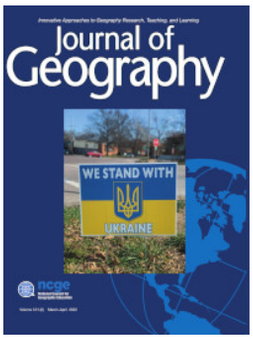

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How Key Competencies Progress across School Terms? A Study of "Activities" in Geography Textbooks for Secondary Schools

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ABSTRACT
The recent round of curriculum reform in China has proposed the educational goal of developing key competencies. This study examined how key competencies are integrated into geography textbooks for middle schools through pre-designed activities. The results showed that the textbooks emphasized the regional awareness competency. The activities in these geography textbooks promoted key competencies differently across the school years, and each competency showed a different type of learning progress over time.

KEYWORDS
Geographic competency; textbook evaluation; learning activity; temporal analysis; cognitive development

Introduction

Against the backdrop of digitalization, informatization and globalization, policymakers and education experts are asking: what kind of future citizens should we be raising? How can students adapt to the changing social and personal environment in which artificial intelligence is replacing humans in some areas? As a guiding system for educational reform in line with the lifelong learning strategy, key competencies are, by definition, the essential character traits and key skills that students should acquire to adapt to personal and social developments (Organization for Economic Co-Operation and Development (OECD)) 2005). These competencies enable students to navigate a complex, interconnected, and ever-changing world and, as a result, have attracted considerable attention worldwide (Halász and Michel 2011).

A growing number of countries are taking steps to build competency-based education systems. China, for example, has intensified its national curriculum reform in recent years, gradually shifting from quality-based (suzhi) to competency-based (suyang) education. The former type of education aims to form a stable quality structure based on innate abilities and influenced by schooling and social experiences, while the latter assumes that competencies can be nurtured in school and developed throughout life (Wang 2019). Educational reform aims to recognize and develop students' potentials so that they can lead successful lives (Moon 2007), and nurturing individuals' unique abilities, talents, and inclinations is regarded as the most important element in competency-based education (Achieve 2015). Therefore, fostering key competencies in students becomes a high-level system design that is critical to achieving the goal of educational reform.

Secondary textbooks are the template and fundamental basis for subject matter instruction, while teachers, as curriculum makers, are instrumental in ensuring that textbooks fulfill this pedagogical function (Mili and Winch 2019). However, most of them find it challenging to implement a competency-based curriculum using existing textbooks. Therefore, this study examined how key competencies are integrated into textbooks for middle schools in different school years. Using pre-written activities in a set of Chinese geography textbooks for grades 6 and 7 as research samples, we applied the content analysis method to investigate how these activities aligned with the Key Competency System (KCS) for the subject of geography. The results of our study will improve teachers' ability to promote key competencies in students through the use of activities in geography textbooks.

Literature review

Key competencies in subject-related learning areas

The competency-based approach sets the direction for curriculum reform in K-12 education in the twenty-first century (Halász and Michel 2011). To implement it in school education, countries such as Australia and New Zealand have created frameworks based on three broad categories classified by the OECD, including the components of interactive use of tools, interaction in heterogeneous groups, and independent action (Organization for Economic Co-Operation and Development (OECD) 2005). Many other countries around the world have developed new models. For example, the framework used in the United States includes three sections of competencies for 21st-century learning, including learning and innovation skills; information, media, and technology literacy; and life and career skills (Trilling and Fadel 2009).

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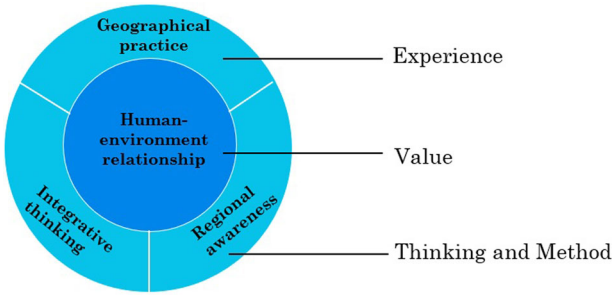

Figure 1. China's key competency framework in geography.

Achieving learning outcomes requires a base of core subject knowledge and supporting systems. The Japanese framework defines three domains, basic knowledge as thinking tools, collaborative thinking and problem-solving skills, practical ability to act for the world, as 21st century competencies that students need to grow (National Institute for Education Policy Research 2012).

