Professional Curriculum Development: Models for Transforming Teaching Science

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Abstract
The current study sought to cement the place and impact of transformational learning models by linking theory and practice through the existing curriculum frameworks for science teachers. Through a review of the existing literature, the study screened past studied to identify the critical steps in curriculum development's transformational models. The initial search identified 102 studies published in the last five years. The studies were further screened based on inclusion criteria that incorporated transformational models of learning and teacher's professional development in today's schools. A second screening led to the exclusion of 87 studies whose statistical data analyses were not adequate to generalize the results. The quality of methodology approaches in the screened studies was also assessed and reported on a 7-item-Likert scale. The last screening included 14 studies that were systematically reviewed. The study results depicted that transformational learning models in teaching science were glued in four significant steps, that is, offering a dialogue on past research, authenticating teachers' personal beliefs and experiences, designing assessment, and curriculum development. The study's findings show that transformational learning models equip learners with real scientific concepts that can be easily applied in real-world scenarios.

Keywords: *Transformational; model; theory; practice; professional development; curriculum development*

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1.0 INTRODUCTION

Education is a continuous and lifetime process that entails our daily experiences and knowledge from formal educational settings such as schools and universities. Educational institutions offer contextualizing knowledge that enables learners to understand the world around them. Consequently, as professionals make learning method decisions, they continuously reflect on how to construct experiences that better challenge their learners to understand classroom and life experiences. According to the Dubai learning Authority (2012), the Mohammed Bin Rashid Smart Learning Program (MBRSLP) was established to incorporate technology in teaching. It proposed that science teachers designing school programs need to collaborate with the Ministry of Education (MOE), universities, and state agencies to produce professional development sessions for educators and teachers to examine reform issues (Yas, Alsaud, Almaghrabi, Almaghrabi, & Othman, 2021). The program provides new tenets where teachers are provided with technological gadgets that enhance teaching. However, most of the institutions and curriculum development agencies in the UAE have not achieved this collaboration. According to Arbid et al. (2020), most teachers report that their essential classroom guide is the Ministry of Education's adopted textbook. The existing literature proves that teachers should be incorporated in designing teaching curriculums since they link learners and other educators.

According to Richard et al. (2016), curriculum reforms and classroom teaching changes are dependent on successful curriculum reform implementation, which has teachers as critical decision-makers. Farah and Ridge (2009) report that implementing curricula should not be a top-down change done to teachers but regulation and change that is done with teachers. Curriculum development and reform implementations should move from the current regulations and focus on enhancing teacher recognition of the processes. Arbid et al. (2020) argue that lasting, genuine, and deep reforms call for

transforming how teachers think about and teach science. All professional development models based on transformation move the focus from teacher workshops to those surroundings that enhance teacher professionalism amidst a community of educationists who focus on the complex needs in schools and modern society.

Additionally, this transformational reforms focuses on addressing the current diverse and sophisticated needs of leaner's in schools (Almekhlafi & Abulibdeh, 2018). The issues surrounding teaching science today require teachers to employ sophisticated approaches to teaching, such as those proposed in conceptual change literature, discourse analysis, and those studies that focus on societal and cultural influence on schools and classrooms Hopykns (, 2014). Consequently, the current research seeks to assess the suitability of various models of teaching science in an attempt to cement the need for a transformational model that is focused on linking theory and practice and through curriculum development. The current model seeks to challenge teachers' beliefs concerning educational practice while inviting them to consult and listen to the current research literature on designing curriculum and teaching and learning methods.

2.0 LITERATURE REVIEW

The concept of transformational curriculum development in teaching science has been an existing element in modern educational systems. Given that education is a lifetime experience that takes place through life experiences and informal settings, teaching models, should focus on offering contextualizing knowledge that enhances students' ability to link school and life experiences. Tyumeneva & Shkliaeva (2016) notes that the application of scientific concepts in real-life situations and the incorporation of the life experience into a scientific conceptual framework is a difficult task. Consequently, educators think that schools' concepts will mostly remain as verbalism experiences rather than real concepts unless they are applied in situations encountered by learners in their daily lives (Khudhair & Hamid, 2015). The authors establish that even though teachers must connect science with real-life experiences, they also need to make classroom socio-cultural systems mutually created by teachers and learners (Tyumeneva & Shkliaeva (2016). Classroom discourse must entail concentration and share as the fundamental basis of a knowledge-sharing interrelationship that starts from the student.

