notes should be given on the website as this will help me to learn better. I would like to try it first before learning it* [the concept] *at school.*	*It is pleasing to find readily available materials which are directly related to the curriculum and I will use the materials as a resourceful means to address students' misconceptions.*
Interest and value	*I was happy to see my daughter working on something on the computer on physics.*	*The quiz and the answers – right and wrong – helped* [me] *to learn better.* *It* [the web-based activity] *is simple and easy and is very useful and will help me to make a good revision.*	*The activites on 'Motion' have helped me to understand in which specific areas students hold misconceptions. They also offer me with the opportunity to innovate in my teaching.* *I see myself as a facilitator now.*

developed into better understanding and conceptualisation of the factors into different constructs. Yet, despite the recent advances, we acknowledge the challenge in coordinating the various constructs related to interest, motivation and values in the teaching and learning processes. As part of our discussion from various literature sources (e.g. Renninger & Hidi, 2016), we have considered the interplay between the three constructs as follows:

Interest ————> Motivation —————> Values

We posit that, based on the data generated from discussions with students and parents, when situational or personal interest (Durik & Harackiewicz, 2007) is engendered in a certain task, motivation – particularly intrinsic – (Ryan & Deci, 2000) is then developed, provided the interest is sustained over a long period of time. Subsequently, values – utility, attainment or simply intrinsic – (Eccles & Wigfield, 2002) are developed by learners.

By their own admission, the students clearly acknowledged that their engagement in the various activities prompted the construction of new knowledge the moment they obtained the feedback (Hattie & Timperley, 2007) from the system (web platform). Additionally, such involvement on the part of the students is evidence of gains in personal interest, motivation and values. The development of the concepts has been conceptualised in such a way that assessment *for* learning is an integrated component of the teaching-learning process and we view the students' comments as encouraging, as they will serve to further improve the lessons.

Moreover, some students highlighted that though the videos were helpful in fostering conceptual understanding of 'measurements', they expressed discomfort at the fact that the viewing of this resource did not orient them towards problem-solving. The students were making reference to the 'drill-and-practice' type of questions which they usually encounter in tests and examinations. Such a type of argument reminds us of established learning practices that are more geared towards scoring high marks and grades (Ramma, Samy, & Gopee, 2015).

During the lesson, the teacher regrettably found that a few students were still displaying passivity and waited for her instruction before performing certain tasks which were displayed on the student's platform. We would here like to clarify that at home, students had no other choice than to display independence in thinking, while at school, they have the tendency to view the teacher as the expert, and they consequently display a submissive attitude in their quest for knowledge. We acknowledge that bringing change in the mind-set of students is not a straightforward matter.

On the contrary, it involves recurrent engagement from parents at home, following invitations from school (Menheere & Hooge, 2010) and also adequate teacher interaction in the classroom to guide students to reconfigure, revise or abandon existing knowledge (Duschl & Osborne, 2002). Gess-Newsome's (2015) model of teacher professional knowledge and skills expresses these ideas in terms of 'amplifiers' and 'filters' of teachers and students. Campbell & Campbell (2008) add that existing knowledge facilitates learning experiences and increases interest in learners. 'Parental time' and 'parental availability' are two important variables which teachers must continuously consider in order to invite parents to support their children's learning endeavours. Research shows that undertakings that engage parent-child collaborations constitute a long-term process. As more and more parents take cognizance of the benefits of this type of collaboration, they develop a sense of dedication in helping their children to succeed (Fan & Williams, 2010).

Limitations

Even though this case study has generated preliminary insights into the use of PTIM, more work has to be undertaken to confirm its effectiveness. For this case study, the availability of internet facilities at home and at school motivated our choice of sample; however, factors such as socio-economic background and technological illiteracy, amongst others, could have influenced the non-participation of some parents. Moreover, this study was conducted over a two-week period only, since the concept of 'Measurements' is usually taught in our schools within this period of time. It stands to reason that an improved trend would have most probably been obtained over a longer time span involving a diversified number of physics concepts. Moreover, information about students' engagement in the community (Grangeat & Kapelari, 2015) was obtained only from parents.

