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Research Paper

Curriculum Materials in Middle School Science Teaching in Ethiopia: Teachers' Textbook Use and its Impact on Students' learning experience

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Abstract

The curriculum materials' inherent potential to influence curriculum implementation depends on the way teachers make use of them in the enacted instruction. This case study examines how middle school science teachers use textbooks and how their approaches shape students' learning experience. The findings reflect the features of the perspectives that view 'curriculum use as participation with the text': and it as well evidence that this perspective is valid even in a situation where state- approved textbooks are mandated. The finding also evidenced that the teachers' use of textbooks facilitates learning experiences of science as a domain of knowledge but fails shortly to support the development of science process skills. This resulted in discrepancy between intended and implemented curriculum. The findings imply that teacher education programs should strengthen teachers' Pedagogical Design Capacity to make better use of the affordances of curriculum materials. It also suggests the realization of this could be enhanced through providing the teachers with educative science curriculum materials designed with this intention.

Keywords: Curriculum materials, science learning experience, Textbook

INTRODUCTION

Curriculum materials operationalize the goals embedded within education policy. Owing to the greater specificity they provide, they serve as a primary clarifying mechanism for how to interpret and enact national standards (Choppin et al., 2022); are mediators between the intended curriculum and classroom instruction in interpreting the implementation of the curriculum (Polikoff, 2022; Smart et al., 2020; Stein & Kim, 2009). The implementation of the curriculum ideas and practices embedded in the curriculum materials, however, depends on the way they are used in instructional practice. With reference to developing countries' science curriculum implementation, Rogan and Grayson (2003) identified teacher factors- which pertain to the teachers' own background, training and level of confidence, and their commitment to teaching, as either support, or hinder, the implementation of new ideas and practices. Recent study finding (Nsengimana et al.,2025) reveals as there exists gaps between the intended and implemented science curriculum in the context of Sub-Saharan Africa. The results of the study indicate that although the competence-based curriculum has been adopted in various countries across Sub-Saharan Africa to improve educational quality, the science curriculum is still implemented in traditional ways. Referring to synthesis of studies' findings, they also state that "it seems that attention is not yet given to the implementation … particularly in SSA countries since gaps between what is intended by the curriculum and what is achieved in practice are still there" (Nsengimana et al.,2025,p.7).

In most low- and middle-income countries, as Smart et al. (2020) pointed "textbooks play a powerful role in guiding classroom practice and often become the de facto curriculum" (p.7). The very notion of textbook's purpose and its link with the general curricular goal resonates in the Ethiopian General Education Curriculum Framework stated as: "...curriculum materials … are essential for ensuring the effective implementation of the curriculum… and achievement of the goals of the curriculum" (MOE, 2020, p. 14). From the perspective of textbooks potential in resource scarce settings, a study in Ethiopia also indicated as "…the role of the teaching learning materials is particularly significant in Ethiopia where teacher quality is low, instructional time is short, class size is large, and school facilities are either scarce or substandard" Girma and Chandrani, 2017, p. 22). Our study is situated in this context and sought to examine curriculum implementation issues within the science education context. The need to improve quality and relevance of science education gains attention as "… science education is vital to train the mind to understand the world in which we live, make choices and solve problems." (UNESCO, 2015). In the context of developing countries, "Improving science education is often regarded as a priority… in order to promote long-term economic development" (Rogan and Grayson 2003, p.1).

In the realm of science education, according to Schneider et al. (2005), textbooks influence both the content that students are taught, and the methods teachers use, acting as a link between standards and classroom implementation. This view is also noted by other scholars: although many other factors and sources influence the translation of curriculum, textbooks have a dominant influence in the science classroom as they determine teaching strategies and the learning experience of students (Hansen 2018); students' engagement in science learning experiences presented in curriculum materials improves students' performance (Harris et al, 2014). With this conception, the classroom practice of teachers in their interaction with the curriculum materials deserves close examination to benefit from insights of studies in the areas. Bagoly-Simó (2018) noted as academic research dedicated to both content and usage of textbooks are important to improve the teaching and learning of science. As of Davis et al. (2016), better understanding of how science teachers use these tools could help to improve both curriculum design and on them in planning and enacting instruction, and the role resources play in teachers' practice." (P.7). theory related to teacher learning and decision- making. Discussing studies on science education that connects curriculum materials, instruction and student outcomes, Davis et.al (2016) further state:

