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Spatial Thinking Skills Acquisition and Textbook Inclusion for Female 10th-Grade Social Studies Students in Oman

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Abstract
Purpose: To investigate the inclusion of spatial thinking skills in 10th-grade social studies textbooks and their acquisition by Omani female students.
Methodology: An analysis card was developed to evaluate the inclusion of spatial skills in 10th-grade social studies textbooks according to a spatial skills thinking test, considering six skills. The study sample comprised 408 female students from Al-Batinah Province, Oman.
Findings: The six thinking skills were included 98 times in the reviewed social studies textbooks, and participants had a relatively low rate of acquisition of these skills (60%).
Unique contribution to theory, practice and policy: This study sheds light on the under-explored issue of spatial thinking skills, with particular insights on their acquisition among Omani female students in the 10th grade, a population lacking pedagogical studies in general. Its findings support policy targeted to enhance the target group's spatial thinking skills with improved learning resources provision.
Keywords: Oman, 10th grade, social studies, spatial thinking
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Introduction

A spatial thinking skill (STS) is widely acknowledged in the social studies curriculum due to its link with the description and analysis of human and natural phenomena in different places. Its importance has increased with the technological revolution and the advent of GIS and other programs dealing with locations and features. Thus, according to Christor., Margatita & Eleni, 2016), spatial thinking skills have become crucial for individuals in their daily lives, workplaces, and science. They play an important role in the perception and analysis of spatial relations between geographical locations, associated phenomena, and the changes that accompany them at different time periods (Carol., Cathryn., Thomas., Basil., Harwood, Kinnari., Atit &Alexander, 2014)

Thus inclusion of STS in the social studies curriculum needs to be parallel with technological revolution in order to build and develop students' abilities to understand and analyze interactions between place and human and natural phenomena to come up with a right decision. However, the inclusion of the STS in social studies curriculum requires first defining spatial thinking skills themselves, and the literature reveals different perspectives on their nature. This study adopts the definition of STS posited by the GI Learner Report (2016, p. 8): "the ability to understand spatial relationships, the knowledge of how geographic space is represented, and the ability to reason and make key decisions about spatial concepts". It is operationalized according to the STS classification of Abdel-Hakim (2016), comprising seven key skills: spatial wandering, visualizing the place appearance, cognition of the spatial pattern and gradient, the perception of spatial correlation, understanding temporal-spatial changing, spatial preference determination, and understanding spatial representation hierarchy of geographical phenomena.

Introducing STS in the content of social studies textbooks has received wide attention among educators (Anthamatten, 2010; Manson *et al.*, 2014; Scholz *et al.*, 2014). Barth (2004) explains that introducing STS enables students to optimally process and deploy studied information (Barth, 2004), and to analyze and interpret studied phenomena (Osk, 2008). According to Kim and Bednarz (2013), teaching these skills contributes to developing students' problem-solving skills. It also enables them to understand and address current and future issues (Boonen et al, 2014), and enhances understanding and application of spatial concepts to understand numerous phenomena, and to predict future outcomes (Abdul-Hakim, 2016; Hamdi & Malek, 2016). It also builds students' personality through recognizing surrounding phenomena and how to address them through five questions: when, where, how, and why. STS develops students' ability to assess the quality of spatial data and the validity of arguments based on spatial information (Downs, 2006, p. 20).

Due to its importance, studies in this part strongly support introducing STS in the social studies curriculum (Lay, Vhih, Chia, & Chung, 2011; Jo, 20

07), and some investigations demonstrated the impact of using GIS on the development of students' spatial thinking skills (Abdul-Hakim, 2016; Lee & Bendarz, 2009). Such results indicate the need to evaluate the

extension of introducing STS in the social studies curriculum, as advised by Shin, Milson, and Smith (2016), but despite the acknowledged importance and value of introducing STS in the school curriculum it is not an explicit part of the US K-12 curriculum. Thus, it is not surprising that American students find assessment including spatial thinking skills to be challenging.

Based on the above, the current study seeks to investigate the inclusion of STS in Omani social studies textbooks and their impact on developing these skills among female school students (an all-female population was chosen as the education system is generally gender-separated in Oman, and the data was collected from one school, by convenience sampling). There is a dearth of studies investigating the extension of STS inclusion in social studies textbooks and the impact of this on the development of STS among school students. It is quite important to conduct such a study in the Ministry of Education, Oman, as part of effort to reform and continually improve the social studies curriculum. The results of the current study highlighted some points which may help in the process of reforming the Omani social studies curriculum, and may encourage other researchers to investigate the introduction of STS in social studies curriculums from other perspectives.

1.1 Research Questions

- To what extent does the 10th-grade social studies textbook in Oman contain spatial thinking skills?
- To what extent do 10th-grade female students in Oman acquire spatial thinking skills?

1.2 Research Objectives

- To discover the extent to which the 10th-grade social studies textbook in Oman contains spatial thinking skill.
- To discover the extent to which 10th-grade female students in Oman acquire spatial thinking skills.

Methodology

The study used mixed methods to achieve its objectives. Analytical respective method was used to evaluate the inclusion of STS in the 10th-grade Omani social studies textbook, and the second descriptive method which was used to evaluate 10th-grade female students' acquisition of STS in Oman. Using mixed research methods helps to add more value compared to using one method (Courtney, 2017).

