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# Productive Pedagogies as Framework to Improve Preservice Teachers' Practices

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*Abstract: Reforming pedagogy in mathematics education has been the focus of numerous educational reforms around the world. Productive Pedagogies is a framework for reflection on teaching that aims at improving student's intellectual reasoning, making school teaching and learning more connected to students' everyday lives, and addressing the concerns of equity support that students need. This paper reports on a study using the Productive Pedagogies framework with a group of final year pre-service teachers at a teacher education college in Saudi Arabia. The students were introduced to the framework in a unit on mathematics education and were observed during the following semester in their field experience to ascertain their level of understanding and use of the framework. The results showed that there was a high level of acceptance of the framework as an effective tool for planning and performing teaching. In particular, the preservice teachers demonstrated a shift towards student-centred teaching. Reflecting on some of the problems that were observed, this paper makes some recommendations for teacher training programs in general.*

Keywords: Mathematics Education, Teacher Education, Pre-Service Teachers, Professional Development, The Productive Pedagogies Framework

**D**URING THE PAST decade, there has been a national initiative to renew teaching and learning in Saudi Arabian schools. A report prepared by a team of educator supervisors in the Ministry of Education found that the teaching methods used within the Saudi classrooms often were based on traditional teaching that focused on memorization of facts and the development of routine techniques and failed to assist students to develop deep understandings and higher order thinking (Ministry of Education, 2000). The report recommended that there be a focus on the quality of teaching. Consequently, the Riyadh Teachers College<sup>1</sup> engaged in the implementation of major reform to improve teaching practices in all its courses. This focus on improving teaching is, arguably, parallel to the international concerns that a mere focus on issues of the learner neglects the crucial role of the teacher in the educational endeavour (Atweh, 2010; Darling-Hammond, 2000). Alghamdi (2002) in his discussion about the future vision of teachers' colleges in Saudi Arabia stressed that colleges should keep up with the global changes towards student-centred approaches. This challenge was adopted in the reforms at the Riyadh Teachers College along the lines of previous mathematics education reforms around the world which advocated a shift from the traditional teacher-centred approach towards a more active involvement of the learners (Australian Education Council, 1991; NCTM, 1989;).

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<sup>1</sup> The College is the context of employment of the first author who was the lecturer-researcher in the project.

This paper reports on a study conducted in the context of a doctoral research project with one group of preservice teachers in that college. The project employed the Productive Pedagogies framework (Lingard et al. 2001) in mathematics education during the last year of the preservice teachers' course. In particular, this paper aims to a) investigate the preservice teachers' views about the usefulness of the framework, b) their ability to implement it, and c) to raise some issues that may limit such implementation. The following section outlines the main features of the Productive Pedagogies framework. This is followed by a discussion on the context and design of the study. The major findings of the study, as they relate to the preservice teachers' views of the usefulness of framework and their implementation of it in their field experience, will then be elaborated. After making a few observations on some of the difficulties encountered in the use of the Productive Pedagogies to reform teaching, the paper concludes with recommendations for improving teacher education programs in general.

### **The Productive Pedagogies Framework**

Based on the Queensland School Reform Longitudinal Study (QSRLS) (Education Queensland, 2001) and decades of research on teaching from around the world, a comprehensive framework known as Productive Pedagogies was developed in Queensland, Australia to identify the essential features of effective teaching. A primary rationale for developing Productive Pedagogies was to provide a tool for teachers to use to increase their students' learning outcomes, both academic and social (Lingard et al. 2001). The new approach was not conceived as a recipe or panacea for teaching but described as "a balanced theoretical framework enabling teachers to reflect critically on their work" (Education Queensland, 2002, p. 2). The framework has a focus on the improvement of student intellectual reasoning and makes teaching and learning in schools more applicable to the students' everyday lives in addition to creating supportive environments which accommodate diversity in the classroom and achieve the agendas of equity (Luke, 1999). The developers of Productive Pedagogies postulated that there were four dimensions that characterised effective teaching: Intellectual Quality, Connectedness, Supportive Classroom Environment, and the Recognition of Difference. Each dimension was further elaborated by a number of elements constituting the dimensions (Lingard et al. 2001).

