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## Teachers' Conceptions About Physics Instruction: A Case Study in Malaysian Schools

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### ABSTRACT

**Background:** Physics is often labeled as a difficult and boring subject to be learnt at school. An appropriate teaching method is important to attract students to get involved in this subject, as well as to change their negative perceptions. As previous studies show that teachers teaching method are related to their conceptions of teaching, it is necessary to make teachers' conceptions about teaching explicit. **Objective:** The purpose of this study was to examine the current Physics teachers' conceptions about Physics instruction in Malaysian secondary schools and how urban Physics teachers' conceptions differ from rural teachers'. Respondents involved consist of twelve Physics teachers (six from urban schools and six from rural schools) who are currently teaching the subject of Physics at the form four and form five levels at schools in the northern peninsular states of Malaysia. Data were collected through structured interviews with the teachers individually, and were then analyzed qualitatively. **Results:** Results obtained show that except for the ideas of the concept of scientific literacy, it was found that the current Physics teachers in general have alternative conceptions about Physics instruction. There is no significant difference between urban and rural Physics teachers' conceptions towards Physics instruction. **Conclusion:** The current Physics teacher's conceptions about Physics instruction in Malaysian schools are consistent with alternative instructions.

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## INTRODUCTION

A conception is generally defined as an idea, a notion or a concept. According to Pratt (1992); "Conceptions are specific meanings attached to phenomena which then mediate our response to situations involving those phenomena. We form conceptions of virtually every aspect of our perceived world, and in so doing, use those abstract representations to delimit something from, and relate it to, other aspects of our world. In effect, we view the world through the lenses of our conceptions, interpreting and acting in accordance with our understanding of the world" (page 204).

In the context of education, a teacher's conception about subject teaching is important as it influences the instruction performed in the classroom (Canbay & Berecen, 2012; Lotter, Harwood & Bonner, 2007). This conception does not only affect a teacher's judgement and his or her teaching behavior, (Pajares, 1992) but also students' learning outcomes as well as the way in which students go about their study (Devlin, 2006). The two main categories of teaching conceptions that have constantly become a public concern are teacher-centered/content-oriented and student-centered/learning-oriented (Kember, 1997). A teacher/content-centered conception of teaching is one where the teacher's job is imparting information and transmitting structured knowledge, whereas in a student-centered/learning-oriented category, the job lies in facilitating understanding and conceptual change/intellectual development of the learners (Kember, 1997).

Teachers form conceptions consciously and they guide their teaching throughout their careers (Mokiwa & Msila, 2013). What teachers do in their classrooms are oriented by their conceptions of teaching (Canbay & Berecen, 2012). These conceptions are derived from their beliefs, including a teacher's prior experiences, school practices, and a teacher's individual personal (Canbay & Berecen, 2012). To improve teaching practices and student learning outcomes, teachers are suggested to move away their thinking paradigm from a traditional teaching conception towards a more meaningful, alternative teaching conception.

### Problem Statement:

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The teaching and learning strategies in the Physics curriculum in Malaysian schools emphasize on thoughtful learning (Curriculum Development Centre, 2012). Thoughtful learning is a process of acquisition and mastery of skills and knowledge that can expand a student's mind to its optimal levels (Curriculum Development Centre, 2012). It is also a process that can occur through a variety of different approaches to learning such as inquiry, constructivism, contextual learning and mastery learning. Activities planned in a thoughtful learning process must be able to provoke critical and creative thinking of students and should also be non-routine (Curriculum Development Centre, 2012).

In rural areas, however, Physics instruction often occurs by way of presenting materials from a textbook, performing problem solving examples and occasionally conducting demonstrations and laboratory exercises aimed at verifying concepts taught in the classroom (Salmiza & Afik, 2011; Effendi & Zanaton, 2007; Syarifah Maimunah, 2003; Sulaiman *et al.*, 1996). While teaching Physics in urban schools fare better, there are also cases where teachers are still stuck to the traditional way of teaching (Salmiza & Afik, 2011). Students, on the other hand, only listen to the teacher's explanation and receive the delivered knowledge without any queries (Salmiza & Afik, 2011; Effendi & Zanaton, 2007; Syarifah Maimunah, 2003; Sulaiman *et al.*, 1996). This type of method has been found to have retarded students' learning skills, as well as their creativity and curiosity to learn Physics effectively (Schank *et al.*, 1999; Sulaiman *et al.*, 1996). Therefore, Physics is often labeled as a difficult and boring subject to be learnt at school. (Bennett & Hogarth, 2009; Khalijah, 2004; Angel *et al.*, 2004; Robiah, 2003). This negative perception has led to the lack of interest and motivation towards learning Physics among students. As a result, most students tend to avoid this subject at the higher level of education because Physics, in contrast to other science subjects, is often perceived to be tougher (Mohd. Mustamam *et al.*, 2006; Khalijah, 2004; Lee *et al.*, 1996).