However, our future endeavour will be directed towards a consideration of the interplay of the PTIM framework with all the components of the community (teacher groups, heads of schools, etc.).

Conclusion

The present work has proposed a framework – the *pedagogical technological integrated medium* (PTIM) – to facilitate the practical fusion of the affective domain into technology integration within a learner-centered perspective. The novelty of this framework is that it places learning at the intersection of content/contextual knowledge, pedagogy and technology, without downplaying the importance of technological pedagogical content knowledge. Through an exploratory case study in a school in Mauritius, the collaboration of the physics teacher, students and parents has been promoted within the context of the affective domain, namely motivation, interest and value. Consideration is also given to the social milieu as a key determinant for learning through a multi-loop model while reflecting, sharing and collaborating through various activities.

On the one hand, the web-platform offers parents with the opportunity to contribute to the education of their children and also to communicate with the teacher. On the other hand, the teacher uses feedback from parents and students to structure the current and forthcoming lesson(s) and extend students' thinking in extra-curricular activities in the environment. The platform has been instrumental in inculcating values in students through the various interactions, as an offshoot of interest and motivation, in the learning of physics through the diverse tasks (prior work, home tasks, classroom activities, amongst others).

By integrating the affective domain into this model, we have shown the potential of the three stakeholders – parents, students and teacher – to collaborate in harmony with each other. For instance, the teacher took a prominent role in establishing a network with parents and learners by referring to the database (on the web platform) to construct her interactive lessons. Most of the students also valued this collaboration in their study at home with their parents, a practice which dates back to their early schools days when they were in pre-primary and primary schools.

The evaluative case study has provided us with adequate evidence of a change in the attitude of students, as they claimed to be interested, motivated and better prepared to learn new concepts in class. We acknowledge that, in a context like Mauritius, it is going to take some years for the three stakeholders to truly work in harmony within the PTIM and that the success of this mode of teaching and learning depends on the degree of mutual trust among the teacher, parents and students.

Future directions

We have, at the time of completing this paper, embarked upon the development of more web-based interactive physics lessons using the PTIM framework of technology integration by using the multi-loop model illustrated in Figure 4. Training programmes for in-service and pre-service teachers are also envisaged in our teacher education programmes for capacity building.

ORCID

Yashwantrao Ramma http://orcid.org/0000-0003-4967-2572

References

Alsop, Steve and Watts, Mike. (2000a). Facts and feelings: Exploring the affective domain in the learning of physics. *Physics Education*, *35*(2), 132–139.
Alsop, Steve and Watts, Mike. (2000b). Interviews about scenarios: exploring the affective domain in science education. *Research in Education*, *63*, 21–32.
Angeli, Charoula and Valanides, Nicos. (2009). Epistemological and methodological issues for the conceptualization, development, and assessment of ICT-TPCK: Advances in technological pedagogical content knowledge (TPCK). *Computers & Education*, *52*(1), 154–168.
Anwaruddin, Sadar. (2015). ICTs in language and literacy education in Bangladesh: A critical review. *Current Issues in Education*, *18*(1), 1–12. Retrieved March 10, 2015, from http://cie.asu.edu/ojs/index.php/cieatasu/article/view/1282
Attride-Stirling, Jennifer. (2001). Thematics networks: an analytic tool for qualitative research . *Qualitative Researc, I h* (3), 385–405.
Autio, Ossi. (2011). The development of technological competence from adolescence to adulthood. *Journal of Technology Education*, *22*(2), 71–89.
Autio, Ossi and Hansen, Ronald. (2002). Defining and measuring technical thinking: Students technical abilities in Finnish comprehensive schools. *Journal of Technology Education*, *14*(1), 5–19.
Baeck Unn-Doris. (2010). Parental involvement practices in formalised home-school cooperation. *Scandinavian Journal of Educational Research*, *54*(6), 549–563.
Bah-lalya, Ibrahima. (2006). *Mauritius 2000-2005 Educational Reform: Initiating and Conducting and Experimental Peer Review Exercise in Africa*. Paris: UNESCO.
Barab, Sasha; Hay, Kenneth; Barnett, Michael and Squire, Kurt. (2001). Constructing virtual worlds: Tracing the historical development of learner practices. *Cognition and Instruction*, *19* (1), 47–94.
Barab, Sasha and Kirshner, David. (2001). Guest Editors' Introduction: Rethinking methodology in the learning sciences. *The Journal of the Learning Sciences*, *10*(1&2), 5–15.
Baxter, Pamela and Jack, Susan. (2008). Qualitative case study methodology: Study design and implementation for novice researchers. *The Qualitative Report*, *13*(4), 544–556.