The notion of Productive Pedagogies has become a central focus of research and academic interest over the last decade. Zyngier (2005, p. 4) indicated that "variations of the Productive Pedagogies framework have been adopted in New South Wales, Tasmania, South Australia and Victoria". Likewise, there are several studies highlighting Productive Pedagogies in teacher education and training. Some studies attempted to model Productive Pedagogies in pre-service teachers programs to 1) change pedagogic practice, 2) increase students' awareness of teaching pedagogy and 3) implement critical reflection for their understanding of the framework (Wilson & Klein, 2000; Sorin & Klein, 2002; Zyngier 2005; Aveling & Hatchell, 2007). Gore, Griffiths and Ladwig (2001) studied the use of the Productive Pedagogies in their field experience of pre-service teachers. Other studies prepared a series of professional development activities focussed on Productive Pedagogies for in-service teachers (Gore, Griffiths & Ladwig, 2002).

## The Study

Prospective teachers of mathematics at the Riyadh Teachers' College undertake a four year Bachelor of Education course. They study a unit called "Mathematics Teaching Methods" in their seventh semester. The unit contact time is 2 hours each week for 14 weeks. In this unit, the students consider various mathematics teaching methods and their application. During the following final semester, the students are engaged in fulltime field experience which includes teaching mathematics for a minimum of eight lessons per week for the full semester.

This study took place during both final semesters of the course and was conceptualised to consist of two phases. In *phase 1*, pre-service teachers were introduced to the Productive Pedagogies framework in the unit of Mathematics Teaching Methods. In other words, the framework constituted part of the content of the unit and was used as an overall organizer to integrate the other content usually covered in the subject. At the same time, the framework was used by the lecturer in his teaching of the subject, thus modeling the principles of the framework in the classroom. The data collection for this phase consisted of the lecturer-researcher and preservice teachers own reflective journals and three focus groups with selected preservice teachers.

In *phase 2*, six pre-service teachers were followed into their field experience at two participating primary schools. Each preservice teacher was observed by the lecturer researcher five times during semester as part of the college requirement. However, in each observation, evidence of implementation of the four dimensions of the framework was ascertained by using the QSRLS Productive Pedagogies Classroom Observation Manual (Education Queensland, 2001) which formed the basis for the usual feedback from the lecture on their observed teaching. The coding manual contains each element of the four dimensions, together with five Likert scale score indicating the level of manifestation of the element in that particular lesson (1 being the lowest). For example, in Higher Order Thinking element of the Intellectual Quality dimension, the lesson was rated as 1 if the students were engaged only in tasks requiring lower order thinking such as receiving or reciting information, or participating in routine practice of acquired skills. However the lesson was rated as 5 if almost all the students, almost all of the time, are engaged in higher order thinking (Education Queensland, 2001). In addition, semi-structured individual interviews were conducted with each of three participants to investigate their understanding and views about the implementation of the Productive Pedagogies in their practice. Finally, one focus group was also conducted with all six pre-service teachers at the end of their field experience.

## Key Findings and Discussion

The data collected from the preservice teachers in *phases 1 and 2* of the study showed that there was widespread approval of Productive Pedagogies by the preservice teachers and, to a large extent, they provided evidence of an ability to implement it in their teaching. The following two sections discuss each theme separately. The third theme discussed here relates to some of the pending issues identified by research that may require further, investigation and action.

### **Preservice Teachers' Perceptions of the Framework**

In general there were many positive comments towards the use of the Productive Pedagogy framework demonstrated in the different reflective journals and focus groups conducted in *phase 1* of the project. In particular, the framework was perceived as an effective framework for teaching for two reasons. Firstly, it was found to be valuable as an overall guide for the preservice teachers' practice. Secondly, it enabled them to adopt a shift towards student-centred teaching.

#### **A Valuable Overall Guide for Practice**

The use of Productive Pedagogies as an overall guide to teaching practice was a common theme made by several of the preservice teachers. In interviews and focus groups, the majority of them stated that the framework was a highly helpful tool for good teaching practice. During their study at the College, these preservice teachers experienced a range of courses addressing teaching and learning theory, curriculum and educational philosophy. As part of their studies, the preservice teachers had been exposed to different theories for teaching and learning and had explored a variety of teaching pedagogies. While the framework does not provide a particular philosophy of education, a set of aims nor, for that matter, a set of pedagogies, it has provided these preservice teachers with a tool that can integrate the different knowledges they acquired in the course and that is, at the same time, a practical tool for reflection and to inform practice. Hence it was seen as a useful tool for learning about teaching at their level of development. In the words of one student:

*I saw the productive pedagogies principles as a key basic model for teaching; it is a tool that can lead pre-service teachers to the right steps to become a successful teacher in the future (PT1, Phase 1, focus group).*

Gore, Griffiths and Ladwig (2001) stressed that there is evidence that preservice teachers who were introduced to the framework have tended to find it useful to guide their teaching. The participants felt that the different dimensions of Productive Pedagogies have helped to direct their teaching practice. Becoming a good teacher is a goal of beginning practitioners, and the Productive Pedagogy framework was seen as helpful in guiding them about strategies teachers might apply in specific lessons.