As teachers' actions mediate the impact of changes on students achievement in Physics, it is crucial for teachers to demonstrate a good understanding of the concepts of Physics instruction. Hence, this study attempts to examine teachers' conceptions on Physics instruction in schools to better understand the problems encountered.

#### **Literature review:**

Research findings show that the approaches adopted by teachers are found to be related to their conceptions of teaching (Khajornsak, 2009; Lotter, Harwood, Bonner, 2007; Trigwell & Prosser, 1997; Ineke *et al.*, 1994; Hewson & Kerby, 1993; Cronin-Jones, 1991) and such a relationship seems to be more apparent for experienced teachers than inexperienced or new teachers (Tsai, 2002). Teachers tend to choose instructional strategies which are consistent with their own personal conceptions about teaching (Koballa, Glynn & Upson, 2005; Hewson & Kerby, 1993), and tend to alter the curriculum around their conceptions about teaching (Cronin-Jones, 1991). Teachers who perceive teaching as transmitting information to students approach their teaching in terms of teacher-centric strategies, whereas those who perceive teaching in terms of helping students to develop and change their conceptions approach their teaching in a more student-centric way (Prosser & Trigwell, 1998). As such, teachers who hold constructivist or sophisticated beliefs are more likely to encourage students' conceptual change than teachers who hold more dualistic or naive beliefs (Hashweh, 1996). However, according to Leaderman (1998), teachers' conceptions of science do not necessarily influence classroom practice; what is of more critical importance are teachers' level of experience, intentions, and perceptions of students.

The younger generation tend to see teaching from a cognitive-constructivist perspective rather than seeing it from a behaviourist perspective (Krull, Koni & Oras, 2012). Therefore, the current teachers' conceptions about science teaching are found to be related to the views of constructivist and discovery approach (Antoniadou & Skoumios, 2013). The conceptions of good science teaching are classified as (i) focusing on science learning, (ii) facilitating students understanding, (iii) encouraging students' involvement, (iv) creating conducive environment, (v) encouraging active experimentation and (vi) preparing students for exams (Yung, 2013).

Even though science teachers in rural schools have been found to perform less effectively than those in urban schools, due to less exposure to a stimulating environment, (Wahyudi, 2004; Markstrom *et al.*, 2000), research findings on the conceptions of instructional practices among urban and rural teachers have not been consistent. Lü & Wang (2004) found that there is no significant difference between the belief of constructivism instructional approach between teachers from urban schools and rural schools, whereas Sang *et al.* (in press) observed that teachers working in developing areas hold higher constructivist beliefs than those working in developed areas. Previous research conducted shows that there is no significant difference in the proportions of urban and rural science teachers utilizing the traditionalist's view of the conception of science, whereas significant differences have been found between them on certain aspects of constructivist's view (Patrick, 2012).

Despite research showing that Physics teachers nowadays generally emphasize on knowledge related to day-to-day teaching practice, they still appear to lack some of the essential key ideas of modern Physics teacher education, such as a holistic view of instructional approaches (Asikainen & Hirvonen, 2010).

Thus, it is necessary to make teachers' conceptions about teaching explicit so that they can become aware of their own conceptions about teaching and examine how such conceptions influence their teaching practice (Koballa *et al.*, 2005).

#### **Objective:**

The objective of this research is to examine Physics teachers' instructional practices and conceptions in Malaysian schools. The research questions are:

- What are the current Physics teachers' conceptions about Physics instruction in Malaysian schools?
- How do urban and rural Physics teachers' conceptions about Physics instruction differ?