Reforms strive to create a level of interaction between learners and teachers that replicates the need for a permanent change in behavior through learning. According to Arbid et al. (2020), science classrooms should be environments where teachers reflect on their practice and are open to transforming their practice when theory and evidence from research and their reflections support the change. Despite these understanding, science teachers have acquired sets of personal theories and beliefs concerning classroom practice resistant to change and shaped by experience (Yas, Mardani, Albayati, Lootah, & Streimikiene, 2020). These deep-rooted beliefs act as obstacles for reformers in education since teachers are the most critical change agents in the modern classroom.

According to Hopkyns (2014), the transformational teaching practice allows teachers to understand the barriers that hinder or interfere with learning as they challenge student's prior conceptions and understanding of various concepts. Linn and Muilen (1996) present that a transformative learning model must be built on the perspective that education supports lifelong learning and makes learning designs problem-based in authentic contexts. Transformational learning also involves a wide variety of teaching approaches that appreciate and accept learners' ideas and create connections between concepts while incorporating socio-cultural perspectives that reflect teaching practices (Ricard et al., 2016). this interactive environment provides an avenue for understanding and scientific concepts and students' best learning methods to combine them in an instructional model.

Jogsma and Jogsma (2005) carried out a study to assess the impact of the Science and Mathematics (SAMIE) project instituted by the Abu Dhabi Educational Zone (UAE Ministry of Education) and the College of Education at Zayed University. The study focused on teachers' methods and practices in teaching science and mathematics in grades 1 and 2. The study focused on teaching science and mathematics methods through an integrated approach and an attempt to shift from teacher-centered to learner-centered approaches. Elmesky (2012) revealed that external control tactics and internal miscues affect the relationships between administrators, learners, and teachers in school settings (Yas, Mardani, Albayati, Lootah, &

Streimikiene, 2020). This is due to the top-down model of leadership guided by regulations to teachers and learners in teaching and designing curriculums. Elmesky (2012) also argues that these relationships serve to truncate rather than expand the possibilities for individual and collective needs. Therefore, introducing a collaborative and transformative model of teaching science in classrooms can provide individuals with opportunities that contribute and develop new practices in understanding, reconceptualizing, and transforming shared teaching and learning experiences.

According to Adams (2019), transformative models in curriculum development places teachers as architects of curriculum reforms and the essential designers of challenging classroom environments. These models are not solely based on professional experience teachers go through as sole designers of the curriculum but as valuable and collaborative curriculum reformers. Besides, transformational models direct teachers to always build a practice based on the existing literature to establish meaningful learning situations for their learners and themselves. According to Balla and Cohen (1996), the process of ensuring that curriculum material support teacher's professional practice is termed curriculum enactment. Additionally, Adams (2019) noted that curriculum is collaboratively constructed by teachers, students, and materials in specific contexts.

3.0 RESEARCH METHODS

3.1 Systematic Review

The current study utilized a systematic review design conducted by searching various databases such as Google Scholar, Ebscohot, Scopus, and the National Control Board (NCIB). The intensive literature search focused on identifying papers published between 2015-2021 and were relevant to the topic of study. The search strategy included papers with abstracts that covered transformational curriculum reforms in education and science in general. The references in the identified papers were further screened to identify other sources that might have failed to be detected in the searched databases. Additionally, the titles and the references of the identified papers were further screened separately to identify any relevant papers that might have been omitted from the initial search. Further, the selected studies' full text was screened to pinpoint epidemiological studies that might offer further information on transformation curriculum models.

3.2. Inclusion Criterion

Studies included in the current research were supposed to be cross-sectional studies, government publications, reports, or ecological research that reported the role of transformational curriculum models in teaching science in the past decade. The second inclusion criteria were that all included papers must have discussed transformational curriculum models of teaching science schools. The research also included those papers that discussed technological advancements as an element of transformation models of curriculum development and implementation.