More specifically, the students identified the comprehensiveness and organisation of the framework as particularly useful. The four dimensions of the framework: intellectual quality, connectedness, supportive classroom environment, and recognition of difference, helped the preservice teachers to focus on the *all* aspects of the classroom practice. Overwhelmingly, the preservice teachers expressed very positive views about the potential of Productive Pedagogies as a model for teaching that provides comprehensive and organized aspects of teaching strategies. One participant mentioned that:

*In my view, Productive Pedagogies is a complete model of teaching and it has all the elements of good teaching (PT7, Phase 1, focus group).*

Another student put it this way:

*Productive Pedagogies is well-organized model and I found that the four dimensions of the framework complete each other and must be applied in mathematics lessons in order to benefit all students (PT6, Phase 2, reflection).*

### **Facilitating Change towards Student Centred Teaching**

The principle of student centred education was not a new concept for these preservice teachers. As indicated above, this has been a focus of recent reforms at the College in which they have been situated. There is, however, an apparent gap in acknowledging this as a general principle and a teacher's personal understanding and implementation. Previous research has indicated that preservice teachers often revert to traditional theories of learning and teaching methods during their field experience and in their transition to the practice of teaching (Richardson, 1996). In this project there was strong evidence that the framework was seen by participating preservice teachers as influential in challenging their personal theories of teaching and learning and their practice towards more student centred approaches.

Teachers' personal views on learning theories are important influences on classroom practice. What teachers do in the classroom reflects their (at times unarticulated) beliefs on how students learn. If the teachers believe that knowledge can be transmitted, then their class instructions might involve the directed one-way flow of information to students. However, if teachers subscribe to the constructivist view of learning, activities to help students to build knowledge would prevail. Student-centred teaching was stated to be one of the central implications of the framework. There is considerable evidence in this study that the consideration of the Productive Pedagogy has influenced the preservice teachers by challenging their views about their assumed learning theories. There was an indication by the preservice teachers that their views of learning and teaching had changed after studying and implementing the framework. One preservice teacher commented:

*I think the Productive Pedagogies framework was necessary for pre-service teachers, because it helps us to become teachers in ways that change the picture of a teacher from one who just transfers knowledge to the student. (PT3, Phase 2, focus group)*

Similarly, there was evidence that the use of Productive Pedagogies in the course has assisted the preservice teachers to consciously think of means of replacing traditional and familiar teaching methods with more student-centred activities. They commented that the framework has assisted them to achieve this shift. In the words of one participant:

*With Productive Pedagogies I believe that knowledge must be expressed in various ways. I see us moving away from the traditional teaching process and we are trying to introduce new student interactions with the knowledge gained through discussion and a consensus being reached...In the end, students will have the correct information in an interactive learning environment which will ultimately help their learning skills. (PT1, Phase 1, reflection)*

Another participant has put it this way:

*During my field experience, Productive Pedagogies helped me to consider the background knowledge of students to build on the new information, as part of this I was able to assess good dialogues to help students to analyse and synthesise knowledge in a socially supportive class. (PT7, Phase 2, interview)*

Teacher's beliefs about teaching and learning play an important role in classroom practices (Kagan, 1992). Applefield, Huber and Moallem's (2000, p. 1) state, "teachers' personal theories of learning have long been viewed as having considerable influence on virtually all aspects of teachers' decisions about instruction". The advantage of Productive Pedagogies is that it provides a more tangible means of promoting teacher understanding about student-centred learning. It was expected that pre-service teachers in this study saw the framework as a guide towards a student-centred classroom. These findings are consistent with earlier studies that found that the framework exposure does lead pre-service teachers to change their practices (Gore et al., 2001).

