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Instructional Strategies in Teaching Physics: An Integrated Approach

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Abstract

This paper attempts to establish a theory which ascertains the effectiveness of integrating both teacher-centered and student-centered instructional strategies especially in teaching physics. Integration in learning is a more intimate procedure in which ideas and individuals get together via suitable instructional strategies towards making the learning process effective rather than simply making them interactive. The proposed theory is being further analyzed and verified for support from major learning theories, both psychological and educational. Major types, levels, process/logic and execution of integration are also discussed in detail. In the meantime, a comprehensive comparison is made between advantages and disadvantages of both these strategies when implemented alone during physics instruction.

Instructional strategies are philosophical paradigms to reveal the nature of teaching, learning and knowledge. Teachers prefer the best for their students by modifying their classroom practices in order to receive optimum results in learning process, level of enjoyment while learning, modification of student behavior and ultimately in representing them as noble individuals. Many studies show that there have been attempts of implementing and testing a number of instructional strategies in the last few decades (Jonassen, 1991; Langley & Eylon, 2006; Napoli, 2004). However, many of these new strategies are mostly constructed without using the old ones as foundation and thereby fail to be complete and successful in their pedagogical aspects. A teaching strategy that works for one situation may not be effective in a different environment (Ramsden, 1998). Therefore a debate on accepting student-centered vs. teacher-centered learning is one of the key issues among educators worldwide (Which is best: Teacher-centered or Student-centered education? 2012).

Lecturing has been the major instructional strategy until the 1990's. For example, in teaching physics teacher delivers lectures, gives notes and solves problems without any active participation from students. Students are passive listeners of information from the instructor. Major arguments against the teacher-centered instructional strategies like lecturing are on motivation, conceptual change, misconceptions and transfer of learning. Misconceptions are not rectified through traditional teaching strategies (Gunstone, 1987; White & Gunstone, 1989; Brown, 2003). The instructor is usually unable to identify misconceptions and bring in conceptual change during traditional instruction. Conceptual change occurs in the learner when learning could be related to his/her cognitive level, and interrelate it with understanding in other content areas. Effective transfer of learning occurs when learners get motivated upon rectification of their misconceptions. Learning science is not possible only by reading, listening, memorizing or problem-solving (McDermott, 1996). In learning physics, it has been reported that mere problem-solving alone doesn't change misconceptions among students (Kim et al., 2010). As a result a strong urge for active communication between the teacher and learners has been identified.

An outbreak of researches and theories occurred in the later years to support the active involvement of students in the learning process. Most of the strategies developed thereby were student-centered (Chang & Mao, 1999; Hakkarainen, 2003; Schwartz et al., 2004). For implementing student-centered learning activities, researchers suggest inquiry as the platform. This is based on the theory that science education must follow a constructivist approach and students must be doing science rather than reading or being told. However, there is a lack of evidence for improved student outcome since teachers feel discomfort directing or controlling student inquiry (Kock et al., 2013; Hodgson, 2010). Some students feel uncomfortable with non-traditional approaches (Redish, 1998; Coleman, 1998; Mottmann, 1999; Fagen, 2002). They enjoy the subject by analyzing the real world applications of the qualitative concepts (Elby, 2011). There is a need of bridging both the extremes of instructional strategies is emerged to accommodate learners at all levels. Therefore, an attempt to establish a theory assures the effectiveness of integrating both teacher-centered and student-centered instructional strategies in the teaching-learning process of physics. In order to strengthen our argument, an in depth analysis of the learning process and the most popular psychological and educational learning theories has been carried out.

Rationale of Integration

It is conceivable that an inquiry-based strategy which is both student-centered and teacher-centered in nature would be a impeccable option to provide an activity-oriented learning with ample as well as active support from the teacher. Using well-structured activities, students are able to think of the topic as a dynamic process of inquiry rather than absorbing it as a body of language. This paper proposes an integrated instructional strategy by intentionally picking and combining both student-centered and teacher-centered strategies to teach physics. "Integration" means that student-centered and teacher-centered strategies can be purposefully chosen, applied and matched based on the nature and difficulty level of the topic in a specific content area. Research shows that a large proportion of students favor a combination of learning styles (Langley & Eylon, 2006). The logic of integration can thus be detailed by discussing the advantages and disadvantages of both teacher-centered and student-centered instructional strategies, and the concept of integration with the support of learning theories.

