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Assessment of Science Teachers' Implementation of Deep Conceptual Learning in Senior Secondary Schools in Ilorin, Nigeria

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ABSTRACT

The importance of producing lifelong learners who will be able to translate theory into practice cannot be underestimated in the teaching and learning process. Research has informed the need to produce deep conceptual learners as contrary to surface learners due to the numerous advantages attached to it. This study, therefore, investigated the assessment of teachers' implementation of deep conceptual learning in science classrooms in Ilorin, and five research questions were raised and answered in this study. The study was exploratory and adopted descriptive research of the survey type. A sample of 200 science teachers who were selected through the purposive sampling technique was involved in the study. The instrument used for data collection was a questionnaire entitled Questionnaire on Teachers' Implementation of Deep Conceptual Learning in Science Classrooms (QTIDCLC). The questionnaire was adapted from the work of Rillero (2016). The validity of the instrument was determined through the split-half method and a reliability value of 0.86 was obtained at a .05 level of significance. Findings from the study revealed that the majority of the teachers reported that they implement deep conceptual learning methods in their classrooms. Participants indicated that methods such as applications of concept to everyday life, teacher-led discussions and classroom lectures are commonly used in their classrooms. It was also revealed from the findings of this study that highly experienced teachers and qualified teachers utilize deep conceptual learning instructional methods than their counterparts who are low experienced and less qualified. The study, therefore, concluded that science teachers implement deep conceptual learning in their classrooms and teachers' qualifications and experience influenced their implementation of DCL instructional methods. Hence, it was recommended relevant stakeholders such as policymakers and curriculum planners should put measures in place to ensure that less qualified and less experienced teachers are supported to implement DCL methods probably through means of professional development.

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INTRODUCTION

The concept of learning is important especially as it involves modification of human behaviour. It has been explained as a quantitative increase in knowledge, memorizing of facts, skills, and methods that can be retained and used as necessary (Behlol & Dad, 2010). Meaningful learning is premised on a constructivist approach, and it is developed according to the cognitive theory of learning. In meaningful learning, the information to be learned takes on meaning with their latest version. The prior information considerably determines the planning of the instruction. Learning occurs when a connection between the existing information of the student

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and the new information is established (Demirbas, 2014).

Literature has reported concerns about meaningful learning of science concepts (Demirbas, 2014; Prabha, 2020; Rehna, Laly & Abid, 2018). Students have reportedly signified difficulties in understanding scientific concepts. These difficulties were reported to stem from an inability to find relevance in scientific concepts to everyday life and the fear of being ridiculed when asking questions during classroom instructions (Prabha, 2020). Research into students' views on meaningful learning indicated that the role of teachers is exceptionally important. Science teaching should revolve around meaningful learning to enable conceptual understanding of scientific concepts. Science teaching should be accompanied by more hands-on activities and interactions between learners and teachers to enhance the transaction of scientific ideas in a more sophisticated form. Hence, the role of science teachers in enabling conceptual understanding of scientific concepts cannot be overrated.

Science teaching aims at training science-literate students, constructing the knowledge they learn, and adapting the acquired knowledge to daily life. In this respect, the knowledge students learn must be meaningful to them. A constructivist approach that defends that students must play an active role during the learning process suggests that active learning environments must be created to enable students to become problem solvers (Demirbas, 2014).

A major way of enabling meaningful learning is largely dependent on the ability of teachers to help learners develop conceptual understanding through deep conceptual learning. Deep conceptual learners tend to develop problem-solving skills than surface learners and deep conceptual learners tend to think, discuss, and question more, seeking to understand rather than only memorize (Rillero, 2016). There is evidence that teachers who implement deep conceptual learning in their classrooms, tends to produce learners who are versatile problem solvers. In particular, a high level of teachers' expertise in implementing deep conceptual learning is fundamental to achieving the goal of science education.