### **Preservice Teachers' Ability to Implement the Framework**

There is some evidence that, during the field experience, the preservice teachers have been consciously using the framework in their planning of their lesson. One student summarised his experience as follows:

*As I always have the four dimensions in my mind in every lesson and try to apply some of the elements that facilitate teaching to achieve the lesson's objectives, (I find) this framework is the best way to improve my practice. (PT6, Phase2, reflection).*

In reflecting on their field experience some preservice teachers talked about how the model was useful for them in preparing for their teaching by planning activities that provided for a range of aims inspired by the model. Other preservice teachers indicated that they were aware of the framework in conducting their classes and interacting with students. When possible they employed open ended questioning for the students. Lastly, the reflective journals demonstrated that they were able to use the framework to reflect on their teaching towards a deeper awareness of their assumptions and practices. According to Zyngier (2006) the framework provides preservice teachers who have no experience in teaching with intelligible and efficacious language for thinking about teaching. The Productive Pedagogies framework provides teachers with a vocabulary to help them discuss their pedagogies and reflect upon them (Lingard, Hayes, & Miles, 2003).

In a previous paper we have discussed in some detail the implementation of the Connectedness dimension of the Productive Pedagogies framework by these preservice teachers during their field experience (Alsharif & Atweh, 2010). In this paper, we will focus only on the elements of the Intellectual Quality dimension. The data collected from classroom observations suggested that there was some evidence of attempts to implement Intellectual Quality elements by the various preservice teachers in their teaching – arguably more successfully by some than others. Based on the data collected using the Classroom Observation Manual.



Table 1 presents the means of the Intellectual Quality elements for each preservice teacher across the 5 observations and shows the low and high scores for the different preservice teachers. The Table represents the observed implementation of the six components of Intellectual Quality of the Productive Pedagogies framework: Higher Order Thinking (HOT), Deep Knowledge (DK), Deep Understanding (DU), Substantive Conversation (SC), Knowledge as Problematic (KAP), and Metalanguage (ML).

The data shows that the mean scores for the preservice teacher seemed to be relatively higher in the Higher Order Thinking, Depth of Students' Understanding and Substantive Conversation and were between 2.2 and 2.3. In contrast, their mean scores on Knowledge as Problematic and Metalanguage were a bit lower and ranged between 1.76 and 1.53. While direct comparison with other studies may not be very meaningful, we note that these results are within the ranges of those obtained in Australian data (Gore at al., 2001; QSRLS, 2001).

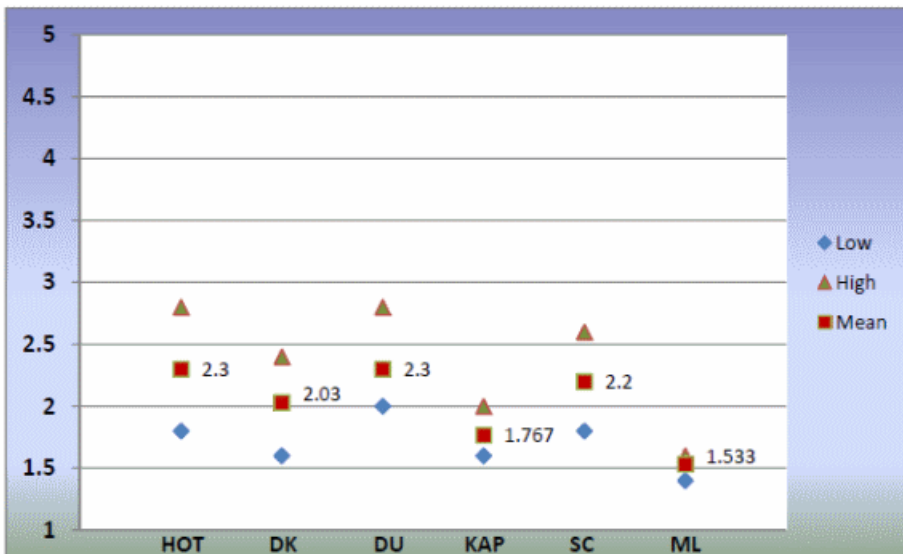


Table 1: Preservice Teacher Scores on the Implementation of the Six Components of Intellectual Quality of the Productive Pedagogies Framework

In order to illustrate the meaning of these scores, the lecturer-researcher recorded the following diary item from one observed Year 3 lesson. The preservice teacher aimed to develop knowledge and skills of the young students regarding the concept of *weight*. Through group-work, the teacher exploited the Substantive Conversation element allowing the students to self-assess and peer-assess their conceptions. Through the task, the teacher drew Higher Order Thinking from the students requiring them to problem solve and think deeply about the topic.