Objectives

The major objectives of this study are to highlight the strength of integrative approach in teaching physics rather than implementing either student-centered or teacher-centered instructional strategy alone, to emphasize that teacher-centered and student-centered instructional strategies are not mutually exclusive; they constitute a continuum, and to reinstate the role of the instructor in a student-centered learning environment with the support of major learning theories.

Instructional strategies whether teacher-centered or student-centered are not simply strategies; rather they are models based on various learning theories to reflect various views on the nature of teaching, learning and knowledge (Napoli, 2004). A firm understanding of the learning processes of students is inevitable to ascertain effective learning. Although students claim attaining knowledge through teacher-centered activities, they realize the effectiveness of more independent, investigative, and task-oriented learning activities in constructing concrete knowledge. A thorough analysis of the pros and cons of both types of strategies has also been carried out to build a platform for the major argument of integration.

Comparison between Teacher-centered and Student-centered Instructional Strategies

Table 1
Pros and cons of teacher-centered instructional strategy

Teacher-centered Instructional Strategy: Pros	Teacher-centered Instructional Strategy: Cons
Teachers direct the learning process and control access of information.	Teachers serve as the center of knowledge; students are viewed as empty vessels as learning is considered as an additive process (Napoli, 2004).
Classroom remains orderly and the teacher retains full control of the whole activities.	Instruction could be occasionally ineffective as students are just passive receivers of the information delivered.
Students learn by themselves, and learn to be independent.	Students are not given opportunities to express themselves or to direct their own learning.
All topics will usually be covered or delivered according to the priority determined by the teacher.	Teaching is made for the average student so that everyone is forced to progress at the same rate irrespective of their abilities (Napoli, 2004).
A large amount of information is shared in a short amount of time in an orderly manner.	Students do not learn to collaborate with others and may lack proper communication skills.
Students do not miss important topics as the teacher has control on topics to be delivered.	Little or no attempt is made to consider students' prior knowledge.
Assessments are made quick, easy to evaluate and straightforward.	Assessments are done through traditional examinations; no attempt to measure if the information is transferred into usable knowledge (Napoli, 2004).

Table 2

Pros and cons of student-centered instructional strategy

Student-centered Instructional Strategy: Pros	Student-centered Instructional Strategy: Cons
The classroom is more democratic in nature; students and the instructor share the control on the learning activities.	Teachers struggle to manage student activities that are at different stages and pacing (Hodgson, 2010).
Students are able to direct their own learning, interact one another, express themselves, and participate actively (Huba& Freed, 2000).	Students may miss important facts as the teacher doesn't deliver all information at the same time (Which is best: Teacher-centered or Student-centered education? 2012).
Students gain communicative and collaborative skills.	Students who prefer working alone cannot be accommodated.
Students are more interested in learning activities as they are more engaged.	Classrooms lose order, and are mostly noisy and chaotic; activities are difficult to be implemented with large number of students.
Students are allowed to foster their critical thinking skills.	More time consuming and can be difficult to follow the predetermined teaching/learning goals at the predetermined periods during the year.
Real life connections are provided to students (Huba & Freed, 2000).	Strategy is found to be ineffective for all content areas in which students find difficulty to create abstract level understanding (Blumberg, 2004; 2009).
Multiple learning styles and assessment strategies are implemented.	Students may find it hard to have the required conceptual change when it is difficult to transfer information from the concrete to abstract level without the help of the teacher. (Pederson & Liu, 2003).

Teacher-centered and Student-centered are not simply strategies or methods. Teacher-centered strategy is more traditional in nature whereas student-centered is the newly developed strategy to make learning more effective and enjoyable. In an explicitly teacher-centered classroom, teachers serve as the center of knowledge whereas students are considered as empty vessels to receive knowledge. Students' prior knowledge is usually not explored. Teaching is mainly carried out without taking students' individual pacing or knowledge level into consideration. In the meantime, teachers are advised to make transition from teacher-centered to student-centered without providing ample guidance. Irrespective of theoretical arguments, the practice of student-centered classroom is still a matter of dispute. A large group of educators believe that they carry out student-centered activities in their classrooms without grasping the actual meaning of student-centeredness. As a result, they would engage students in some pair work or having them present their work without any clear instructions. In addition, pure student-centered strategies are neither effective in all subject areas nor an optimal way of learning for all types of learners (Napoli, 2004). Clearly, both student-centered and teacher-centered classrooms have their own pros and cons. The advantages and disadvantages of both student-centered and teacher-centered strategies can be drawn in order to gather support for the need for integrating the strengths of both the practices. Tables 1 & 2 depict the pros and cons of both the strategies for close examination.