3.3 Data collection

Data used in the current study was extracted from the studies that met the inclusion criteria. Data relating to the study design, setting, definition of outcomes measure, the source population's inclusion and exclusion criteria, and the methodological design quality using the Newcastle Ottawa Scale (NOS) (Wells et al., 2019). Data outcomes were further screened extracted independently using a standardized data extraction form. The studies chosen' methodological quality was classified using classes with scores of seven or higher showing a high-quality methodology.

3.4 Data analysis

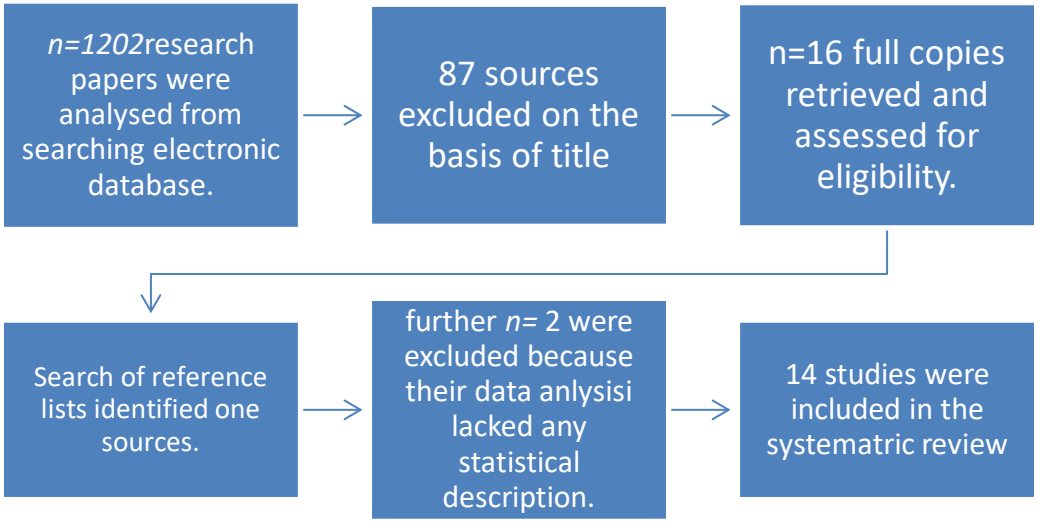
Data collected from the current study were analyzed using the arithmetic percentage analysis with charts and graphs—a dialogue on research and national goals, articulation of personal beliefs, curriculum design, and assessments. The data was then used to conduct arithmetic percentages using graphs and charts. The levels of heterogeneity were examined among the studies using percentage calculations. Given that the current research used data from already written sources, it is vital to consider and expect high I-square differences due to differences in sampling and methodological approaches.

3.5 Results

After a review of the existing literature, 102 studies published between 2015-2021 were identified. After a further screening of the titles and abstracts, 15 studies were obtained for full-text

review. Eighty-seven studies were excluded after reviewing each full text. Further, one study was included after screening the reference list of the chosen papers, as shown in Figure 3.1 below.

Figure 3.1 Summary of the Systematic Literature Review



3.6 Characteristics of the Studies Included

Papers included in the current review were conducted in either the United Arab Emirates, United Kingdom, or the United States on the GCC countries, which had a similar educational system to the UAE kingdom. The review did not focus on studies conducted on non-English or Arabic countries. Only four studies of the included 14 in the current review were given a high score in their methodology quality assessments. Most of the studies had inadequate data reporting methods. The remaining studies were given a low score in the methodological quality even though they were included in the study to avoid bias.