Bell, Randy; Maeng, Jennifer and Binns, Ian. (2013). Learning in context: Technology integration in a teacher preparation programme informed by situated learning theory. *Journal of Research in Science Teaching*, *50*(3), 348–379.

Berland, Leema and Hammer, David. (2012). Framing for scientific argumentation. *Journal of Research in Science Teaching*, *49*(1), 68–94.

Blickenstaff, Jacob. (2010). A framework for understanding physics instruction in secondary and college courses. *Research Papers in Education*, *25*(2), 177–200.

Borinca, Islam and Maliqi, Amir. (2015). The influence of teachers on increasing students' motivation to the Ismail Qemaili High School in the city of Kamenica, Kosovo. *Psychology*, *6*, 915–921.

Borko, Hilda; Whitcomb, Jennie and Liston, Daniel. (2009). Wicked problems and other thoughts on issues of technology and teacher learning [Editorial]. *Journal of Teacher Education*, *60*(1), 3–7.

Brownlee, Lucy. (2015). Parental involvement in school benefits students and develops teacher-parent relationships. *Journal of Initial Teacher Inquiry*, *1*, 54–56.

Campbell, Bruce and Campbell, Linda. (2008). *Mindful learning: 101 proven strategies for student and teacher success* (2nd ed.). London: Corwin Press.

Cobb, Paul; Confrey, Jere; diSessa, Andrea; Lehrer, Richard and Schauble, Leona. (2003). Designs experiments in educational research. *Educational Researcher*, *32*(1), 9–13.

Crompton, Helen. (2013). A historical overview of mobile learning: toward learner-centered education. In Z. L. Berge, & L. Y. Muilenburg, *Handbook of mobile learning* (pp. 3–14). Florence: Routledge.

Cuban, Larry. (2001). *Oversold and underused: Computers in the classroom*. Cambridge: Harvard University Press.

de Jesus, Pedrosa. (2014). Managing the affect of learners' questions in undergraduate chemistry. *Studies In Higher Education*, *39*(1), 102–116.

Dunn, Janet; Kinney, David and Hofferth, Sandra. (2003). Parental ideologies and children's after-school activities. *American Behavioral Scientist*, *46*(10), 1359–1386.

Durik, Amanda and Harackiewicz, Judith. (2007). Different strokes for different folks: How individual interest moderates the effects of situational factors on task interest. *Journal of Educational Psychology*, *99*, 597–610.

Duschl, Richard and Osborne, Jonathan. (2002). Supporting and promoting argumentation discourse in science education. *Studies in Science Education*, *38*, 39–72.

Eccles, Jacquelynne and Wigfield, Allan. (2002). Motivational beliefs, values, and goals. *Annual Review of Psychology*, *53*, 109–132.

Epstein, Joyce and Salinas, Karen. (2004). Partnering with families and communities. *Educational Leadership*, *61*(8), 12–18.

Fan, Weihua and Williams, Cathy. (2010). The effects of parental involvement on students' academic self-efficacy, engagement and intrinsic motivation. *An International Journal of Experimental Educational Psychology*, *30*(1), 53–74.

Fereday, Jennifer and Muir-Cochrane, Eimear. (2006). Demonstrating rigour using thematics analysis: A hybrid approach of inductive and deductive coding and theme development. *The International Journal of Qualitative Methods*, *5*(1), 1–11.