It is therefore important to investigate the extent of implementation of deep conceptual learning among science teachers at the senior secondary school level. It is important to note that the expertise of teachers improves as they acquire higher teaching qualifications and spend more years in the teaching profession; this, therefore, influences their choice of instructional methods and selection of materials for implementing the science curriculum. Therefore, teachers' qualification and experience could influence their implementation of deep conceptual learning in science classrooms. Against this background, this study focuses on the implementation of deep conceptual learning in senior secondary school science classrooms and examines the influence of teachers' qualifications and experience on their implementation of deep conceptual learning.

Objectives of the Study

The objectives of this study are to determine the:

1. The extent of implementation of deep conceptual learning by science teachers in senior secondary schools.
2. Methods used by teachers to implement deep conceptual learning.
3. Influence of teachers' experience on implementation of deep conceptual learning.
4. Influence of teachers' qualification on implementation of deep conceptual learning.

Research Questions

The following research questions were raised to guide this study.

1. Do science teachers in senior secondary school science classrooms implement deep conceptual learning?
2. To what extent do science teachers use the instructional methods that support deep conceptual learning?
3. What is the influence of teachers' experience on their implementation of deep conceptual learning in science classrooms?
4. What is the influence of teachers' qualifications on their implementation of deep conceptual learning in science classrooms?

METHODOLOGY

The study adopted descriptive research of the survey type. A questionnaire entitled

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assessment of teachers' implementation of deep conceptual learning among senior secondary school science classrooms. The instrument was adapted from the works of Rillero (2016). The instrument was validated by lecturers in the Department of Science Education to point out areas of concern in the instrument and their suggestions were put into consideration in the final draft. The instrument was administered to twenty respondents and the split-half method was used to establish the reliability. A value of 0.86 was obtained at a 0.05 level of significance, hence, the instrument was considered reliable. The instrument was randomly distributed to 200 science teachers (physics, chemistry and biology teachers) across public and private secondary schools in the Ilorin metropolis. The teachers were assured of the confidentiality of their responses through consent forms. Data gathered were analyzed using descriptive and inferential statistics.

RESULTS

Data gathered from this study was analyzed using frequency counts and percentages, mean, standard deviation and t-test.

Research Question 1: do science teachers in senior secondary school science classrooms implement deep conceptual learning?

Using frequency counts and percentages, Table 1 revealed that the majority of the teachers (83%) implement deep conceptual learning (DCL) in their classrooms. While 17% of the respondents reported that they do not. It can be deduced from Table 1 that a higher percentage of the respondents indicated that their current instructional approach supports DCL and they use technology to support deep conceptual learning.

Table 1: Percentage of participant responses on the implementation of deep conceptual learning in science classrooms.

Items	Yes	No
Do you implement the deep conceptual learning method in your classroom?	83%	17%
Do your current instructional material supports deep conceptual learning?	71%	29%
Do you use technology to support deep conceptual learning?	63%	37%
Have you ever had professional development in deep conceptual learning?	53%	47%

Research Question 2: to what extent do science teachers use the instructional methods that support deep conceptual learning?

Using mean and standard deviation Table, 2 presents the extent of usage of instructional methods that supports DCL in science classrooms. A benchmark of 3.0 was used as a baseline for determining participant responses. It can be inferred from the table that teachers consented to utilize instructional methods that support DCL. Although, teachers reported that self–paced learning using technology and PowerPoint presentation are not frequently used instructional methods.

Table 2: Mean and standard deviation of respondents on the extent of utilization instructional methods that supports deep conceptual learning

Items	Mean	SD	Extent of usage
Application of concepts to everyday life	3.93	0.99	High
Problem-based learning	3.66	0.91	High
Discovery learning	3.70	0.97	High
Multiple representations	3.39	1.03	High
Using analogies to tie new concepts into already learned concepts	3.37	1.16	High
Student research	3.26	1.08	High
Student-led discussion	3.37	1.03	High
Projects	3.19	1.19	High
Immediate feedback	3.30	1.14	High

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Items	Mean	SD	Extent of usage
Trial and error learning	3.13	1.16	High
Virtual manipulative	2.91	1.08	Low
Reading from recent science news	3.30	1.17	High
Self-paced learning using technology	2.73	1.11	Low
Teacher-led discussions	3.51	1.16	High
PowerPoint presentations	2.58	1.00	Low
Classroom lectures	3.49	1.20	High
Reading from textbooks	3.63	1.17	High

Research Question 3: What is the influence of teachers' experience on their implementation of deep conceptual learning in science classrooms?