Table 3.1 Characteristics of the studies included

Year of Publication	Selected Area of Study	Type of study
2020	• The Impact of COVID-19 Pandemic on Modes of Teaching Science in UAE Schools	Quantitative
	• Ibrahim, A. (2020). What hurts or helps teacher collaboration? Evidence from UAE schools. *Prospects*, 1-18.	Qualitative
	• Implementing pragmatism and John Dewey's educational philosophy in Emirati elementary schools: the case of mathematics and science teachers	systemic review
	• What hurts or helps teacher collaboration? Evidence from UAE schools.	Qualitative
2019	• The Effects of Teachers', Parents', and Students' Attitudes and Behavior on 4th and 8th Graders' Science/math Achievements: A model of School Leaders' Perspectives	Systemic Review
	• The 'S'and 'Tin STEM: Integrating Science and Technology in Education in the UAE	Quantitative
	• The aspects of the formative assessments on improving the inquiry skills in science classes for middle and high school students in Al-Ain	Qualitative

	City, UAE • Virtual lab implementation in science literacy: Emirati science teachers' perspectives	Systemic Review
2018	• K-12 teachers' perceptions of Web 2.0 applications in the United Arab Emirates?	
2016	• Transformational leadership in the educational system of the United Arab Emirates • Correlating beliefs and classroom practices of public school science teachers in Abu Dhabi, UAE	Quantitative mixed-method
2015	• Current status of operations research/management science education at the United Arab Emirates business schools • Science teacher professional development needs in the United Arab emirates. • Primary teachers' perceived challenges in teaching science in Abu Dhabi public schools • The science of teaching science: An exploration of science teaching practices in PISA 2015	Qualitative Systemic review Qualitative Qualitative

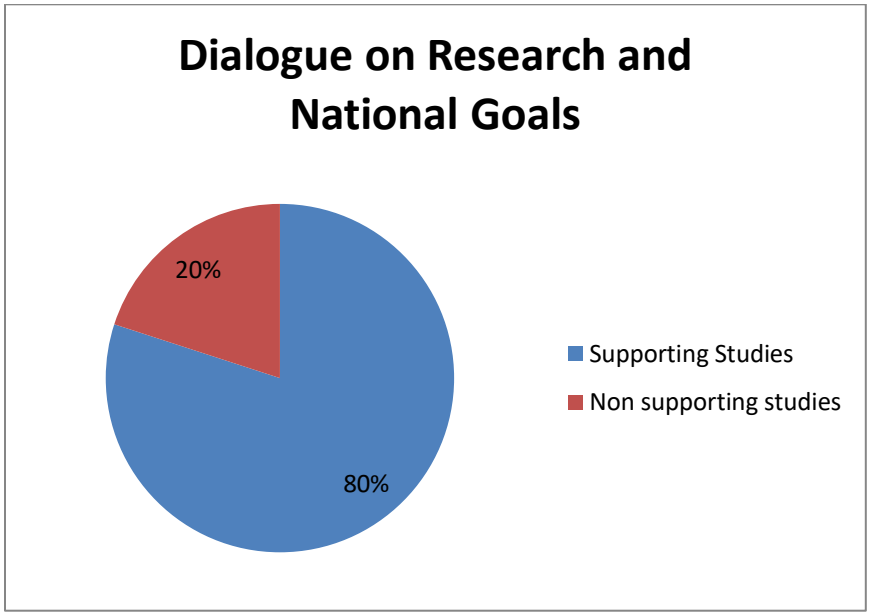
Table 3.2: Major Results and Conclusions Drawn from the studies Include

Results and Conclusions	
Results	**Conclusions**
Four studies reported that institutions and the government had to engage in an inclusive dialogue on research and national goals.	It is concluded that teachers engage in a dialogue on barriers to incorporate this knowledge in the belief system.
Two studies reported that teachers should be the center of designing assessments for a transformational model to occur.	It was concluded that as teachers share their experiences and incorporate them with research, they develop new ways of understanding their classrooms.
Three studies reported that curriculum materials should be an essential part of teacher development and an enhancement to personal beliefs.	It was concluded that teachers should examine science concepts to make decisions that incorporated learner's daily ideas.
Four studies reported that curriculum reforms and development should be aligned with school programs.	The conclusion was that teachers should develop supportive student environments that enhance learning.
Four studies indicated that teachers should design a lesson plan and other curriculum materials following the articulated personal beliefs and experiences.	It was concluded teachers should assess what learners have understood as a result of their teaching processes.