Table 3
A comparison of Teacher-centered and Student-centered instructional strategies with a focus on their disadvantages

Teacher-centered: Cons	Student-centered: Cons
Teachers serve as the center of knowledge; students are viewed as empty vessels as learning is considered as an additive process (Napoli, 2004).	Teachers struggle to manage student activities that are at different stages and pacing (Hodgson, 2010).
Instruction could be occasionally ineffective as students are just passive receivers of the information delivered.	Classrooms lose order, and are mostly noisy and chaotic; activities are difficult to be implemented with large number of students.
Students are not given opportunities to express themselves or to direct their own learning.	Students may miss important facts as the teacher doesn't deliver all information at the same time (Which is best: Teacher-centered or Student-centered education? 2012).
Teaching is made for the average student so that everyone is forced to progress at the same rate irrespective of their abilities (Napoli, 2004).	Strategy is found to be ineffective for all content areas in which students find difficulty to create abstract level understanding (Blumberg, 2004).
Students do not learn to collaborate with others and may lack proper communication skills.	Students who prefer working alone cannot be accommodated. More time consuming and can be difficult to follow the predetermined teaching/learning goals at the predetermined periods during the year.
Little or no attempt is made to consider students' prior knowledge.	Students may find it hard to have the required conceptual change when it is difficult to transfer information from the concrete to abstract level without the help of the teacher. (Pederson & Liu, 2003).
Assessments are done through traditional examinations; no attempt to measure if the information is transferred into usable knowledge (Napoli, 2004).	The learning goals are not usually met since the "facilitators" do not have the clear picture of the activity or are incompetent in following the guidelines (Hodgson, 2010).

Upon comprehensive examination of the pros and cons of both teacher-centered and student-centered strategies, it is obvious that none of these strategies are entirely effective when implemented alone. The cones of the teacher-centered and the student-centered strategies lie at the extremes of the continuum. For example, in teacher-centered classrooms, teachers serve as the center of knowledge; students are viewed as empty vessels just to receive the delivered information, whereas teachers struggle to manage student activities that are at different stages and pacing in a student-centered environment. When teaching is made for the average student so that everyone is forced to progress at the same rate irrespective of their abilities in teacher-centered atmosphere, student-centered strategy is found to be ineffective for all content areas in which students find difficulty to create abstract level understanding without sufficient guidance from facilitator. This scenario calls for the need of a strategy which is in between these two extremes. A detailed comparison of the cons of both teacher-centered and student-centered strategies is given in Table 3.

Novice learners irrespective of the stage education require more facilitation.

As far as the learning outcomes are concerned, in a student-centered learning environment, there is an emphasis on the multiple aspects of the acquired knowledge through a multidisciplinary window. Students receive vigorous enforcement of higher order thinking skills. In the meantime, the teacher-centered strategies provide discipline-specific oral information, lower order thinking skills such as recall, identify or define, and encourage memorization of abstract and isolated information (Napoli, 2004). Therefore, designing suitable activities that involve combination of both teacher-centered and learner-centered approaches, it can undoubtedly be argued, can pave the pathway from a firm basic understanding toward kindling the higher order thinking skills in the content. Such an integrated strategy requires enormous amounts of preparation, thought, energy and creativity from the instructor.

Teacher has a significant role in facilitation

According to the American Association for the Advancement of Science, teachers bear a conscientious role in the learning process of their students, especially in learning science, mathematics and technology. To understand various subject areas, students should be able to consider them as ways of thinking and doing, and as bodies of knowledge. In order to develop such thoughts in students, teachers must be cautious and accountable in engaging their students in the learning process by providing ample evidence that are more natural. Teachers should also make sure that students get opportunity to express clearly in a team approach, not to separate knowing from finding out, and to de-emphasize memorization of technical vocabulary. The techniques mentioned above are mostly used in student-centered instructional strategies; however, the role of teachers to make them happen in classrooms has been confirmed with much emphasis (AAAS, 1990). The Association further details that:

> "Teachers should recognize that for many students, the learning of mathematics and science involves feelings of severe anxiety and fear of failure. No doubt this results partly from what is taught and the way it is taught, and partly from attitudes picked up incidentally very early in schooling from parents and teachers who are themselves ill at ease with science and mathematics. Far from dismissing math and science anxiety as groundless, though, teachers should assure students that they understand the problem and will work with them to overcome it. Teachers can take such measures on Build on Success, Provide Abundant Experience in Using Tools, and Emphasize Group Learning."