> While relatively limited work has focused on making empirical connections between curriculum materials use and student outcomes, some work that exists suggests a potentially important role for curriculum materials in shaping students' outcomes. However, the role of teachers as a mediating factor between curriculum materials and student outcomes is often not clear. This warrants further research. (p.15)

Referring to studies in South Africa and Sub-Saharan states, Miguel's study also indicates the content of the materials has been the main object of study (Miguel, 2015). Recent studies on science curriculum materials/ textbooks in other contexts too tended to focus on how specific concepts or approaches of teaching are represented in textbooks. For instance, on Nature of Science (Korsager et al., 2024, Zhuang, et al., 2021), on inquiry teaching (Isaksen et al., 2025), on Science Process skills (Yalçınkaya-Önder et al., 2022). Thus, the potential of the materials has been analyzed, whereas how this potential has been turned into teaching and learning is still under-researched. Regarding the level of education, in science education textbook research trends, Vojíř and Rusek (2019) found the most frequently researched on are science books for secondary schools. The study finding of 'a scoping review of textbook related research in Ethiopia (Mohammed & Kenea, under review), also reveals as very few of the research focused on science textbooks in primary and middle level. The review also indicated that there was no research conducted that examined textbook use in science teaching combining with its impact on learning experience.

Building on these gaps and findings that highlight the need for further research combining curriculum materials use with students' outcome, the present study seeks to address the concern by investigating the situation of middle school science teachers' textbook use in Ethiopia guided by the following research questions. (*1) How do teachers use science textbooks in planning and instruction? (2) What outcome is prevailed/ denied as a learning experience of science through teachers' approaches of textbook use?* With all these considerations, the study aims to examine how middle school teachers use science textbooks and the status of science learning experience resulted from their textbook use approach.

LITERATURE REVIEW

Curriculum materials are considered as a primary pedagogical resource in the curriculum implementation process. They represent and guide the content, pedagogic approaches, sequencing of teaching and the strategies to be used for instruction (Moore et al.,2021). In designing the enacted lessons, teachers use textbooks and their accompanying curriculum materials to ensure that the curricular goals are reflected and to achieve the desired learning outcomes. In this respect, Remillard (2018) identifies instructional objects, pedagogical guidance and insights, curricular sequences as three layers of communication that the materials communicate with teachers which must be interpreted when designing instruction. With these features, the materials ''convey rich ideas and dynamic practices… that relies heavily on interpretation" (Brown,2009, p.2).

The Interpretation of curriculum materials in lesson enactment requires teachers to observe the affordances embedded and use to create meaningful learning experiences which is conceptualized in the literature as '*curriculum materials use'*. As of Lloyd et al. (2009) description:

> "[curriculum materials] use means a variety of interrelated pedagogical activities. It includes how teachers engage or interact with these resources as well as how and the extent to which they rely

Curriculum materials use has been studied by taking different perspectives which shows as different conceptualizations exist about the construct of *Curriculum materials use* in the instructional practice. Remillard (2005) explores the four ways that researchers conceptualize and study curriculum use. Conceptions of curriculum material in the perspective of 'Use as Following or Subverting the Text', assume the teacher role to be enactor of planned curriculum and fidelity is possible under ideal conditions. The weakness is that it does not consider the difficulties of creating an ideal situation in most educational context. While 'Use as Drawing on the Text, curriculum use as ways in which teachers draw upon; but the role of curriculum materials is dismayed. In the view of 'Use as Interpretation of Text', the teacher is interpreter of the written curriculum and fidelity is impossible. The fourth perspective is 'Use as Participation with the Text' - the assumption in this perspective is that teachers and curriculum materials are engaged in a dynamic interrelationship that involves participation in the parts of both the teacher and the text.

This study adopts the perspective-Use as Participation with the Text' because contextual determinants that potentially influence teachers textbook use in Ethiopian context [teacher, student, curriculum and other context related factors] are conceptualized within this framework and provide a framework for the analysis of findings. It also considers the planned and the enacted curriculum linking with other variables that involve in the teachers' curriculum materials use. This also aligns with the central issue that our research sought to address.