Despite the international trend toward key competency-based education, there is a disconnect between the educational goals of improving key competencies and the enacted curriculum content in classroom practices in the Chinese context (Wang 2019). Researchers argue that key competencies should be addressed through the content of the learning domains (Hipkins 2018), although the relationship between the competencies and the subject-related learning domains is believed to be dynamic. China has taken a further step by developing more operational key competencies, referred to as "subject key competencies," to emphasize the significant role of the individual subject in developing competencies (Ministry of Education of the People's Republic of China 2018a). For example, the new national curriculum reform has established a system of key competencies for the subject of geography, which consists of four competencies: human-environment relationship, integrative thinking, regional awareness, and geographical practice (Ministry of Education of the People's Republic of China 2018b) (Figure 1). Because these competencies are in accordance with the overarching goals of competency-based learning, they provide a foundation for students to build geographic understanding. The formulation of such a system aligns with the capability approach that links geography education to broader educational goals (Lambert, Solem, and Tani 2015) and was therefore considered as a starting point for this study.

Embedding key competencies in geography textbooks

Support systems such as curriculum, instruction, assessment, and professional development should complement each other to support student outcomes related to key competencies (Trilling and Fadel 2009). Among the many supporting systems, the geography curriculum is a critical element that drives instruction, textbooks, and assessment, while textbooks are a translation of the curriculum (Nguyen 2019). Since the role of textbooks is not only to impart knowledge but also to stimulate the development of learning and thinking processes (Mili and Winch 2019), they are probably the most widely used educational resources in formal education to teach essential knowledge, skills, and attitudes (Ide 2018). Correspondingly, the analysis of textbooks has gradually moved away from content-related aspects to a greater emphasis on the use of textbooks for subject-specific teaching and learning (Bagoly-Simó 2018). A few studies have investigated the extent to which geography textbooks support thinking and reasoning, for example comparing (Simon, Budke, and Schäbitz 2020), analyzing (Yang, Wang, and Xu 2015), higher order thinking (Krause, Béneker, and Tartwijk 2022), and spatial reasoning (Jo and Bednarz 2011). While the KCS provides a systematic and holistic approach to developing learning outcomes in geography, a systematic overview has not been conducted to access how the new [Chinese] national curriculum reform is integrated into geography textbooks.

Conceptualized as multimodal objects, geography textbooks consist of three subsystems, including the main texts, visuals, and activities. All the subsystems play an irreplaceable role in promoting secondary students' key skills, and activities are the most important component (Cai 2013). The concept of activity has the basic meaning of "doing" and emphasizes the need to adopt the approach of "learning by doing" (Vygoysky 1978). In the experiential learning vision, education is a process of continuous reorganization, reconstruction, and transformation of experiences through which students learn about the world (Dewey 1998). Activities in geography textbooks provide challenging tasks and authentic contexts in which students gain experience and better interact with the environment. This way, they can independently construct knowledge and expand their understanding through the application of key skills (Nguyen 2019; Raath and Golightly 2017). Nevertheless, the relationship between the completion of learning activities in geography textbooks and the improvement of certain geographic competencies is not well established.

Connecting learning progression perspectives with competency-based education

The key competencies highlight the big ideas that students need to develop incrementally across grade levels (Achieve 2015). Increased research on learning progression in recent years emphasizes a deep understanding of the individual learning experience, which plays a critical role in a competency-based education system (Achieve 2015). Researchers have categorized key competencies into different levels that represent successively more sophisticated ways of thinking about a topic that students engage with over a long period of time (National Research Council 2007). According to the categorization of Fullan, Quinn, and McEachen (2018), student competencies progress from the limited, emergent, developing level to the accelerated and proficient level. Weeden (2013) defined the development of key competencies in geography learning as increasing breadth and complexity of knowledge studied, greater precision in performing intellectual and practical tasks, more mature awareness and values on topics. The application of the learning progression perspective could potentially support further analysis of geography textbooks and improve pedagogical practice.