Significant role of teacher in a student-centered environment makes the strategy integrated

Since the part of the teacher is significant in the learning process, an argument is made for an integrated approach by combining teacher-centered strategy in a student-centered environment. Traditionally, by integration educators mean that the knowledge from different branches is connected together as the subject matter of knowledge is fundamentally united. In higher education, the term "integration" is used to describe the idea of applying learning in multiple contexts. Integration of learning is a more intimate process in which ideas as well as individuals come together rather than simply interacting (Barber, 2009). In the context of this paper, we use the term "integration" to make an argument for creating an effective teaching-learning environment by combining both teacher-centered and student-centered instructional strategies. Through the purposeful integration of the instructional strategies, the common goal of conceptual understanding in the content area of physics can be met.

Conceptual change occurs among learners due to real-life and active engagement

Traditionally formal learning was conceived mostly as a passive process from the learner's point of view, in which the learner acquires knowledge from the instructor to have predictable and measurable outcomes. This conception of learning does not specify prior conditions of the learner or the context in which learning occurs. It provides no reference to other individuals like teachers, peers, or facilitators and their roles in the learning process. The definition for learning has been restated as an active process in which the learner relates new experience to existing, and interprets the modified information into new ideas (Gao & Watkins, 2002). Effective instruction paves pathway for effective learning and should be able to make conceptual change among learners. The aspect of effective learning is connected to real-life examples in which learners make sense of their environment cognitively with an active mental engagement (McDermott, 1996).

Learning theories suggest integrative methods

While it is a fact that most of the popular learning theories mainly focus on solving the learning difficulties among students, there is not a common theory to describe the learning process. Behavioral, cognitive and social-cognitive are the most prominent theories of which the cognitive perspective of learning describes the mental processes of the learner that occur as a result of various experiences. Learners modify their mental structures created from their experiences with the external world (Resnick & Collins, 1996). They carry out the process of constructing knowledge through social interactions (Vygotsky, 1978). Learning happens when learners attain knowledge by disrupting the cognitive equilibrium (Piaget, 1954). The most important aspect of learning is the knowledge construction. The process of knowledge construction can be influenced by interactions with other people, which constitute the essence of socio-cultural theory of cognitive development (Vygotsky, 1978). Most of the learning theories derived from the educational contexts are integrative in nature and more integrative than the psychological theories (Dewey & Small, 1897; Hannon et al., 2002).

Learners look for connections while receiving information with their existing knowledge structures. To invest time and effort on a new material the learner must be intrinsically motivated in order to continuously practice with the possibility of further explanation. Therefore the need to reiterate the classroom environment that supports intrinsic motivation is important in improving learning processes (McCord & Matusovich, 2013). With the proper implementation of instructional strategies, the instructor could establish a transparent rapport with the learner in measuring their knowledge and the level of understanding. According to the socio-cultural theory of cognitive development, the process of knowledge construction can be influenced by the interactions with other people when learning takes place (Vygotsky, 1978).

Students acknowledge the value of activities that require higher cognitive skills over drill-type exercises. Expanding the range of learning activities can develop more sophisticated epistemologies in students. A student's epistemology plays a major role in defining his/her attitude toward the subject like physics. A good pedagogy must essentially be a judicious mix of approaches. A large proportion of students favor a combination of learning styles and instructional strategies (Langley & Eylon, 2006).For example, direct instruction which is primarily teacher-centered can be made relevant and meaningful if the teacher is an expert in the content area. It can be used for well-structured topics. Direct instruction really works well in a wide range of situations as long as the teacher employs a variety of pedagogical techniques (Cotton, 1991). In other words, the distance between the student and teacher can be bridged by selecting appropriate teaching strategies.