Gess-Newsome, Julie. (2015). A model of teacher professional knowledge and skill including PCK: Results of the thinking from the PCK Summit. In A. Berry, P. Friedrichsen, & J. J. Loughran (Eds.). *Re-examining Pedagogical Content Knowledge in Science Education* (pp.28–42). NY: Routledge.

Ghadirian, Hajar; Ayub, Ahmad; Silong, Daud; Bakar, Kamariah and Zabeh, Ali. (2014). Knowledge sharing behavior among students in learning environments: A review of literature. *Asian Social Science*, *10*(4), 38–45.

Grangeat, Michel. (2008). Complexity of teachers' knowledge: a synthesis between personal goals, collective culture and conceptual knowledge. *Paper presented at Network 10 – Teacher Education Research*, European Conference on Educational Research (ECER). Gothenburg.

Grangeat, Michel and Hudson, Brian. (2015). A new model for understanding the growth of science teacher professional knowledge. In M. Grangeat (Ed.), *Understanding Science Teachers' Professional Knowledge Growth* (pp. 205–228). The Netherlands: Sense Publishers.

Grangeat, Michel and Kapelari, Suzanne. (2015). Exploring the growth of science teacher's professional knowledge. In M. Grangeat (Ed.), *Understanding Science Teachers' Professional Knowledge Growth* (pp. 1–9). The Netherlands: Sense Publishers.

Groth, Randall; Spickler, Donald; Bergner, Jennifer and Bardzell, Michael. (2009). A qualitative approach to assessing technological pedagogical content knowledge. *Contemporary Issues in Technology and Teacher Education*, *9*(4), 392–411.

Guillies, Robyn. (2011). Promoting thinking, problem-solving and reasoning during small group discussions. *Teachers & TeachingL Theory and Practice*, *17*(1), 73–89.

Harackiewicz, Judith; Barron, Kenneth; Tauer, John; Carter, Suzanne and Elliot, Andrew. (2000). Short-term and long-term consequences of achievement goals: Predicting interest and performance over time. *Journal of Educational Psychology*, *92*(2), 316–330.

Harris, Alma and Goodall, Janet. (2008). Do parents know they matter? Engaging all parents in learning. *Educational Research*, *50*(3), 277–289.

Hattie, John and Timperley, Helen. (2007). The power of feedback. *Review of Educational Research*, *77*(1), 81–112.

Henderlong, Jennifer and Lepper, Mark. (2002). The effects of praise on children's intrinsic motivation: A review and synthesis. *Psychological Bulletin*, *128*(5), 774–795

Hudson, Peter; English, Lyn and Dawes, Les. (2009). Analysing preservice teachers' potential for implementing engineering education in the middle school. *Australasian Journal of Engineering Education*, *15*(3), 165–174.

Ionas, Ioan; Cernusca, Dan and Collier, Harvest. (2012). Prior Knowledge Influence on Self-Explanation Effectiveness When Solving Problems: An Exploratory Study in Science Learning. *International Journal of Teaching & learning in Higher Education*, *24*(3), 349–358.

Isseks, Marc. (2011). When teachers reduce curriculum content to bullet points, student learning suffers. *Educational Leardership*, 74–76.

Jethro, Olojo and Aina, Falemu. (2012). Effects of parental involvement on the academic performance of student in elementary schools. *International Journal of Academic Research in Business and Social Sciences*, *2*(1), 196–202.

Johnson, Karen and Golombek, Paula. (2016). *Mindful L2 Teacher Education: A sociocultural perspective on cultivating teacher's professional development*. New York: Routledge.

Jupp, Victor. (2006). *The SAGE Dictionary of Social Research Methods*. Thousand Oaks: SAGE Publication Inc.

Kapon, Shulamit. (2015). From new educational technologies to a personal-instructional repertoire. In M. Grangeat (Ed.), *Understanding Science Teachers' Professional Knowledge Growth* (pp. 171–186). The Netherlands: Sense Publishers.

Kim, ChanMin; Kim, Min; Lee, Chiajung; Spector, Michael and DeMeester, Karen. (2013). Teacher beliefs and technology integration. *Teaching and Teacher Education*, *29*, 76–85.