Researchers have explored how the learning activities in textbooks are sequenced to lead students to develop geographic competencies over the course of their schooling (Lee and Catling 2016). Lee et al. (2021) suggest two types of developmental progression reflected in learning activities in secondary school geography textbooks. One focuses on geographic knowledge presented in activities that cover an increasing breadth and abstraction of topics, which is considered a content-centered approach (Steegen et al. 2016). The second type is concerned with cognitive skills embedded in increasingly sophisticated activities with varying degrees of cognitive complexity, as envisioned by the cognitive developmental approach (Mohan, Mohan, and Uttal 2015; Piaget 2001). In recent years, researchers have begun to pay attention to the temporal dimension as a lens for analyzing textbooks. Simon, Budke, and Schäbitz (2020) conducted an in-depth study and found that the complexity of activities in geography textbooks increases with students' age, suggesting the effect of time duration on the achievement level of geographic literacy. In addition, Woods, Mountain, and Griffin (2015) asserted that geography textbooks do not necessarily lead students to develop each competency at the same pace as they progress through different school years. However, there is limited research on the extent to which the progression of learning activities is considered in geography textbooks, which is a major challenge to implementing action-based learning.

Research purposes

School textbooks in China have been developed to reflect curriculum content, which is largely disciplinary based and bound for higher academic learning. This can pose a challenge for educators, who may struggle to teach the required key competencies. In addition, educators may also find it challenging to connect the content of textbooks with the KCS, to promote students' key competencies across school years, and to find the best way to aid students to gain each competency over time. Given the dilemmas school teachers are faced with and the gaps in previous studies as reviewed above, three research questions were formulated:

1. How do secondary geography textbooks equipped with activities align with the key competencies students should develop in recent years?
2. How can prefabricated activities in secondary geography textbooks promote key competencies across the school years?
3. How are students led to develop different types of key competencies across the school years by activities in secondary school geography textbooks?

Method

Research design

This study used an exploratory case study research design to uncover the distribution of key skills hidden in geography textbooks. Summative content analysis was used to quantify the occurrence of key words related to key competencies in the texts of the "Activities" sections. This method began with classifying and counting the specific keywords, followed by discovering the underlying meaning of the data through analysis (Drisko and Maschi 2016).

Research samples

Although key competencies are growing progressively, this vision of the curriculum in China has been implemented only at the upper secondary level, resulting in students' learning being fragmented and discontinuous. Therefore, we propose that key competencies should be taught in the classroom at the lower secondary level to provide students with an important foundation for acquiring knowledge, skills, and values for the next level of schooling. There are approximately ten kinds of geography textbooks in lower secondary school, distributed by different publishers and introduced in different regions of China. We selected the textbook for the nine-year Compulsory Education: Geography (2nd edition) utilized in Shanghai for two reasons. First, this series of textbooks was written according to the requirements of the national geography curriculum standards, thus has a certain degree of representativeness. It was approved by Shanghai Municipal Education Commission and published by Shanghai Education Publishing House. It has been popular in Shanghai since 2006 and almost all local secondary schools have used it so far. Second, Shanghai, as the national experimental laboratory, has become a role model for education in China, and the geography textbooks adopted there have their own characteristics. In addition to the texts and pictures introduced in the previous editions, this series includes a new component, "activities," to improve geographical skills and promote creative thinking.

Specifically, these textbooks are divided into two volumes and each for grades 6 and 7, for a total of four volumes. Accordingly, they have been designed to be used by students aged 11 to 12 during four school semesters, with each semester lasting four and a half to five and a half months. The four volumes of the geography textbook are organized thematically: The volume used for the first semester of grade 6 teaches basic map skills and the geography of selected countries on the various continents. The textbook used for the second semester of grade 6 contains three main parts: natural and human components of the Earth, issues of environment, resources and development, and geography of the polar region. The textbook used for the first semester of Grade 7 allows students to study physical geography and explore the major geographical regions of China. During the second semester of Grade 7, students are expected to study human geography, address environmental issues, and continue their study of the remaining geographic regions of China using the textbook. We chose the school term as a unit for textbook analysis, as students study different volumes of textbooks for each term.

The activities we studied are located at the end of each chapter of the textbooks and there are 272 activities in total,

Table 1. Types of learning activities in secondary geography textbooks and their design features.

Type of learning activity	Design feature
Interpreting maps and drawing diagrams	Incorporate an enquiry process into map reading and mapping work.
Reading and thinking	Encourage students to use their experiences and transfer learning into different situations.
Discussion and sharing	Provide opportunities for extended learning and further reading through working with others.
Geographical fieldwork	Engage students in hands-on experiences, for instance, survey, questionnaire, using geospatial technologies (e.g., GIS).
Information gathering and synthesizing	Collect geographic information from multiple sources (e.g., books, newspapers, the internet) and combine information for in-depth analysis.