Strategies and Methods of Integration

Teacher-centered and Student-centered learning are not mutually exclusive. They constitute a continuum in the learning environment. In the present scenario of teaching/learning, there is hardly a single strategy adopted by teachers that is explicitly one way or the other. In every activity there used to be an element of integration though it is not done intentionally. Applying any individual strategy in its radical form is practically impossible. This section comprises the major categories and levels of integration during the learning process. A detailed investigation is done on possible ways of integrating curriculum, academic standards, teaching/learning goals, instructional strategies and modes of evaluation.

Integration can be categorized into integrative practice, interdisciplinary approaches and integration of learning. Integrative practice is the broadest of the three and functions as an umbrella term for structures, strategies and activities that connect various stages in the educational scenario (Klein, 2005). Integration depends on a combination of factors such as student needs, teacher skills, and available facilities. During such integration or transition educators should focus on how and why to teach rather than considering what to teach (Curriculum Council, Govt. of Western Australia).

Types of Integration

There is an element of integration or transition of the two instructional strategies in a typical learning environment which happens inadvertently. For example, background, objectives, learning goals, and standards for any student-centered activity are usually not determined by students themselves, but by the classroom teacher or the concerned personnel in the school district. Similarly, most of the teacher-centered activities possess student-centered components in them such as exploring the topic as a group, investigating prior knowledge of students, scaffolding the content for learners of differing abilities, or focusing on higher order thinking skills during assessment. As long as the curriculum, syllabus and assessment techniques follow a design without student participation, it is impossible to say that the learning environment is purely student-centered. Basically, any learning activity adopted, to an extent, is integrated in nature.

There are different ways for **curriculum integration**, focusing on combination of subjects, relationships among concepts in the same content area, emphasis of projects or other similar tasks into the learning activities, flexible student scheduling or grouping, use of authentic sources other than textbooks, and design of activities based on student needs or interests (Fogarty & Stoehr, 1995). In the present system, integration has been made in content areas like languages, history, and fine arts to an extent.

Integration can be implemented in teaching and learning goals by individualizing the requirements in learning for each student. Since student-centered activities promote opportunity to carry out the learning process at the learner's pace, **integrating the teaching and learning goals** is directed to integrated academic standards. In most of the developed countries, the integration of the teaching/learning goals has been implemented by introducing gifted and talented programs, accelerated course work, and remedial activities along with the usual academic standards to meet the individual requirements of the students in every content area. In order to make these integrative activities possible, the student-teacher ratio is critical. This type of integrations can be difficult in large classrooms.

Integration on the instructional strategies which is the primary focus of this paper is mainly integrating teacher-centered and student-centered strategies, traditional strategies with technology, or integrating multimedia into learning strategies. However, an effective level of integration can be achieved by integrating **the teacher-centered and student-centered strategies** since students appreciate a balance between the role of teacher in communicating at their level and at the same time present the content with confidence ((Mulholland & Turnock, 2012). A list of commonly used instructional strategies used in physics is given in table 4.

Student performance and the mode of assessment constitute another area of concern in this regard. To provide an accurate feedback is always necessary for any kind of assessment. Most researches highlight the significance of feedback whether it is intrinsic or extrinsic on students' performance. An in-depth learning occurs when students receive opportunity to integrate the feedback with the teaching or learning goals for any specific course. It is more beneficial for students when they perceive the feedback as a result of the implementation of the newly acquired knowledge rather than merely striving to meet the teaching/learning goals set by the instructor or administration (Gagne et al., 1992; Laurillard, 1993). The rubric and other similar assessment tools become more valid when students realize the actual objective of each criterion. In a purely student-centered environment, teachers usually hand the material out to students without any immaculate instructions which results in partial fulfillment of the academic goal. With the implementation of integration, in other words, with an active involvement of the teacher, educators are able to assign and maintain higher expectations on their students. This provides students unblemished understanding on what to expect during the learning process and attain mastery level in that content area (Hollingsworth & Ybarra, 2008). The introduction of Performance Task is an efficient way of **integration with the traditional methods of assessment**. In addition to summative and formative assessments, portfolios, and self assessments, the purpose of performance task is to evaluate what students know and what they can perform with their knowledge. This assessment technique provides opportunities to demonstrate students' knowledge on academic standards, teaching and learning goals and specific objectives for the content (Shavelson, 1991).