Kraft, Matthew & Dougherty, Shawn. (2013). The effect of teacher–family communication on student engagement: Evidence from a randomized field experiment. *Journal of Research on Educational Effectiveness*, *6*(3), 199–222.

Krathwohl, David; Bloom, Benjamin and Maisia, Bertram. (1964). *Taxonomy of educational objectives. The classifications of educational goals, handbook II: Affective domain*. New York: David McKay Company, Inc.

Lau, Eva; Li, Hui and Rao, Nirmala. (2011). Parental involvement and children's readiness for school in China. *Educational Research*, *53*(1), 95–113.

Lee, Cherin and Krapfl, Lisa. (2002). Teaching as you would have them teach: An effective elementary science teacher preparation program. *Journal of Science Teacher Education*, *13*(3), 247–265.

Lim, Cher Ping; Zhao, Yong;Tondeur, Jo; Chai, Ching Sing; Tsai, Chin-Chung. (2013). Bridging the gap: Technology trends and use of technology in schools. *Educational Technology & Society*, 16(2),59–68.

Lobato, Joanne. (2003). How design experiments can inform a rethinking of transfer and vice versa. *Educational Researcher*, *32*(1), 17–20.
Menheere, Adri, and Hooge, Edith. (2010). Parental involvement in children's education: A review study about the effect of parental involvement on children's school education with a focus on the position of illiterate parents. *Journal of the European Teacher Education Network (JETEN)*, *6*, 144–157
Merkley, Donna; Schmidt, Denise; Dirksen, Carrie and Fuhler, Carol. (2006). Enhancing parent-communication using technology: A reading improvement clinic example. *Contemporary Issues in Technology and Teacher Education*, *6*(1), 11–41.
Mestry, Raj and Bennie, Grobler. (2007). Collaboration and communication as effective strategies for parent involvement in public schools. *Educational Research & Review*, *2*(7), 176–185.
Mirza, Muller and Perret-Clemont, Anne. (2009). *Argumentation and Education: Theoretical Foundations and Practices*. NY: Springer.
Mishra, Punya and Koehler, Matthew. (2006). Technological pedagogical content knowledge: A framework for teacher knowledge. *Teachers College Record*, *108*(6), 1017–1054.
Mishra, Punya and Koehler, Matthew. (2007). Technological pedagogical content knowledge (TPCK): Confronting the wicked problems of teaching with technology. In R. Carlsen, K. McFerrin, J. Price, R. Weber, & D. Willis (Ed.), *Proceedings of Society for Information Technology & Teacher Education International Confernece 2007* (pp. 2214–2226). Chesapeake, VA: AACE.
Moon, Jenny. (2005). Progression in higher education: A study of learning as represented in level descriptors. In P. Hartley, A. Woods, & M. Pill, *Enhancing Teaching in Highr Education*. London: Routledge Falmer. doi:10.1016/j.jesp.2014.02.004
Muller, Florian and Palekcic, Marko. (2005). Continuity of motivation in higher education: A three-year follow-up study. *Review of Psychology,12*(1),31–43.
O'Keefe, Paul and Linnenbrink-Garcia, Lisa. (2014). The role of interest in optimising performance and self-regulation. *Journal of Experimental Social Psychology*, *53*, 70–78.
Osborne, Jonathan; Erduran, Sibel and Simon, Shirley. (2004). Enhancing the quality of argumentation in school science. *Journal of Research in Science Teaching*, *41*(10), 994–1020.
Pachler, Norbert; Bachmair, Ben and Cook, John. (2011). *Mobile Learning. Structure, Agency, Practices*. London: Springer.
Pahl-Wostl, Claudia. (2009). A conceptual framework for analysing adaptive capacity and multi-level learning processes in resource governance regimes. *Global Environment Change*, *19*, 354–365.
Patall, Erika; Cooper, Harris; Robinson, Jorgianne. (2008). Parent involvement in homework: A research analysis. *Review of Educational Research*, *78*(4), 1039–1101.
Pedrosa-de-Jesus, Helena, Moreira, Aurora, Lopes, Betina, & Watts, Mike. (2014). So much that just a list: exploring the nature of critical questionning in undergraduate sciences. *Research In Science & Technological Education*, *32*(2), 115-134. doi: 10.1080/02635143.2014.902811
Piaget, Jean. (1971). *Biology and Knowledge*. Chicago: University of Chicago Press.
Pope, Margaret; Hare, Dwight and Howard, Esther. (2005). Enhancing technology use in student teaching: A case study. *Journal of Technology and Teacher Education*, *13*(4), 573–618.
Ramma, Yashwantrao; Bholoa, Ajeevsing; Watts, Mike and Ramasawmy, Jagambal. (2014). Pre- and in-service physics teachers' content and pedagogical content knowledge: Implications and Challenges. *American International Journal of Research in Science, Technology, Engineering & Mathematics*, *8*(1), 30–34.
Ramma, Yashwantrao; Samy, Martin and Gopee, Ajit (2015). Creativity and innovation in science and technology - bridging the gap between secondary and tertiary levels of education. *International Journal of Educational Management*, *29*(1), 2–17.
Ramma, Yashwantrao;Tan, Kah-Chye & Mariaye, Hyleen. (2009). Engaging Mauritian primary school pupils to develop core constructs in science using PDA wth a learner centered pedagogy. *International Science Education Conference*. Singapore: NIE.
Renninger, Ann and Hidi, Suzanne. (2016). *The power of interest for motivation and engagement*. New York: Routledge.
Robinson, Keith and Harris, Angel. (2014). *The Broken Compass: Parental Involvement with Children's Education*. London: Harvard University Press.