Adapted from Yang and Jiang (2004)

comprising 797 tasks. These activities cover topics ranging from physical geography to human geography and from world geography to the geography of China. Completion of the activities requires students to reflect, communicate, or do practical work. Following Yang and Jiang (2004) classification of classroom activities for geographical learning, we classified the activities into five types: (i) interpreting maps and drawing diagrams; (ii) reading and thinking; (iii) discussion and sharing; (iv) geographic fieldwork; and (v) collecting and summarizing information (Table 1).

Application of the analytic framework

The competency contains a series of key concepts, principles and theories and should serve as the focal point of curriculum and instruction (Organization for Economic Co-Operation and Development (OECD) 2005). An analytical framework for key competencies in geography was created in Geography Curriculum Standards for Upper Secondary Schools (2017 edition) (Table 2). In selecting the competencies in this framework, a panel of experts led by the Ministry of Education (MOE) reviewed geography curricula and textbooks used in more than ten countries and identified twenty-five frequently used concepts, namely, geographic inquiry, space, human-environment relationship, sustainability, spatial change, multi-culture, map literacy, place, new technology, and interdependence (The working group on geography standards for upper secondary schools 2018). The panel finally identified four competencies to define student learning outcomes upon completion of geography education, taking into account the OECD competency framework, key concepts central to the discipline of geography, student cognitive development, and social needs (Ministry of Education of the People's Republic of China 2018b).

The *human-environment relationship* refers to values and attitudes one holds in order to evaluate the relationships between human activities and the environment (Bagoly-Simó 2014; Wiek, Withycombe, and Redman 2011). *Integrative thinking* means mastering thinking skills to analyze geographic phenomena occurring at various spatial and temporal scales in a holistic way (Favier and van der Schee 2014). *Regional awareness* requires understanding the complexity of the physical and human environment from a spatial perspective and with a regional approach (Gersmehl and Gersmehl 2007; Golledge, Marsh, and Battersby 2008; Jo and Bednarz 2011). *Geographic practice* includes the skills and character traits to conduct geographically relevant activities such as surveys and experiments (Rydant et al. 2010). In addition, each competency is represented by three dimensions. For example, take the competence of regional awareness: the first dimension requires students to apply the place-based knowledge (e.g., location, spatial pattern) so that they can understand geographical phenomena from a spatial perspective (Golledge, Marsh, and Battersby 2008). To achieve the outcome of the second dimension, students must describe the physical and human characteristics and explore geographic similarities and differences of place using appropriate geographic methods and tools (Gersmehl and Gersmehl 2007). The third dimension involves analyzing the geographic factors that influence decisions about regional development (e.g., site selection) and evaluating their appropriateness through a synthesis of geographic information (Jo and Bednarz 2011).

The KCS framework was chosen over other frameworks for three reasons. To begin with, it is important for learning geography with the aim to nurture a geographically informed person (Heffron and Downs 2012) who develops characters and key abilities essential to the subject of geography, who applies ecological perspectives to critically think about relations between humans and environments, and who is concerned about geographic and sustainable development issues occurring at the local, national and global scales. As is illustrated in Figure 1, the relationship between people and the environment is central to the KCS framework as it addresses the core values of geographic education. Integrative thinking supports students to analyze geographic processes and interactions between humans and nature dynamically and systematically, while regional awareness provides tools and methods to comprehend the complexity of environments. The geographic practice offers a pathway to understanding the human-environment relationship by providing students with rich and real learning experiences. Besides, as the capability approach proposes (Lambert, Solem, and Tani 2015), this framework shows an example that connects general key competencies with key concepts in geography, offering a pathway to implementing educational reform. Additionally, it has some advantage of developing ecological perspectives of future citizens to promote education for sustainable development, thus can be adopted in the classroom by educators in various countries.

Data coding

Two researchers collaborated to code the texts for "activities" included in junior high school geography textbooks in Shanghai. Table 3 shows how they compared key

Table 2. Specification of key competency framework in the subject of geography.

Category	Dimension
Human-environment Relationship	• Understand the effects of the physical environment on human activities (H1). • Understand that human activities affect the physical environment in different ways, at different intensity levels and with different consequences (H2). • Evaluate the human-environment relationship for policy making (H3).
Integrative Thinking	• Recognize the unity of geographic features and analyze the interactions among various geographic factors (I1). • Analyze the occurrence and evolution of geographical events and features from the spatial-temporal dimension (I2). • Analyze the impacts of natural and human factors on the formation of geographic characteristics of regions considering multiple elements (I3).
Regional Awareness	• Acquire the habit of mind to comprehend geographic phenomena from a spatial perspective (R1). • Select proper geographic methods and tools to study regions (R2). • Explain regional development decisions and evaluate their gains and losses (R3).
Geographical Practice	• Collect geographic information by referring to methods like observation, survey, process the information, and develop inquiry questions (G1). • Design action plans to test geographic principles through collaborative learning and validate geographic assumptions with geographic tools (G2). • Implement action plans, make reflections, and learn from experience (G3).