In order to achieve the objectives of the study, two instruments were developed. The first was a content analytical card to investigate the inclusion of STS in the studied textbooks. To develop this card, a list of STS was developed based on the STS classification by Abdel-Hakim (2016), then the list was transformed into an analytical card. The second instrument was STS test, which included 30 questions developed by the researchers, based on reviewing previous literature (Abdel-Hakim, 2016; American Association of Geographers, 2006; Verma, 2007). The validity of the both instruments was examined by a panel of expert judges from the College of Education in Sultan Qaboos University and the Ministry of Education (Oman). The reliability of the two instruments was also examined by using Copper equation to calculate the coefficient of analysis; it was 81.2%, which is considered high and sufficient for the purposes of the study. The reliability of STS was examined by piloting it to 30 female students, and it was 769.

Results

- To what extent does the 10th-grade social studies textbook in Oman contain spatial thinking skills?

The results shown in Table 1 indicate that all of the STS were included in the studied textbooks (n=98), with varying proportions. It was found that skills of spatial wandering and spatial influence represented 55% of the total inclusion (27.5%) for each skills variant, followed by spatial hierarchy (22.4%), temporal-spatial changing (15.3%), and spatial preference and spatial correlation (7.17%).

The results also revealed that inclusion of STS in the studied textbooks took two manners: explicit, representing 41%, and implicit, with 59%. It also found that inclusion of STS in the studied textbooks generally tended to not appear explicitly, but implicitly, except for wandering skills (18 explicit and 9 implicit), while spatial preference skill was only included implicitly.

Table 1: Frequency and percentage of spatial thinking skills in "The origin of the earth and its composition" unit

Skills	Concept			
	Explicit	Implicit	Frequency	Percentage
Spatial wandering	18	9	27	27.55
Spatial correlation	2	5	7	7.14
Spatial influence	12	15	27	27.55
Spatial preference	0	11	11	11.22
Temporal-spatial changing	5	10	15	15.30
Spatial hierarchy	3	8	11	11.22
Total	40	58	98	100
Percentage	40.8	59		

- To what extent do 10th-grade female students in Oman acquire spatial thinking skills?

Table 2 shows that participants' acquisition of spatial thinking skills in general was low (60.09%). It also reveals that their acquisition of spatial hierarchy skills was high compared to other skills, which showed a low level averaging around 50%.

Table 2: Students' acquisition of STS

Spatial thinking skills	% of mean	STD	Level of acquisition	Rank
Spatial wandering	55, 00%	22.909	low	3
Spatial influence	58, 70%	21.144	low	2
Spatial correlation	55, 44%	30.649	low	3
Spatial preference	53, 31%	30.633	low	5
Spatial hierarchy	83, 58%	40.740	high	1
Temporal-spatial changing	54, 53%	36.268	low	4
Average	60, 09%	21.054	low	

Discussion

The results showed that the 10th-grade textbooks in Oman included 98 instances of STS. This reflects that there is awareness among the designers of the Omani social studies curriculum about the importance of STS in understanding human and natural phenomena, and for students' daily lives. This is in line with previous studies affirming the importance of introducing STS in the school curriculum (Christor et al., 2016; Ormand et al., 2014). The inclusion of STS indicates the real need to develop students' ability to interact positively with surrounding environment at the local and global levels (Boonen et al, 2014; Barth, 2004; Kim & Bednarz, 2013; Osk, 2008).

The results also showed that despite the inclusion of STS in social studies textbooks *per se*, the extent of this inclusion varied from one skill to another, and most of these skills were included implicitly. The reasons for this are unclear, given that lesson content clearly includes human and natural phenomena to allow applying all STS skills. Shin, Milson, and Smith (2016) also showed that the inclusion of STS in the US social studies curriculum is not explicit. This common characteristic of the partial, uncoordinated inclusion of STS in both Oman and the US suggests a lack of coherent planning based on targeted skills, and the nature of content etc. Aside from such speculative observations, it is clear that there is a need to rethink the way in which STS is included in 10th-grade social studies textbooks in order to ensure that students receive enough information and practice to actualize STS education appropriately, allowing them to understand studied natural and human phenomena and to prepare them for life.

The results also showed that the participants had low achievement in STS. This result could be due to several expected reasons. Firstly, the majority of these skills were introduced implicitly, and this manner may induce less specific attention to them from social studies teachers . Secondly, most of these skills were introduced as a text more than as activities, with questions, homework, graphs, and maps etc., which reduces students' opportunities to practice them, either in the classroom or in their daily lives. Thirdly, the content of the studied textbooks focused more on developing students' knowledge about the concepts, lacking development of their knowledge and skills to apply these concepts in reality.

This result is consistent with the findings of Uhlenwinkel (2013), which revealed that only 14% of students were able to think spatially, based on which it was recommended that teachers should be specially trained to employ spatial thinking skills with their students. These results reveal that the situation of STS inclusion in social studies textbooks and their low influence (reflected in students' patchy and limited acquisition) call for action. Some studies showed that developing the curriculum to include the use of programs such as GIS makes a

difference in students' achievement of STS (Abdel-Hakim, 2016; Kima & Bednarzi, 2013).

Conclusion

Based on the above results, it is clear that the Omani 10th-grade social studies textbooks need to be reformed in order to improve students' acquisition of STS. Also the inclusion of these skills needs to be explicitly taken into consideration in terms of curriculum design and lesson planning, to ensure that social studies teachers recognise and apply these skills in their lessons.

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