The perspective of 'curriculum materials *use as Participation with the Text' is* widely referred to and used in research that examine materials use in instructional context. According to this perspective, *t*eachers are viewed as active users of curriculum materials and shapers of the enacted curriculum and the process of using curriculum materials is mediated by their knowledge and beliefs. Evidence from research, as Brown (2009) noted, also suggests that using curriculum materials is a dynamic process involving reading, interpretation, appropriation, and design. As Gunckel et al.

(2007) explained this relationship referring to science lessons, curriculum materials bring representations of science content, task procedures, and instructional approaches that mediate teacher action through their affordances and constraints. Teachers bring knowledge, beliefs, experience, and identity to the relationship. These descriptions reveal that it is how teachers use the curriculum materials that matter for improved learning and student outcome than focusing only on what the curriculum materials constitute to guide instruction or even content which reflects the curriculum intent.

Situated in this perspective there are different analytical frameworks proposed to the study of curriculum materials used in classroom context. One of which is Brown's (2009) conceptualization which offers three analytical constructs to help understand the different ways teachers use curriculum materials such as Offloading (following curriculum materials closely), improvising (crafting instruction without specific guidance from their materials) and adapting (modifying materials to support instructional goals. In our study, Brown's analytical model is used to examine the teachers' appropriation of the mandated curriculum materials – aspect of official curriculum, "which specifies what should be taught" (Remillard and Heck, 2014). The three analytical constructs guide the observation and analysis of the instructional episodes with specific focus on how the different components of the textbooks are used. Sherin and Drake's (2009) propositions that when adapting the resource teachers either omit components of a lesson, or replace one component with another, or completely create new components which align with the perspective are employed for the further analysis of the adaptation practice.

These conceptualizations will be considered as a guiding theoretical framework in our study. However, according to Brown (2009) it "characterizes the nature of a teacher's interaction with a given resource, but it does not evaluate the outcomes of this interaction" (Brown, 2009, p.25). Hence, as our research also investigates the outcome of their approach in terms of the learning experiences, it also considers constructs considered as fundamental outcomes to science -education. In science instruction, Bell et al (2012) identified three interacting domains to be viewed as a framework for science instruction that represents a specific component of science: *Science as a body of knowledge*: - Facts, Definitions, Concepts, Theories, Laws, Etc. *Science as processes/Science process skills*: - Observing, Measuring Inferring Classifying: *Science as a way of Knowing*. This study integrates Brown's (2009) analytical model and Bell et al 's (2012) interacting domains of science instruction. Integration is essential because our study addresses two interrelated issues that neither model alone can fully explain. To examine the textbook use approach that the teachers follow, Brown's analytical model is used, and we interpret the outcome of this approach by considering the specific components of science education that Bell et al 's interacting domains of science instruction identifies. The analysis of combining the approach with the specific component of science learning allows us to examine the prevailed or denied learning experience.

RESEARCH METHOD

In this research, a case study methodology was adopted. It involves elements of explanatory design one of the purposes of which, as Hancock and Algozzine (2016) noted, is to determine how events occur and which ones may influence outcomes. This method is considered for its appeal to studies which focuses on answering the how related questions and to cover contextual conditions relevant to the phenomenon under study (Yin,2003).

The study was conducted in two public schools in Ethiopia when a new curriculum is implemented. The schools were selected using homogeneous purposive sampling, a technique aimed at identifying cases that share similar characteristics or traits (Etikan et al.,2016). The justification for purposive selection of the schools for this study, other than pragmatic reason, was that both schools were a site for piloting the implementation of the new curriculum. Hence, there is well-

established system in the schools to support the full implementation of the curriculum. The participants were five general science teachers who were selected as they have exposure of using the new textbooks in the same school and grade level when the new curriculum was being piloted. This ensures selection of participants based on relevance to the research question (Bryman,2012).