Hypothesis 1: there is no significant difference between low experienced and highly experienced science teachers' implementation of DCL.

Table 3 shows independent t-test statistics on the influence of teachers, experience on their implementation of DCL in science classrooms. It can be inferred from the mean presented in Table 3 that highly experienced teachers (M=89.03) utilize DCL instructional methods than the low experienced teachers (M= 85.45). A *t*-value of 1.03 at 0.05 level of significance was obtained, which is greater than 0.05, this implies that the hypothesis was not rejected. Hence, a significant difference exists in the extent of use of DCL instructional methods between experienced and less experienced science teachers.

Table 3: Independent t-test showing difference in the implementation of DCL between experienced and less experienced science teachers

Experience	N	Mean	SD	*T*	*Df*	P-Value	Decision
Low Experience	61	85.45	13.15	-1.93	198	0.06	Not rejected
Highly Experienced	139	89.03	11.51				

Research Question 4: What is the influence of teachers' qualifications on their implementation of deep conceptual learning in science classrooms?

Hypothesis 2: there is no significant difference between qualified and less qualified science teachers' implementation of DCL.

Table 4 presents the difference in the implementation of DCL methods between qualified and less qualified science teachers. It can be deduced that qualified teachers implement DCL instructional methods larger than the less qualified teacher. This is evident with the mean score for qualified teachers (M= 88.07) greater than the less qualified teacher (M= 87.90). A significant difference exists in the extent of use of DCL instructional methods between qualified and less qualified science teachers with a P-value of 0.93 which is greater than the 0.05 level of significance. Hence, the null hypothesis was not rejected.

Table 4: Independent t-test showing difference in the implementation of DCL methods between qualified and less qualified science teachers

Qualification	N	Mean	SD	*T*	*df*	P-value	Decision
Qualified	156	88.07	14.51	1.03	198	0.93	Not rejected
Less Qualified	44	87.90	11.40				

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DISCUSSION

This study examined science teachers' implementation of DCL in senior secondary school science classrooms. The findings from this study revealed that the majority of science teachers (83%) implement deep conceptual learning methods in their classrooms and 71% of them reported the use of instructional materials that supports DCL. A moderately large percentage (63%) also reported that they utilize technology to support DCL although a lesser percentage (53%) i.e. about half reported that they never had professional training on DCL. This finding corroborates the findings of Rillero (2016) who reported that teachers implemented DCL in their science classrooms with a few populations of the respondents reporting they have not attended any professional development programme on DCL. This finding supports the findings of Parker (2008), who established the need to intensify efforts in the professional development of teachers, especially in areas related to implementing deep conceptual learning. Findings also revealed that teachers utilize DCL instructional methods in their classrooms. Furthermore, findings revealed that most respondents agreed that they apply scientific concepts to everyday life in their science classroom largely while the use of PowerPoint presentations was used to a low extent. It can be deduced that the application of knowledge to daily life activities enables learners to be more engaged in the learning process and as such becomes strategic thinkers. This corroborates the position of Peng and Chen (2019) who posited that learners that utilize a deep approach to learning have a high impact on cognitive gains and as such improve students' learning outcomes. In addition, findings from this study indicated that teachers with higher qualifications and more experience reported the use of DCL in their classrooms to a great extent. This finding corroborates Toropova, Johansson and Myrberg (2019) who reported that teachers' qualifications and experience are factors that influenced their instructional quality.

CONCLUSION AND RECOMMENDATIONS

It can be concluded from the findings of this study that science teachers implement DCL methods in their instructional delivery. Teachers' variables such as qualification and experience positively influence their utilization. Hence, it is, therefore, recommended that relevant stakeholders such as quality assurance in education advocate for an increase in professional development programs. This will enable teachers especially the less experienced and qualified to gain insight into various instructional methods that will foster DCL since it helps students to become lifelong learners.

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