Adapt from Ministry of Education of the People's Republic of China (2018b).

Table 3. Examples of coding texts of learning activities in secondary geography textbooks.

Activity	Text	Key competency	Frequency
Japan: The neighborhood (page 37, the textbook for 2nd term of Grade 6)	Task 1: *Collect information* about earthquakes in Japan *through newspapers, books and the internet*.	Geographical practice (G1)	1
	Task 2: Understand *impacts of earthquakes on Japan* and how local *students* learn to *take precautions against the disasters*.	Human-environment relationships (H1, H2)	2
India: Ancient Civilization (page 45, the textbook for 2nd term of Grade 6)	Task 1: *Identify* Himalayas, Ganges, Gangetic Plains, Deccan Plateau, Indian Ocean *on the map of India* provided by Map Atlas	Regional awareness: (R2)	1
	Task 2: Explain *how* the largest cropland in India *is related to* its topographical characteristics.	Integrative thinking (I1)	1

competencies to activities by making inferences from the texts of these activities. For Task 2 of the activity on page 37 in the Grade 6 2nd term textbook, they identified relevant keywords and phrases related to the analytical framework, such as "effects of earthquakes on Japan," and "how students take precautions against the disasters." They also found two phrases that matched the first and second dimensions of human-environment relationships in the analytical framework, namely, "understand the impact of the physical environment on human activities" and "understand that human activities affect the physical environment in different ways." The data recorded indicated two frequencies of human-environment relationships associated with this task. Codes H1 and H2. were also recorded, and they showed an inter-rater reliability coefficient of 0.72, which was high based on existing benchmarks (Drisko and Maschi 2016). Inconsistencies during coding were also investigated and reconciled by both researchers.

Data analyses

Based on the data coding results, we calculated the frequency of occurrence of four key competencies in each school year and obtained four sets of data after adding: (i) the frequency with which each competency occurs in each school year, (ii) the frequency with which each competency occurs in secondary school, (iii) the total frequency with which four competencies occur in secondary school, and (iv) the frequency with which a particular dimension occurs under each competency in secondary school.

The number of times each competency was mentioned at the lower secondary level was divided by the total number of times the four competencies were mentioned at the lower secondary level to determine the percentage of times each competency was mentioned at the lower secondary level. On the other hand, the number of occurrences of each competency in every school semester was divided by the number of occurrences of four competencies in every school semester to obtain the percentage of each competency for different school semesters. In addition, the number of times a particular dimension appeared under each competency in secondary school was divided by the number of times each competency appeared in secondary school to obtain the percentage of activities corresponding to the different dimensions under each competency. Then, a one-way ANOVA

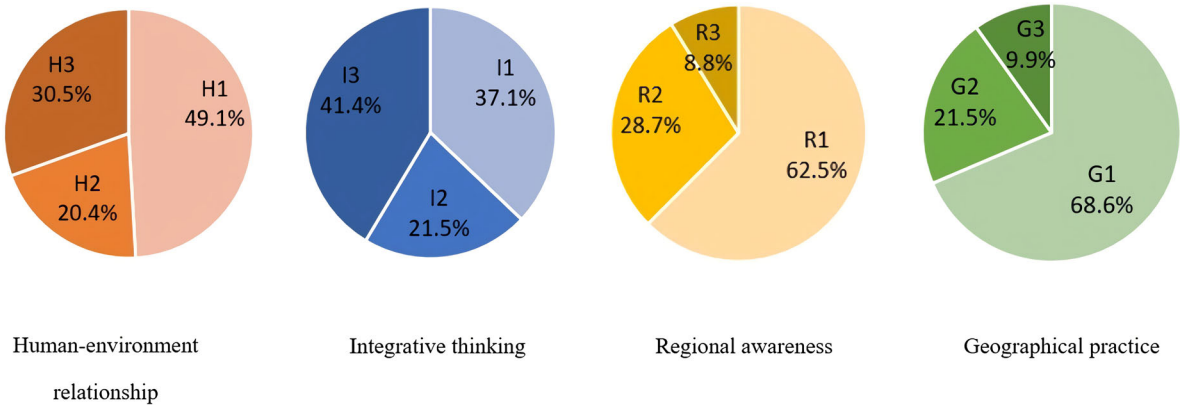

Figure 2. Percentages of activities that fit into the different dimensions of each competency.