Data for this study were collected through observation, interviews, and document analysis to integrate insights from a variety of data sources. This enables us to triangulate data sources and data types; a basic principle in case study research (Baxter and Jack, 2008). Observations of classroom teaching scenarios were carried out as it is an approach with the potential to explore practices of textbook use (Fuchs and Bock ,2018). A total of fifteen lessons from all five teachers' teaching were observed - when the unit starts, in the middle and at the end of the unit. A semi-structured observation approach was followed during the observations. A pre- defined category of the different types of textbook use from the theoretical framework combined with the identified key components of the science textbooks [*see the details in the finding and discussion section*], were listed to make records of the how this specific component is integrated during the lessons. The observer also wrote narrative notes to capture specific examples and the context of the teachers' approaches. Each observation period was followed by discussion with teachers on issues that arise from the events noted in the lesson enactment. At the end of the unit, interview with the teachers were conducted using a semi structured interview which are particularly well-suited for case study research (Hancock and Algozzine, 2016). The interview protocol contains both broad questions on textbook use in enacting instruction as well as questions elicited during lesson observation related to the specific approach they follow with different textbook components. Contents from the students' exercise book and assignments and from teachers' lesson plans were also examined as data sources. In the case of textbook related practices that take place in the classroom, Bruillard (2021), state analysis of pupils' exercise books and testimonies of the actors (teachers) are used by researchers since it is not possible to observe classes all the time.

The data were analyzed in two phases: the first of which was examining the data gained from observed lessons, documents and teachers' responses in the interview to assess the ways how teachers used the different components of the textbook (RQ-1) which considers "characterizing the manner in which the curriculum materials are manifested in enactment" (Dietiker et al., 2018). In this phase, the documentation and analysis in this part were guided by the analytical constructs from the theoretical framework of Brown (2009) namely- Offload [adherence] Adapt, [supplement, modify and omit], and improvise. In the second phase, analysis of data to examine the prevailed/ denied science learning experience, (RQ-2) follows. The textbook components were first identified and assessed for the specific learning experience they promote based on Bell et al. 's (2012) description of domains of science viewed as a framework for science instruction as depicted in table-1. Following this, integrated analysis was drawing on evidence from the findings of the first research question- to identify the outcomes of their approach related with science learning experiences. Building on this, we analyzed if the specific approach teachers follow on these components either promote or deny the science learning experience that the very component primary fosters- Science as a body of knowledge, Science as processes/Science process skills and Science as a way of Knowing. (Bell et al.'s 2012). The textbook components were first identified and assessed for the specific learning experience they promote based on Bell et al. 's (2012) description of domains of science viewed as a framework for science instruction as depicted in table-1. Following this, integrated analysis was made taking evidence from the findings of the first research question- to identify the outcomes of their approach related to science learning experiences.

FINDINGS AND DISCUSSION

1. Teachers' Use of Science Textbooks in Planning and Enacting Instruction

From the analysis of the lesson plans, it was observed that there is high level of alignment to the textbook in both the objectives set and the content included in the lesson plans. All the participant teachers in the interview also noted that, as the textbook is a given official curriculum document, planning is made primary based on what is provided in it. The following excerpts show this. *"In the annual lesson plan, it is a must to divide the textbook content and plan so that to ensure all the contents will be covered in the academic year … the department check for this and approve.'' (Teacher-1, 7th grade). ''The weekly and the daily lesson-based plans must be prepared from the textbook, and the department checks for its alignment with the annual plan… of the topics and of time." (Teacher-4, 8th grade)*. The participants further mentioned that when planning, the textbook and the accompanying teachers' guide provide insights into the details of content to base the plan. The finding is also like other studies findings, for instance in Adu et al.'s (2020) study it was noted that the contents, the sequential order of the curriculum allows teachers to use it for lesson planning. Our findings show that this heavy reliance on textbooks in planning seems to emanate from the fact that: the textbook is mandatory to be used, and external supervision is in place as a mechanism to ensure alignment. The performance appraisal standards the supervisors use include items on lesson planning and objective alignment. Low scores of teachers in these standards result in being targeted to increased monitoring. The teachers are also required to replanning of lesson plans with follow-up from department head. In the system, even private schools are required to abide by strict regulations not to use textbooks other than this to ensure equity and comparability. This result seems in line with implicit function of textbook referred related to "the accountability of the teacher" (Smart and Jagannathan, 2018).