Inadvertent vs. Purposeful integration

As mentioned earlier, there usually occurs an unintentional integration of student-centered and teacher-centered strategies in a learning environment. Nevertheless, instructors are also able to integrate these two strategies on purpose based on the type of content, teaching/learning goals, prior knowledge or the learning level of the students. Instead of simply making the two types of strategies mechanically interact in a given scenario, instructors as well as students can come together with a variety of ideas and concepts toward assimilating them in a more efficient manner by integrating strategies on purpose. The logic of integrating the instructional strategies is shown in figure 1.

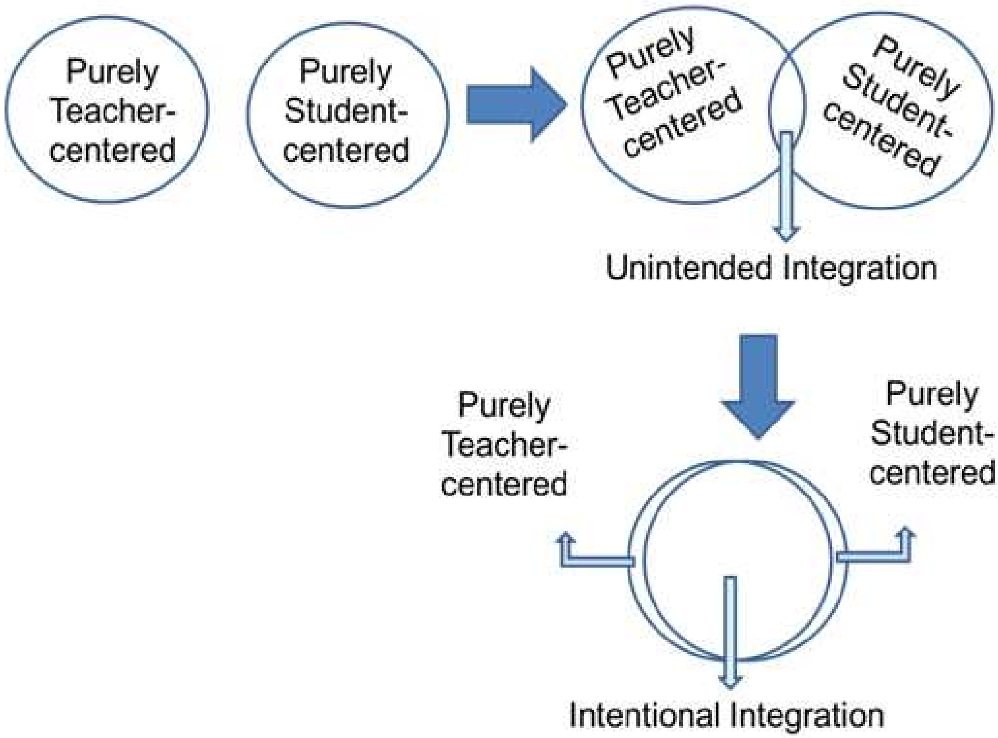

Figure 1. The transition of integrated instructional strategy

Levels of Integration

There seems to be little emphasis in the literature on decisively integrating the teaching strategies for effective learning. Although there occurs accidental mixing up of both strategies during instruction, there is not much evidence in integrating them on purpose. Although integration can occur on any of the aspects such as curriculum, academic standards, teaching/learning goals, and the methods of evaluation during the learning process, they are hardly combinations of student-centered and teacher-centered activities. In usual practices, the integration is mostly done in the curriculum and rarely on evaluation. The hierarchy of the order by which integration is usually found among classroom practices is mentioned in figure 2.