Roschelle, Jeremy; Shechtman, Nicole; Tatar, Deborah; Hegedus, Stephen; Hopkins, Bill; Empson, Susan; Knudsen, Jennifer and Gallagher, Lawrence. (2010). Integration of technology, curriculum and professional development for advancing middle school physics: Three large scale studies. *American Educational Research Journal*, *47*(4), 833–878.

Rosen, Christine. (2011). The new meaning of mobility. *New Atlantis: A Journal of Technology & Society*, *31*, 40–46.

Roth, Kathleen. (2013). Developing meaningful conceptual understanding in science. In B. F. Jones, & L. Idol (Eds.), *Dimensions of thinking and cognitive instruction* (pp. 139–176). NY: Routledge.

Rovai, Alfred; Wighting, Mervyn; Baker, Jason and Grooms, Linda. (2009). Development of an instrument to measure perceived cognitive, affective, and psychomotor learning in traditional and virtual classroom higher education settings. *Internet and Higher Education*, *12*(1), 7–13.

Ryan, Allison and Patrick, Helen. (2001). The classroom social environment and changes in adolescents' motivation and engagement during middle school. *American Educational Research Journal*, *38*(2), 437–460.

Ryan, Richard and Deci, Edward. (2000). Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *American Psychologist*, *55*, 68–78.

Sacker, Amanda; Schoon, Ingrid and Bartley, Mel. (2002). Social inequality in educational achievement and psychosocial adjustment throughout childhood: magnitude and mechanisms. *Social Science and Medicine*, *55*(5), 863–880.

Sampson, Victor and Blanchard, Margaret. (2012). Science teachers and scientific argumentation: Trends in views and practice. *Journal of Research in Science Teaching*, *49*(9), 1122–1148.

Sapungan, Gina and Sapungan, Ronel. (2014). Parental involvement in child's education: Importance, barriers and benefits. *Asian Journal of Management Sciences & Education*, *3*(2), 42–48.

Savard, Caude. (2014). The use of mental model-centered instruction in teaching a university course. *International Journal of Technology and Inclusive Education*, *3*(1), 241–247.

Schmidt, Denise; Baran, Evrim; Thompson, Ann. D., Mishra, Punya; Koehler, Matthew and Shin, Tae. (2009). Technological pedagogical content knowledge (TPACK): The development and validation of an assessment instrument for preservice teachers. *Journal of Research on Technology in Education*, *42*(2), 123–149.