This stern reliance on textbook for planning did not bring fidelity approach to textbook use in enacted instruction. The textbooks considered in this study are structured into units and each unit consists components the core of which can be categorized in to: *Core Content/Explanatory Text -/Main body of scientific information, concepts, and explanations/, Illustrations/Diagrams, Intext- Discussion Questions, conceptual Practice Exercises, End-of-section and chapter questions/problems, Activities/Experiments,5) Summary/recap*- Evidences from the lessons observed, students' work sample and of teachers' interview reveals the varied approaches teachers follow to these components in enacting instruction. In table-1 below how these components are integrated in the enacted instruction is presented.

Table 1. Evidence of Textbook Component use Across Multiple Observed Lessons and Student Work Samples

Core components of textbook	**Science Learning Domain-primary Promoted**	**Descriptions: evidence from the enacted Instruction**		**Approach**
		In observed lessons	**In Student work sample**	
Content/Explanatory Text	– Provides foundational knowledge and understanding [Promotes SPS]	– used in instruction with high level of adherence, in same order as presented in textbooks – in some cases, supplemented from other sources- in some sub-	- All the topics included in the text appear in the students' notebook - In some units it is supplemented.	- High level of Adherence [offloading] - adaptation [supplement, modify]

Core components of textbook	Science Learning Domain-primary Promoted	Descriptions: evidence from the enacted Instruction		Approach
		topics and content-based classroom discussion		
Illustrations/Diagrams	– visual understanding of abstract concepts – [Promotes SBK]	– students refer to visual representation from textbooks. – teachers refer to illustrations in discussion	– Diagrams and illustrations are mostly copied in students' notebook as looked in the textbooks	High level of Adherence [offloading Supplementation [adaptation]
Intext-Discussion Questions	– Encourages peer interaction and critical thinking – [Promotes SPS]	– intext discussion questions are often missing in class discussion – in few it is altered to individual question & answer [not followed as presented in the textbook/ guide]	– very few instances [reports	– Omission [adaptation] inmost – Modification - in some
conceptual Practice Exercises	– Reinforces learning of core content – [Promotes SBK]	– All the exercises are given, and students do individually and the teachers give feedback/ discussion – supplemented from teachers' self-created resources	– The conceptual exercises are seen completed as classwork/ homework – similar exercises are given as assignment	– Adherence [offloading] Supplementation [adaptation]
Activities/Experiments	– tasks students work on / inquiry-based experiential learning and scientific thinking – [Promotes SPS]	– very rarely integrated in instruction	– very few instances [reports/ work samples] that show the integrating of the activities	– Omission [adaptation]

Core components of textbook	Science Learning Domain-primary Promoted	Descriptions: evidence from the enacted Instruction		Approach
Summary/recap	– consolidation of core content for revision – [Promotes SBK]	– used in instruction with high level of adherence [classroom question and answer- based discussion]	– copied in students' notebook for quick reference	– Adherence to text [offloading

SBK- science as a Body of Knowledge, SPS- Science Process Skills (Bell et al., 2012]

As revealed in table 1, the dominant approaches teachers follow in enacting instruction falls under offloading [Adherence to the textbook components] and adaptation [supplementation and considerable level of omission]. The teachers' approaches vary depending on the components of the textbook addressed in the specific lesson. In some lessons, the teachers adhere to some parts and adapt others; while there are also instances where complete adherence and/ or adaptation occurs.

a. Adherence to the textbook components – [Offloading]

High level of adherence was observed in four components: *Content/Explanatory Text*, *illustrations / diagrams, Conceptual practice exercise and summary/ recap*. Across observed lessons, the teachers' explanation and demonstration were based on the textbook. In the follow-up interview, the teachers disclose that it is similar with the other units i.e. all the concepts presented in the contents are included in their instructions. *"We include in our plan & teach all the topics from textbook… there are no subtopics that are left out but the depth of discussion might vary" (Teacher-1, 7th grade). "As we are expected to cover all the topics, we teach them all … but we give less time for some and more for other and we may also add other notes also on some'' (Teacher-2, 7th grade). "The students must learn all content as the national exam questions are from all topics …so try to cover all.'' (Teacher-4, 8th grade).* The other two components of the textbook conceptual practice exercises and summary/ recap are all included in the instruction and as seen in the students' work sample. In the interview, the teachers also confirmed that it is not missed in the other units too. The idea that Content/Explanatory *t*ext *and* exercises are part of the formative assessment and evaluation and therefore adhered is also reflected by all teachers during the interview. In this approach of teachers' textbook use, one of the three levels of relationships between teachers and textbooks distinguished by Nicol and Crespo (2006), which is adhering is highly reflected.