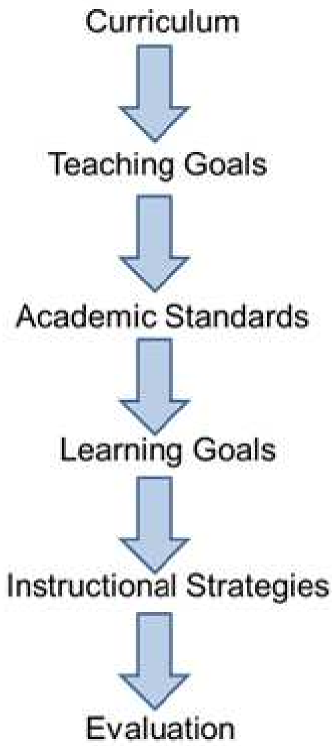

Figure 2: Levels of educational practices that can be integrated

Teaching style and integration

There are two different types of instructors who adopt either teacher-centeredness or student-centeredness. In the teacher-centered environment, the teacher of "Formal authority" follows the extreme traditional style whereas the "Demonstrator" tends to be liberal and draws student participation to an extent. In other words, the "Facilitator" in a student-centered learning environment tends to relinquish the central stage whereas the "Delegator" model tries to actively engage in the learning process (Mulholland & Turnock, 2012). In our argument, the Demonstrator and Delegator models can be bridged toward producing maximum effectiveness.

Integration of Instructional Strategies in Physics Learning

The major goal of the research in physics education which got stronger in the 1980's is to provide hints and suggestions on instructional approaches in helping students work through their difficulties. According to students, physics which is already hard is made even harder and more frustrating by the pedagogical practices itself. Teaching materials and methods must be properly matched to have an accurate assessment of the knowledge state of students. Active and effective learning takes place when class time is used to make students engaged in doing physics (Knight & Burciaga, 2004). Physics cannot be efficiently taught by selecting and manipulating a few equations. To make the conceptual understanding a thorough emphasis on qualitative and qualitative analyses of the situation is necessary. Teachers need to weigh their options thoughtfully and make decisions on strategies to make learning active and effective (Wilson & Peterson, 2006).

Researchers are in the process of developing effective methods to assess conceptual knowledge of students in content areas especially physics (Cahyadi, 2007). A major focus of these studies is on how students understand concepts and how they address misconceptions. The way students engage in learning and how this learning affects their conceptual understanding is very important. It has been found that intrinsic motivation is an influencing factor on conceptual understanding. Learning to be a physicist is all about making concrete connections between the expert and the novice (Lombardi, 2007).

Research studies emphasize the significance of integrating the student-centered and teacher-centered strategies for the smooth transition of knowledge from the expert to the novice in an intrinsically motivated environment for learning physics. Physics education research faces contradicting objectives, one to gain conceptual development and the other to increase interest and attainment in students through constructivist approaches. Constructivist theories are more relevant in the present scenario because of their emphasis that should be given to individuals and to their interpretation during the learning process. However, in most classrooms, students master algorithmic fluency with little conceptual understanding. A sound basis of factual knowledge and a flexible understanding on the application of that knowledge is essential in authentic and novel contexts (Wilson & Peterson, 2006). The quality of instruction must be judged by students' improved understanding of scientific concepts rather than their levels of motivation, engagement and enthusiasm alone (McDermott, 1996).

The decline in the interest toward physics is most likely connected to students' classroom experiences including pedagogical variables (Elster, 2007; Gonen & Basaran, 2008; Trumper, 2006). With the acknowledgement of paradigmatic shift in the research and the role of knowledge on teaching there is an isomorphic relationship between approaches to teaching and modes of learning (Shulman, 1987). Thoughtful teachers consider both learners and the subject matter into account and try to close the gap between the two. The curriculum is flexible for such an effective teacher. Ebenezer & Zoller (1993) argue that necessary emphasis must be placed on science teachers' role and their teaching styles if an educational change is to be achieved in the constructivist direction. However, radical constructivists believe that teachers must never tell students anything; all knowledge must be constructed independently. Research shows that a teacher must provide students an array of instructional strategies in order to actively construct their own knowledge (Wilson & Peterson, 2006).

Current Instructional Practices in Physics

Research shows that attempts of a variety of instructional strategies are made by experts in physics classrooms to improve the conceptual understanding, interest and attitude toward physics, and the perception on the science process and the nature of science. The strategies vary from open inquiry to radically traditional in nature and implementation. However, inquiry-based strategies improve the attitude and understanding of the nature of science but fail in creating solid conceptual understanding (Chang & Mao, 1999; Paris et al., 1998; Schwartz et al., 2004). The argument of Windschitl et al. (2008) that there is a lack of explicit association of inquiry with science content has been verified by the study conducted among high school students of physics in Netherlands (Kock et al., 2013). They found that carrying out inquiry tasks without detailed instructions is difficult for students to obtain conceptual understanding. The finding supports the argument that the needs to provide sufficient guidance to the class for the instruction to be successful made by Kirschner et al., 2006. In another study conducted in USA by Campbell et al. (2010) in a high school physics classroom, the traditional style of lecturing with demonstration was found to be equally or comparatively better to model-based inquiry approach. According to Settlage & Goldston (2007), implementing inquiry in its purest form in a regular basis is practically impossible as there is lack of evidence.