#### **Significance:**

Previous research in education indicated that teachers' conceptions of teaching influenced students' learning processes (Trigwell & Prosser, 1997; Prosser & Trigwell, 1998). Appropriate conceptions which lead to appropriate instructional practices have been found to enhance students' learning processes (Prosser & Trigwell, 1998).

Research suggests that most teachers in Malaysian schools tend to teach in a traditional manner (Salmiza & Afik, 2011; Effendi & Zanaton, 2007; Syarifah Maimunah, 2003; Sulaiman *et al.*, 1996). By studying the current conceptions of Physics teachers in their classrooms practices, educators can better understand not only the factors influencing students' Physics learning and problems that arise with them, but also the ways to improve these methods in teacher education programs and courses.

#### **Rationale:**

Because research on Physics teachers' conceptions in Malaysian schools are not yet heavily documented, this study is expected to be useful as a reference for researchers to conduct further studies in the related area. Any data obtained is crucial and can be served as empirical evidence on the current Physics teachers' conceptions in Malaysian schools. The results of this study are expected to provide guidance to the related parties in order to improve the existing methods of teaching and learning Physics, specifically in the Malaysian context.

#### **Theoretical framework:**

The framework of this study is based on Dancy & Henderson's (2007) comprehensive framework for articulating Physics instructional practices and conceptions, as explained in the tables below. Physics teachers' instructional practices and conceptions in Malaysian schools will be evaluated based on this framework.

Specifically, the current Physics teachers' conceptions about Physics instruction in Malaysian schools and the difference between urban Physics teachers and rural Physics teachers' conceptions will be determined based on the main category of conceptions (Table 1), to ascertain whether or not these conceptions are consistent with traditional or alternative instruction.

#### **Framework of articulating instructional conceptions (Dancy & Henderson, 2007):**

##### **Methodology:**

The research participants were twelve Physics teachers (six from urban schools and the other six from rural schools) who are currently teaching Physics subject for form four and form five students at Malaysian schools in northern Peninsular Malaysia. Each participant were selected from different urban and rural schools, from three states, in the northern Peninsular of Malaysia. Sampling techniques were performed in two stages. The first stage involved the random sampling technique to select the urban schools and rural schools in each state, while the second was purposive sampling technique to draw the Physics teachers from the selected schools as the study sample. Only teachers with a minimum of five years of teaching experience were included in the investigation. Overall, there were 12 teachers selected in this study, all of them with 5-10 years Physics teaching experience. Although these schools serve a heterogeneous population, from students living in affluent neighborhoods to students coming from relatively low income families, Physics students are quite a homogeneous group within these schools because they all learn the same curriculum and partake in the same official Malaysian certificate examinations.

The study adopted the qualitative methodology aimed at obtaining a holistic understanding of the participants' Physics conceptions, and what stays beyond the external expression of their behavior. The teachers were interviewed about their conceptions of Physics instructional practices, using a structured interview protocol. Teachers were asked about their opinion of learning view, expertise, knowledge view, the nature of Physics, the role of the school, students, teacher role, diversity, desired outcomes and scientific literacy according to the previous theoretical framework of Dancy & Henderson(2007). At the same time, field notes on the teachers' body language were also recorded for the purpose of triangulation process.

**Table 1:** Main categories of conceptions.

	Conceptions consistent with traditional instruction	Conceptions consistent with alternative instruction
C1. Learning view	Transmissionist	Constructivist
C2. Expertise	Involves the accumulation of factual information	Involves qualitative changes in thinking
C3. Knowledge view	Positivist: Knowledge is absolute	Post-positivist: Knowledge is socially constructed
C4. Nature of Physics	A quantitative discipline	A quantitative and qualitative discipline
C5. Role of school	Sort and certify students for role in the workplace and society	Develop independent thinkers and enrich students personal lives
C6. Students	All students learn the same way and only some are capable of learning Physics	Different students learn differently but all are capable learning Physics
C7. Teacher's role	Teacher should teach	Teacher should guide
C8. Diversity	Students should adapt to the teacher	Teacher should adapt to the students
C9. Desired outcomes	Students can quickly and accurately solve familiar problems within the context of Physics	Students develop an understanding of Physics concepts as well as the skills apply to these concepts to new situations
C10. Scientific literacy	Informed citizen who can appreciate scientific methods and use science as developed by scientist in everyday and professional decision making	Informed citizen who can apply scientific methods to problems that interest them as well as critique science methods and results

### Data Analysis

Teachers' responses from the interview questions were coded (either alternative or traditional) and analyzed separately, and then together. The patterns, themes and categories of analysis were extracted from the data obtained (by referring to the theoretical framework suggested by Dancy & Henderson, 2007). The themes identified were revisited with the research questions and theoretical framework. Interview data were then triangulated with the recorded filed notes to ensure reliability of the coding scheme.