b. Adaptation – [Supplementation and Omission]

Evidence from the data source reveals that, in the delivered instruction, there are instances where the content for some topics given as a summary note and discussed is a mix of points from the textbook and from other sources. In the conceptual practice exercises, additional objective type questions which require the students to search for the answer from the textbook were added and even the inclusion of more similar exercises from other sources or prepared by the teachers themselves is a common trend*. "…we also add more questions on the exercises as we need the students to be ready for national exam. (Teacher-5, 8th grade). "…the students' gain more knowledge of the concepts, and they understand better when the notes we give is combined with more exercises" (Teacher-2, 7th grade).*

In the other two components of the textbook [*Intext- Discussion Questions* and *activities/Experiment],* the textbooks include activities which require the students to work on tasks

in which they are engaged in observation of their environment, collect information or make simple investigations and report to the class. It was found that these activities were almost always omitted from the instruction. In the interview for instance, two teachers reflected as: *"… to be honest, we hardly engage them in the activities as the students do not understand … some students may try but I think it is better to use the time for exercises (Teacher- 3, 7th grade). "… most students do not show interest to the task." (Teacher- 3, 7th grade). "We use the class time for explanation, discussion and exercise. I think students benefit from this as they are to sit for national exam …so such activities are rarely integrated in classroom teaching. (Teacher-4 8th grade).* In the follow-up discussion with the teachers after lesson observation too, the teachers noted that time, students' motivation and capacity to influence their action.

The findings revealed that the teachers adapt supplements, modify content and practice exercises, and omit other components from instruction. The overall picture generated from looking into how the different components of the textbook are used reveals that the teachers were not following them in a strict sense in the instruction as they did in planning. Results like this were reported by Knecht and Najvarová (2010) as it is becoming apparent that teachers use certain textbooks more frequently during their lesson planning than during the actual lessons.

There are considerable instances in the finding that could be related to Brown's (2009) description of different type of use of instructional materials as "offloading' - when they adhere on the textbooks for content/ explanatory text, and as "improvising" when they supplement/ bring new content and exercise but still within the frame of the textbook content. As a lesson extension the textbook provides activities which requires students to actively engage in knowledge building through engagement in discussion, demonstrations, projects: and the teachers' approach of on these components, as in the third instance fall under Brown's "adaptation" category. The omitted parts specifically align with Sherin and Drake's (2009) description of a continuum of adaptation actions between omit, replace, and create. Such approach to textbook is not a surprise given that many perspectives on curriculum materials recognize an approach other than fidelity which assumes the possibility following curriculum materials in a literal manner (Remillard 2005).

2. Learning Experiences Prevailed/ Denied through Teachers' Approaches of Textbook Use

As the finding above reveals, the teachers' use of textbook components varies some are integrated in the instruction and others are either supplemented, modified or omitted. It is through the analysis of this approach of teachers' textbook use relating with science learning experience the specific components of the textbook promote that the finding in this part presents the learning outcome prevailed or denied.

a. Science as a body of knowledge / Content learning

It was revealed in the finding that the integration of textbook components content/ explanatory text which presents facts, definitions, explanations about science concepts in the instruction was high. All of which relates to science as a body of knowledge. This resulted in helping students to acquire the contents of the intended curriculum integrated in the science textbooks. It was disclosed in the interview also that they are more concerned with science content learning. The following excerpts shows this; *"… for students it is more useful to know the main and basic knowledge from the textbook content notes… [Teacher-5, Grade 8] '… in some portions, we add points from other books which gives better definitions and explanations of concepts…" [Teacher-5, Grade 8] "… we rewrite the note and add to make it easy for the students to comprehend. [Teacher-1, 7th grade).* The use of illustrations, the summary and conceptual practice exercises nature and how they are integrated in

the enacted instruction was intended to consolidate the contents learned. These actions of teachers, which integrate these components with high levels of concern in the enacted instruction steam from their perception of learning and retaining the factual contents of the textbook are more relevant to their students and the context they are teaching.