In order to develop deep understanding in physics, students should have a thorough understanding in concepts, process, and nature of the subject, which could be made possible through appropriate experiences. For most students usual practices are insufficient as they help develop only a superficial understanding (Campbell et al., 2010). Although student-centered and inquiry-based strategies are accepted by many leading science teaching organizations like AAAS (1990, 1993), NRC (1996), NSTA (2007), NCTE (2014), and NCERT (2010), they are found to be difficult in implementation in a long run and to have favorable results (Campbell et al., 2010).

In this scenario, we propose the integrated instructional strategy designed within a proper framework to have improved epistemological beliefs, attitude and achievement in physics at higher secondary level. Many of the present student-centered strategies used in physics instruction can intentionally be integrated with the most prominent teacher-centered strategies like direct instruction, lecturing, lecturing with demonstration, or problem-solving with teacher guidance. Models such as Workshop Physics, Studio Physics, Physics Tutorials and Multimedia Modules are partially integrated, and are mostly used among the undergraduate students (Laws, 1997; McDermott, 1996). However, most of them were found to be effective in higher secondary school setting to have better outcomes (Elby, 2011). Inquiry-based strategies such as Problem-based and Discovery learning, and the Cognitive strategies like Mental models, Metacognition strategies and Graphic organizers can also be modified as integrated strategies to teach physics in higher secondary level. The popular collaborative strategies like project-based learning, Peer Instruction and Workbook approach and popular lesson plan styles such as Learning Cycle and Legacy Cycle lesson plans can be used as an effective platform for the integrated strategies. However, as mentioned above a careful picking and combining of strategies depending on the content and nature of the topic is necessary for an effective implementation. As stated by Redish et al. (2003) teachers could make significant changes in their students' epistemological beliefs and conceptual understanding.

Conclusion

There is an increased urge for inquiry-based instructional techniques which are predominantly student-centered in elementary and secondary schools all over the world (Campbell et al., 2010). However, modification of textbooks, and assessment and instructional techniques still follow the traditional pathway. As a result, the positive effects of these student-centered strategies happen to be the results of certain research studies conducted on a few groups, topics or goals (Brown, 2003; Blumberg, 2004).This drawback can be rectified by adopting an integrated instructional strategy made suitable for any group of learners, topics or learning objectives anywhere. The role of the teacher in a science classroom should not be minimized just to a facilitator. There have been distinct instructions for the instructors of science, mathematics and technology to make the learning process smooth, efficient and relevant (Matthews, 1994).

During the process of integration, the dedication and participation of the classroom teacher should not be diminished. While facilitating students' learning teachers ought to provide a framework to facilitate through activities. Effective learning takes place when students are able to connect the newly learned information to the existing. The role of the teacher in this process is remarkable. The usual practice of the teacher relinquishing the central stage in a student-centered classroom must be modified to being an active co-learner with the same or increased enthusiasm. Without complete rejection or acceptance of an ideology or methodology teachers must be able to bridge them by being elective by nature and necessity (Wilson & Peterson, 2006).

The argument put forward through this paper is that the strategy should be made appropriate to the students, the content area, and the difficulty level no matter what type is chosen. Upon close examining the pros and cons of both teacher-centered and student-centered strategies, it is obvious that there needs to be a strategy that can balance their disadvantages. Teachers who communicate with their students, show the same enthusiasm as that of the learners, and actively participate in every classroom activity while having command of the whole class are always appreciated (Mulholland & Turnock, 2012). Teachers find a good balance by being a demonstrator/delegator rather than being just a facilitator or an instructor of formal authority. There are several teaching strategies like The Learning Cycle or Legacy Cycle

Lesson Plan, Workshop, Studio or Multimedia Modules that can be modified to use as an integrated strategy for physics in which teachers are able to present themselves with confidence and at the same time engage their students in the role of a co-learner. There is no one right way to teach well.

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