### Findings:

#### Conception of learning view:

Five out of six urban Physics teachers and four out of six rural teachers agree that learning is an active process to understand our world, whereas the rural Physics teachers see Physics learning as active process to gain the related knowledge. In addition, urban Physics teachers tend to relate Physics learning with pupils' real life experience while rural Physics teachers tend to not even consider this idea.

#### Conception of expertise:

While all rural Physics teachers view Physics learning as a process of developing pupils' thinking, four out of six urban teachers view Physics learning as process involving accumulation of information that occurs only in the classroom.

#### Conception of knowledge view:

All the urban and rural Physics teachers agree that Physics knowledge is actually socially constructed by the students.

#### Conception of nature of Physics:

All the urban and rural Physics teachers agree that Physics is quantitative subject and requires a quantitative approach to deal with it.

#### Conception of school's role:

Almost all Physics teachers (urban and rural) have traditional conceptions towards the role of the school. They place higher expectations on the school to provide efficient facilities for them and their pupils, rather than placing higher consideration on the aspect of developing pupils who can think independently.

#### Conception of students:

All rural Physics teachers were aware that students, in general, are unique and that tackling them requires a variety of approaches. Compared to rural Physics teachers, only three out of six urban Physics teachers were aware of this aspect, while the rest had negative perceptions towards students. Half of the urban Physics teachers, as well as rural Physics teachers, views were still stuck with the traditional role that is limited to the school students' role emphasis on classroom's learning responsibility only. The other half are able to see students' role in an alternative way, and with greater responsibility.

#### Conception of teacher's role:

Majority of urban Physics teachers (five out of six) view their role as to guide pupils, whereas half of the rural Physics teachers (three out of six) only see themselves as those who teach Physics.

**Conception of diversity:**

All the urban and rural Physics teachers' conceptions regarding diversity are consistent with alternative instruction. This result shows that the Physics teachers performed their duties and did not forsake or lose hope in guiding their pupils, despite the differences in abilities and capabilities among the students. In other words, Physics stand a chance of a better future if teachers are willing to make social transformations and are brave enough to face the new world.

**Conception of desired outcomes:**

Five out of six rural Physics teachers and three out of six urban teachers have traditional conceptions of the desired outcomes of their pupils. They expect students to be well behaved in the classroom as well as succeed in the examinations. However, those with positive conceptions were found to not really consider the development of skilled pupil who can apply concepts learned to new situations.

**Conception of scientific literacy:**

A majority of the Physics teachers (five out of six both urban and rural teachers) hold traditional conceptions of scientific literacy. These conceptions are generally limited to scientific literacy defined in terms of classroom's learning instead of the development of well informed, critically thinking citizen.

The general comparison between urban and rural Physics teachers' conceptions about Physics instruction is described in table 2 below.

**Table 2:** Frequency of Physics teachers' instructional conceptions about Physics.

No.	Categories of Conception	Conceptions consistent with traditional instruction				Conceptions consistent with alternative instruction			
		Urban (N=6)		Rural (N=6)		Urban (N=6)		Rural (N=6)	
1	Learning view	1		2		5		4	
2	Expertise	4		0		2		6	
3	Knowledge view	0		0		6		6	
4	Nature of Physics	3		0		3		6	
5	Role of school	6		5		0		1	
6	Students role	2		3		4		3	
7	Teacher role	1		3		5		3	
8	Diversity	0		0		6		6	
9	Desired outcomes	0		0		6		6	
10	Scientific literacy	5		5		1		1	
	Total	21		18		39	65.0%	42	70.0%