b. Science Process Skills/SPS/

The intent of integration of intext-discussion questions, and activities in the textbook is to support transition from memorization to understanding and application through reflection, discussion and experiential learning and while also facilitating the development of Science Process Skills. As revealed in the finding, however, [the teachers' approaches of textbook use results in the omission of these components from the lessons enacted. The literature shows that embedded in such tasks are opportunities for the students to engage in activities that enhance the development of science process skills. In the table below, sample activities missing from the delivered instruction are depicted. The category of their reference to science process skills [SPS] is made based on Yang and Liu (2016) identification rubrics as used by Tadesse and Solomon (2023).

Table 2. Sample activities from the textbook in SPS Category which are not integrated in the Enacted curriculum

sample activities	SPS category
– *Collect different soil samples from varied locations and measure their PH values. …Write your report in groups and present your findings to the rest of the class*	Investigation, Measurement, reporting
– *Place a prism on a sheet of paper and a few centimeters in front of a source of light Rotate the prism slightly …Using coloring pencil, draw what you observe on the sheet of paper…Based on your observations…*	Observation, Investigation, reporting
– *In groups search … or grow your own fungi on a little moist injera or by letting a piece of fruit go rotten… Look at different structures of fungi Draw several different types of fungus.*	Investigation, recording report
– *Make a collection of flowering plants around your school. Identify them and then classify them …Compare …. Make a table of differences … Draw well-labeled diagrams of the bean plant …*	Classification, recording
– *Record and describe the various chemical changes that occur in your daily lives (e.g. cooking food, etc.) and describe the evidence you use to determine whether chemical reaction occurred.*	Observation, inference, recording

The students would have developed both basic and integrated Science Process skills had the activities been integrated in the enacted instruction. For instance, as indicated in the table, one of the first activities reads as: Collect different soil samples from varied locations and measure their PH values. …Write your report in groups and present your findings to the rest of the class'. In this activity the students notice the physical characteristics of the soil- [engage in observation] measure the PH value - [engage in measurement], Group the soil based on the PH or place- [engage in classification], In the process, they engage in collecting soil sample, testing them and systematically recording

results-[engage in Experimenting and Interpreting]. Similarly, in the third activity – 'In groups search … or grow your own fungi on a little moist injera or by letting a piece of fruit go rotten… Look at different structures of fungi Draw several different types of fungus.' From this activity, the students examine the changes in the food – which is engagement in observation, they also, measure the size or spread in two different conditions that involves measurement and record of the differences they observe and communicate.

In the teachers' use of the textbook components, their approaches were found predominantly facilitating the content/explanatory aspect which enhances the acquisition of knowledge in science. The teachers' approach to using lecture stems from their belief that it is the most effective technique. This belief is influenced by contextual factors such as students' level of understanding-coupled with their concern to have students pass examination which can be realized, as of their belief, when the content aspect is thought thoroughly. It is also in part influenced by the teachers' own limited expertise of pedagogical content knowledge to teach certain contents as their educational preparation was in one of the science disciplines- Physics, Chemistry or Biology. But it is noted in the literature that while it is important for the students to acquire knowledge of science concepts, they must be provided with opportunities to develop the science process skills (McComas 2014; Rillero 1998).