Seebaluck, Ashley and Seegum, Trisha. (2012). Motivation among public primary school teachers in Mauritius. *International Journal of Educational Management*, *27*(4), 446–464.

Shelly, Gary; Gunter, Glenda and Gunter, Randolph. (2012). *Teachers discovering computers: Integrating technology in a connected world* (7th ed.). Boston: Cengage Learning.

Shephard, Kerry. (2006). Higher education for sustainability: seeking affective learning outcomes. *International Journal of Sustainability in Higher Education*, *9*(1), 87–98.

Shulman, Lee. (1986). Those who understand: Knowledge growth in teaching. *Educational Researcher*, *15*(2), 4–14.

Stanhope, Daniel; and Corn, Jenifer. (2014). Acquiring teacher commitment to 1:1 initiatives: The role of th etechnology facilitator. *Journal of Research on Technology in Education*, *46*(3), 252–276. doi:10.1080/15391523.2014.888271

Tiryakioglu, Filiz and Erzurum, Funda. (2011). Use of social networks as an educational tool. *Contemporary Educational Technology*, *2*(2), 135–150.

Treagust, David and Duit, Reinders. (2009). Multiple perspectives of conceptual change in science and the challenges ahead. *Journal of Science and Mathematics Education in Southeast Asia*, *32*(2), 89–104.

Turanli, Adem. (2009). Students' and parents' perceptions about homework. *Education and Science*, *34*(153), 61–73.

Walker, Joi and Sampson, Victor. (2013). Learning to argue and arguing to learn: Argument-driven inquiry as a way to help undergraduate chemistry students learn how to construct arguments and engage in argumentation during a laboratory course. *Journal of Research in Science Teaching*, *50*(5), 561–596.

Westera, Wim. (2015). Reframing the role of educational media technologies. *Quarterly Review of Distance Education*, *16*(2), 19–32.

Wigfield, Allan and Cambria, Jenna. (2010). Stduents' achievement values, goal orientations, and interest: Definitions, development, and relations to achievement outcomes. *Developmental Review*, *30*, 1–35.

Wigfield, Allan and Eccles, Jacquelynne. (2000). Expectancy-value theory of achievement motivation. *Contemporary Educational Psychology*, *25*(1), 68–81.

Yin, Robert. (2003). *Case study research: Design and methods* (3rd *ed.)*. Thousand Oaks: Sage Publications.

Zainal, Zaidah. (2007). Case study as a research method. *Journal Kemanusiaan*, *9*, 1–6.

Zohar, Anat. (2004). Elements of teachers' pedagogical knowledge regarding instruction of higher order thinking. *Journal of Science Teacher Education*, *15*(4), 293–312.

Appendix (Guiding Interview Questions)

Students

(1) How have you been learning physics at school? How different is it to learn physics by using this online platform as compared to the way that you have been learning physics at school?
(2) What constitutes, according to you, the novelty of these activities? Don't you do activities at school also?
(3) How do these videos help in understanding the concepts?
(4) Were your parents involved when you were doing the online home activities? How did your parents respond?
(5) Suppose we didn't have that website, would your parents have been involved in the way that you normally learn, i.e. through the textbook and so on?
(6) In what ways do you think this website will help you or the contents in the website will help you towards your exam preparation?
(7) You were given tasks prior to stepping in the class, do you think that these were helpful to you? Do you usually do some prior work on physics before you are about to learn something new?
(8) Do you think that the lessons appearing on the online platform have helped you to better understand the concepts in class without the teacher's intervention?
(9) What could have been done or what could we have done to improve on what we presented as online activities?

Teacher

(1) Have you yourself gone through the online activities? What are your reactions?
(2) How do you foresee your role now in this new teaching-learning environment?
(3) In this new environment, how will you ensure that misconceptions among your students are addressed?

Parents

(1) Did you like carrying the activities with your child?
(2) What are your views about the web-based questions?
(3) Would you like to participate in the education of your child in the future?
(4) Did you experience any difficulty while proceeding with the web-based tasks?