*I entered the Year 3 class and headed to my seat at the back of the classroom. The balance-scale on the teacher's table drew my attention. The students seemed eager to know more about this equipment. The teacher started his lesson by writing the topic on the board "Weight". In keeping with the Year 3 level of instruction, the lesson focused*

*on the concepts of weight and related skills of using the scale. The teacher began the lesson by present different pictures and asked students to determine which was lighter and which was heavier. That was a task that enabled them to draw from their experience, for example, their knowledge that a car will be lighter than a train. The teacher divided students into four groups and provided each group with five different objects; a pen, a book, a balloon, an empty box and a key lock. Then the teacher instructed each group on how to use the balance-scale to arrange these objects on their desks going from the lighter to the heavier. This activity was challenging for the students and required them to use higher order thinking in order to complete it successfully. For Year 3 students, to order five objects by using balance-scale was not an easy task. Each group had to present their findings and share the results with the rest of the class. The teacher feedback included more extensive discussion on the material from which an object is made is related to its weight. Subsequently, the teacher raised some questions related to students' own weights. Then the teacher opened the floor for a discussion on questions such as what kind of food makes you fat? Or what kind of activities helps you to lose weight? Again, at the end of the class, questions were raised to explain the meaning of equal weight, lighter weight and heavier weight. (Research diary, 30/3/2009).*

In this scenario the teacher created activities that required higher order thinking when asking students to use the balance-scale to arrange five objects from the lighter to the heavier and explaining their reasoning to the rest of the class. These are not easy tasks for the majority of students at that grade level and they are not part of their normal classroom routine. The classification and explanation was designed to go beyond the development of skill of using the scale to compare two weights. It constituted a real-world-like problem situation for the students. Similarly, asking students to work in groups to perform their tasks helped them to co-develop and communicate their understandings with each other. Presenting their findings for discussions helped them to receive useful feedback from their teacher and other peers. Errors in their answers provided discussion about the process they used as well as identify few misconceptions that students had (e.g. bigger objects are heavier) and deepen their own knowledge by responding to challenges from other students.

Another interesting observation from this class was that all the students were heavily engaged in the task and were eager to collaborate towards its achievement – some were responsible for weighting the objectives and others for writing the findings. They showed enthusiasm by helping each other and raising questions on each other's work. This was one productive lesson where the teacher implemented effective pedagogies that focused the implementation of higher order thinking and substantive conversation. Interestingly, these observations correspond to themes identified by the preservice students themselves in discussing Intellectual Quality dimension.

The data from preservice teachers' interviews and reflective journals revealed that they have consciously attempted to apply intellectual quality elements in their practices. They identified two reasons for the importance of a focus on this particular dimension. Firstly, the preservice teachers argued that implementing higher order-thinking and substantive conversation elements helped students to gain deeper understanding of the content discussed.

*Encouraging students to complete tasks that required higher order thinking and critical thinking helped in the achievement of clear understanding of concepts. (PT7, Phase 2, Focus group)*

Another student put it this way:

*Math teachers need to focus on intellectual quality to create activities that allow students to engage in higher order thinking, analysis, synthesis and explanation. Because these will help students to apply the knowledge in different ways and in different situations as well as help them to learn the correct ways of thinking (PT4, Phase 2, reflection).*

Other participants identified specific teaching approaches towards achieving this aim. One student commented on the use of problem solving:

*I used problem-solving technique to engage students in higher order thinking and allow them to solve problem on their own to arrive to some conclusion, in this way the information will establish effectively in the mind of the students (PT3, Phase 2, reflection)*

These comments are in line with Newmann's (1990) claim that teachers who promote higher order thinking will enhance benefits for individual students. He argued that higher order thinking is important for the learning of all students. Later Newmann and Associates (1996) found that when teachers provide students with intellectual challenges, students perform better in their assessment.

Although traditionally Saudi classrooms seem to have less teacher-student interaction, many of the preservice teachers have succeeded in applying substantive conversation at a significant level. Student teachers encouraged their students to engage in substantive conversation to complete their tasks in the classroom. They believed that when students are involved themselves in discussions, they seemed to develop a deeper and clearer understanding of the concepts under consideration.

*I focused on substantive conversation in my classroom because it increased the students' thinking and confidence so they interacted with each other and exchanged ideas, which in turn, facilitated effective understanding of the concept, discussed (PT4, Phase 2, reflection)*

Secondly, the reason for preservice teachers implementing Intellectual Quality elements in their practice is not only to help students to gain a clearer understanding of concepts being taught, but also to make the lesson more enjoyable. The participants expressed views indicating that students seemed to enjoy the learning process more when they were involved in challenging tasks.