The process of selecting and altering tasks shows teachers' assumptions about what students should learn and more importantly, how students should learn with the tasks selected (Remillard, 1999; Stein, Remillard & Smith, 2007). In our study too, there is evidence that the teachers' integration and omission of tasks from textbooks, in which the latter results in denial of opportunities, steam from their belief that learning experiences that directly support knowledge acquisition and preparing for exam is given priority even at the expense of skills. This deviates from what is established in the literature (Rillero,1998; Bell et al., 2012) that both science content and process skills are important in developing scientific literacy. Revealed in our finding is that the tasks mostly omitted are those noted in the accompanying guide of the textbook as tasks that "…helps students develop skills such as identification, observation, collecting, measurement, data manipulation, recording, analysis, report writing and verbal reporting." (Education Bureau Addis Ababa [EBAA],2021, p.8). The syllabus of general science at middle school level also states as these learning experiences are to serve for scientific literacy development and to address the core skills of the twenty first century (MOE, 2021). Referring to the context of moving to secondary school, Braund (2016) mentioned, the impact of pedagogical issues on students are particularly relevant to learning science. Research also shows that if Science process skills of students are improved, their career interests in STEM would also improve (Zorlu and Zorlu, 2017). Situated in this, our research findings, which reveal the denial of SPS development, implies that there is an impact on the students' readiness for secondary school science as the foundational skills and exposure to scientific methods are not promoted. Its impact also extends to diminishing their attitude and interest in pursuing science-related disciplines.

The finding evidence that activities from the textbook relevant to science process skills are omitted/modified in the enacted instruction, which deviates from the purpose they were set to serve in the official/intended curriculum. This resulted from the approach teachers use the textbook which shows what other research asserts as "…adaptations to curriculum materials are inevitable, and modifications can be either productive or limiting for students' learning" (Roth McDuffie et al., 2018 in Jukić Matić,2024).

The finding in our research reveals embedded in the omitted components of the textbook are aspects to promote science process skill and competence development which is the core concern of the reformed curriculum. The reduction of such learning opportunities relates to Leshota's (2015) categorization [developed based on mathematics textbook research] of 'critical omission' - conceptualized as 'content omitted from lessons that is critical to opportunities for mediation'.

Leshota and Adler (2018) also noted 'If a particular textbook is approved as a prescribed textbook in a certain grade, then it…most importantly…prescribes the minimum requirement on content expected in that classroom' (p. 99).

CONCLUSIONS

Curriculum materials, notably textbooks, receive considerable attention in the educational realm because of their inherent potential for curriculum implementation. This study examines how science textbooks are used in middle school context with the learning experience it shapes. The literature reveals as there are varied perspectives which take different conceptualizations of the issue- curriculum materials use'. One of the prevailing conclusions of our study is that the textbooks are not followed with fidelity approach. This aligns with the perspectives that views: curriculum materials use as participation with the text' where both the curriculum materials and the teachers affect the enacted curriculum (Remillard 2005). Our research evidence that this perspective is valid even in a situation where mandated textbooks are expected to be followed to ensure the written curriculum is implemented. Teachers' perception of students' ability and their beliefs about what the students should primarily learn shape how they use the textbook. Their views on how well they satisfy the requirements for preparing students for national examination further influence its use even in a controlled educational context.

The other conclusion emanates is, resulting from how textbooks are used in the enacted instruction, learning experiences sought to be delivered in the intended curriculum are shaped-resulting discrepancy between intended and implemented curriculum. In a situation where teachers mediate between the curriculum materials and the enacted instruction, the inevitable is that the outcome is influenced by their professional competence.

With this, the implication of our research is directed to ways to develop teachers' *pedagogical design capacity (PDC),* which represents teachers' capacity "to interpret key affordances within the materials and utilize those features to craft instructional episodes in order to … achieve their instructional objectives" (Brown, 2009 p.5). Teachers' professional development support programs including seminars/ workshops and integrating PDC concepts into teacher training programs helps. As in the context of middle school General Science teaching, the teachers are from different subject-matter backgrounds, lesson study sessions, reflection, and collaborative planning and design would also be salient. It must be also noted as the approaches of such programs is most successful when sustained and directly linked to the teachers' own classroom contexts and curricula materials (Nalbantoğlu & Bümen,2025). Addressing 'curriculum materials/use' in teacher education programs and in curriculum materials development [Educative supports embedded in the materials (Davis & Krajcik, 2005)] promote teachers' capacity with this respect. To this end, the textbook accompanying materials, such as teacher's guide could be designed: providing the pedagogical rationale i.e. explain 'why' each activity is used, not only of just what to do, linking each activity explicitly to learning objectives and key educational theories and offering suggestions for modifying lessons depending on student abilities or time limits.

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