3.7: Transformational Model

In the current study, 20% of the reviewed sources reported a transformational model must be guided by a dialogue of existing research while incorporating it with the national goal. By reviewing teaching methods in the literature, teachers understand and adopt various teaching methods and interact with their classrooms. According to Badri et al. (2019), teachers should channel their focus in understanding the barriers and problems that affect classrooms and conversing understanding how students learn, how they know what they have learned and what is essential for them to learn.

Figure 3.2: Dialogue on Research and National Goals



Additionally, 60% of the studies reported that students had to be actively involved in learning through an inquiry approach where students learn through an experimental process for a transformational model to occur. According to Dickson (2019), an inquiry approach is appropriate in teaching science as it involves hands-on activities, textbooks as resources, journals, reflections, and writing assignments. Students reported having enjoyed science more when their teachers used these approaches. Besides, these studies also reported that teachers mix their students of mixed gender, race while circulating them to undertake varying roles. Learners in this group reported enjoying science more than those whose teachers used the typical lecture and demonstration method. The studies depicted that teachers who followed the transformational model produced learners who could use scientific procedures and essential scientific tools and equipment.

4.0 DISCUSSION

The current study sought to understand and enhance the need for a transformational curriculum model in teaching science in UAE. The study's findings depict that if a transformational model is implemented in the steps described, it can alter the demeaning, deskilling, and demoralizing effects of the vertical regulations in the current bureaucratic world. Additionally, the study's findings depict that transformational models can improve students' attitudes and interests while ensuring science achievement is measured by the entire kingdom or each Emirate's educational entities (Mostafa et al., 2018). According to Al Darayseh (2020), transformational models of teaching expose teachers to collaborating with their fellow teachers, educators and examining research expertise to improve practice and incorporate teacher requests for

substantive inputs towards science concepts and methods of teaching.

The study's findings depict that implementing transformational models as a part of professional teacher development has implications on science teachers' professions. The study revealed that teacher's past experiences are essential and valuable resources to both the teachers and their fellow educationists. Alneyadi (2019) notes that teachers' experiences, while interpreted through contextual transformational professional development, become an essential part of redesigning and reforming science teaching. This is achieved as they can choose the materials to use in their classrooms, design learning environments, communicate effectively with other educationists, and ensure an appropriate learning environment. As Badri et al. (2019) note, "Examining research knowledge, participating in applied research, observing other teachers teaching, trying out ideas developed elsewhere can all be valuable if they are part of a process of professional interaction, action, and reflection."

The study's findings depict that teachers understand the need to connect with the existing research in their profession while collaborating with educationists and entities that value teachers as partners in advancing the knowledge of teaching and learning. Forawi (2015) argues that in institutions where teachers inquire about their practice while reflecting about their practice in a collaborative manner, they interact with higher institutions and science educators to affect everybody. Besides, teacher research conversations and dialogues offer a mutual benefit to theory and practice (Ibrahim, 2020). Teachers who are aware of how the transformational model works and its implications ensure that they maintain the ongoing reflection process and informed decision-making. Therefore, the transformational model is a way through which teacher's professional development can be examined and transform the way science is taught in modern schools.

4.1 Implications to Practice and Future Studies

The current study offers a challenge to the existing systems to rethink and transform teacher preparation and development goals in the United Arab Emirates. It pushes science educators to think of ways of incorporating teacher preparation programs derived from sophisticated situations in today's schools, experiments, and content with field experiences that require prospective teachers to act on their knowledge while assessing their effectiveness in learners' experiences (Tyumeneva & Shkliaeva, 2016). The current study offers a chance to increase and enhance communication between teachers and administrators to make more informed decisions that involve teachers as active parts of the science curriculum.

5.0 CONCLUSION

Learning models are a continuous process through which teachers and educators reform and shape curriculums to enhance learners' ability to incorporate their classroom concepts in the real world. Besides, explicit learning models create a generation equipped with real scientific concepts that enable them to become pioneering and skilled citizens. Consequently, transformational curriculum models should be conceptualized and applied holistically rather than the mere understanding of what should be taught. These models cover the whole student learning process by allowing teachers to address how content is taught and ways of assessing the learned concepts. The current paper suggested that transformational learning models can enhance science teachers' professional development while improving students' learning experiences.

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