**Based on Table 2, it was found that:**

- A majority of Physics teachers (65.0% urban and 70.0 % rural) hold conceptions that are consistent with alternative instruction. There were no significant differences between urban and rural teachers' conceptions on the alternative instruction of Physics.
- All the urban and rural schools' Physics teachers hold conceptions that are consistent with alternative instruction on Physics, specifically on the aspects diversity and desired outcomes.
- 35% of urban Physics teachers and 30% of rural Physics teachers' conceptions were consistent with traditional instruction. There were no significant differences between urban and rural teachers' conception on the traditional instruction of Physics.
- Physics teachers' conceptions that are consistent with traditional instruction were significant in terms of the role of the school, expertise and the understanding of scientific literacy. Data obtained showed that (i) All the six urban Physics teachers and five out of six rural Physics teachers hold the traditional idea of the role of the school; (ii) Five out of six of both urban and rural Physics teachers still firmly hold on to traditional ideas of the concept of scientific literacy.
- Urban Physics teachers were found to have more conceptions consistent with traditional instruction of Physics in terms of their expertise and the understanding of nature of Physics, while rural Physics teachers hold more conceptions consistent with traditional instruction of Physics in terms of the teacher's role.

**Discussion:**

Data analysis show that in general, teachers hold alternative conceptions towards Physics instruction. This finding supported the research result obtained by Antoniadou and Skoumios (2013) who concluded that current teachers' conceptions about science instruction are related to the constructivist view and discovery approach. The results also show that there is no significant difference between urban and rural Physics teachers' conceptions towards Physics instruction. All the current Physics teachers (from both urban and rural schools) hold alternative conceptions on the aspects of students' diversity and the desired outcomes, and a majority of them are still stuck on traditional ideas of the concept of scientific literacy. The teachers, as a

whole, have the idea of the importance of instructional practices based on students' differences of learning styles and expect to produce better learners, who are not only able to apply the learned knowledge and skills, but can also serve for the community's sake. These findings are in line with Lü and Wang's (2004) research result, which concluded that there is no significant difference between urban and rural schools teachers' belief on constructivism instructional approach, but contrasts with the work of Sang *et al.* (in press) who found that teachers working in developing areas hold higher constructivist beliefs than those working in developed areas.

Although Physics teachers generally hold alternative conceptions towards the Physics instruction, they are not portrayed in their practices, as previous research show, that in general, teachers tend to adopt the traditional way of teaching practices in their classrooms (Salmiza & Afik, 2011; Effendi & Zanaton, 2007; Syarifah Maimunah, 2003; Sulaiman *et al.*, 1996). The result shows that majority these teachers actually understand the concept of alternative instruction (see Table 12) but do not take an effort to practice it regularly in Physics classroom (Salmiza & Nooraida, 2014; Salmiza & Afik, 2011; Effendi & Zanaton, 2007; Syarifah Maimunah, 2003; Sulaiman *et al.*, 1996). This finding confirms the statement that although numerous innovations in teaching methods have been proposed to help teachers teach Physics more effectively, teachers are generally reluctant to practice these alternative approaches, as they require extra effort (Nias, 1987). The result is against the previous research results which show that the approaches adopted by teachers are found to be related to their conceptions of teaching (Khajornsak, 2007; Lotter, Harwood, & Bonner, 2007; Trigwell & Prosser, 1997). Teachers involved in this research tend hold alternative conceptions (other than the traditional conceptions) about Physics instruction but rarely adopt it in their classroom's teaching practices. This finding shows that teachers' alternative conceptions about Physics instruction cannot actually be used as an indicator for their classroom's teaching practice. The finding actually supports Leaderman's (1998) statement that teachers' conceptions of science do not necessarily influence classroom practice.

As appropriate instructional practices are important to attract student enrollment, as well as to change their negative perceptions towards the subject of Physics and to improve their achievement, this situation (the traditional way of instructional practices with alternative conceptions of Physics instruction), if ignored, will continuously retard students' learning skills, as well as their creativity and curiosity to learn Physics effectively (Schank *et al.*, 1999; Sulaiman *et al.*, 1996).

### Conclusion:

It has been found that the current Physics teachers' conceptions about Physics instruction in Malaysian schools are consistent with alternative instructions. There is no significant difference between the urban and rural Physics teachers' conceptions about Physics instruction in Malaysian schools. The results, however, cannot be generalized to a larger population, as the number of respondents involved in this qualitative study is relatively small.

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