*The enthusiasm and interaction of students are apparent when they not only rely on delivery of knowledge, but on their self-reliance in accessing to information and using the high order thinking to combine facts or analyse ideas on the topic. (PT4, Phase 2, reflection)*

## Pending Issues and Limitations

In spite of the positive indicators for the effectiveness of the Productive Pedagogy framework in assisting these preservice teachers in their understanding, planning and conducting of their teaching, there are two issues that are worthy of consideration from the data in this study. Careful consideration of the data represented in Table 1 shows that there was significant variation in the scores in many of the elements and considerable variation between the different elements. We turn now to discuss each of these patterns.

First, not all students demonstrated the same level of application of the framework in their teaching. While the group averages in many of the elements indicate that attempts have been made to implement the principles of Productive Pedagogies in the different classes, some students did that more than others. To a large extent these variations can be explained by consideration of the level in which the preservice teachers were teaching at. In general, preservice teachers teaching at higher level classes (4 – 6) have demonstrated a greater use of the elements of Intellectual Quality dimension than those at lower level classes (1 – 3). The interviews and focus group discussion indicated that preservice teachers at lower levels of the school faced some difficulties in the earlier years.

*It is a difficult task to apply intellectual quality elements on the primary school curriculum, especially at the lowest stage (PT3, Phase2, focus group).*

Some preservice teachers have attributed these difficulties to the level of maturity of the student and their language ability.

*For students at the lowest stage, the activities that focus on higher order thinking can be difficult because they require high mental capacity (PT6, Phase2, interview)*

*Applying substantive conversation with my students (Year 3) seemed to be difficult. I encouraged them to raise questions, but there were no more questions to be raised in the classroom (PT6, Phase2, interview)*

Other preservice teachers expressed wider concerns about the use of higher order thinking activities in their classes. They were concerned that a focus on higher order thinking should provide a challenge for the students; however, some student may find these tasks too frustrating and not be able to cope with them, thus resorting to copying the responses of other more capable students in the class. These preservice teachers have rightly concluded that higher order thinking tasks should be used judiciously with care about their appropriateness to the students' particular level of knowledge development.

The second observation that needs to be made about the data from Table 1 is that not all elements of the Intellectual Quality were demonstrated at the same level. In particular, the preservice teachers did not seem to apply Knowledge as Problematic and Metalanguage to the same level as the other levels. Metalanguage, which refers to pedagogies that incorporates frequent discussion about talking and writing, had limited implementation in most of mathematics lessons observed. One participant stressed the difficulty of incorporating discussion about talking and writing into the mathematical classroom by saying that

*Sometimes, in mathematics classrooms, it is hard to use alternative words to explain the mathematical concepts. In my class (Year 3) focusing on aspects of language or writing will use up too much teaching time. Students have difficulty in reading and writing because they are still young. I usually have to read the questions to them (PT6, Phase2, interview)*

Another student questioned whether metacognition is applicable at all in subject such as mathematics.

*I could not create activities to apply the metalanguage element in my lesson. I think this element will be more suitable for social studies and Arabic language classes (PT3, Phase2, interview)*

### **Concluding Comments**

This paper discussed aspects of the learnings that arose from an intervention of employing a Productive Pedagogy teaching framework in the final year of teacher preparation course in Saudi Arabia. It presented evidence that overwhelmingly students found the framework very useful to integrate their knowledge which developed in the previous units of the course and they also attempted to use it in planning, conducting and reflecting on their practice in their field experience. Due to the nature of the project being focused only on one subject in one semester, one cannot expect a full reform of teaching practices in the classroom. Traditions of teaching developed over a lifetime if not generations require more effort to expose and reform. However, the evidence learnt here is that adopting this framework might be a promising step in the desired direction. The learning from this project raises some interesting areas for further investigation and action. It would be of great interest to investigate the possibility of adopting a framework such as Productive Pedagogy early in the course in an integrated manner across the different subjects taught at the College. However, for that to happen, the issue of current knowledge and understanding regarding pedagogy of all teaching staff at the College needs to be ascertained as well as their need for capacity building towards pedagogical reform.

Finally, in the specific area of mathematics education, this study raises the need for educators to conduct more research about how important aspects of the framework that are not often seen as applicable to mathematics education, such as in the case discussed here of Metalanguage and Knowledge as Problematic elements, can be applied to mathematics education, specially at the lower grades.

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