Table 4. Mean and standard deviation of measures reflecting the level of key competencies by different school terms.

	Key competency	
School term	Mean	SD
Grade 6, 1st Term ($N = 202$)	1.07	0.59
Grade 6, 2nd Term ($N = 170$)	1.22	0.73
Grade 7, 1st Term ($N = 234$)	1.03	0.62
Grade 7, 2nd Term ($N = 191$)	1.19	0.56

was conducted to assess the level of key competencies for different school terms in lower secondary school using SPSS software, with the school year as the independent variable and the total number of key competencies required to complete each task in the "activities" section as the dependent variable. It is worth mentioning that six tasks did not meet the four competencies. The analysis was conducted at a significance level of 0.05.

Results

The distribution of key competencies in geography textbooks by type

The "activities" sections in Shanghai junior high school geography textbooks include a total of 910 key competencies. The results showed that regional awareness accounts for the highest proportion of 62.1% in these textbooks. The other key competencies, namely human-environment relationship, integrative thinking and geographical practice, had relatively similar percentages, 11.9%, 12.7% and 13.3% respectively.

The percentages of activities in the various dimensions of each competency are shown in Figure 2. It can be seen that the textbooks mainly covered the first dimension of each competency. For example, the majority of the activities related to regional awareness were about understanding geographic phenomena from a spatial perspective (62.5%), while only 8.8% of these activities were dedicated to explaining and evaluating regional development decisions. Regarding the competence of geographic practice, the percentage of activities aimed at collecting and processing geographic information reached 68.6 percent, but much fewer opportunities were provided for students to carry out action plans (e.g., conduct simulation experiments, create models) and make reflections (9.9%). The percentages of activities were evenly distributed across different dimensions for the other two competencies, human-environment relationship and integrative thinking.

The level of key competencies in geography textbooks by different school terms

Table 4 shows the mean and standard deviation for the total number of key skills for each task in the "Activities" sections of the geography textbooks according to different school semesters. ANOVA results showed that there were significant differences between school semesters for the level of key skills (F (3, 793) = 4.540, $p = 0.004$), with a mean of 1.07 for the first semester of grade 6, 1.22 for the second semester of grade 6, 1.03 for the first semester of grade 7, and 1.19 for the second semester of grade 7. The results of the Turkish HSD post hoc test showed that the mean score of the key competencies in the textbooks for the first term of grade 7 was significantly lower than that for the second term of grade 6 ($p = 0.009$) and that for the second term of grade 7 ($p = 0.038$), respectively. No significant differences were found between the other four comparison groups (Table 5).

The association between key competency in geography textbooks and school term

Based on the percentages of each competency in the geography textbook activities used for the different school years (Figure 3), we found that the different types of key competencies tended to develop differently over time in the four school years. Specifically, the percentage of regional awareness was slightly higher in the first semesters of grades 6 and 7 (27.4% and 28.2%, respectively) than in the second semesters of grades 6 and 7 (21.2% and 23.2%, respectively). Conversely, the percentage for the relationship between humans and the environment was higher in the second semesters of grades 6 and 7 (27.8% and 30.5%, respectively) than in the first semesters of grades 6 and 7 (20.4% and 21.3%, respectively). The percentage of integrative thinking increased from 17.3% to 38.8% and increased the most in the second semester of grade 7. In addition, the percentage of geographic practice decreased from 31.4% in grade 6 to 16.5% in grade 7, peaking in the second semester of grade 6.

Table 5. ANOVA results for the level of key competencies by different school terms.

Type of statistics	Comparison	
F statistics	Grade 6, 1st Term vs. Grade 6, 2nd Term vs. Grade 7, 1st Term vs. Grade 7, 2nd Term	$F(3, 793) = 4.540$, $p = 0.004^{**}$
Turkey HSD	Grade 6, 1st Term vs. Grade 6, 2nd Term	$p = 0.083$
	Grade 6, 1st Term vs. Grade 7, 1st Term	$p = 0.886$
	Grade 6, 1st Term vs. Grade 7, 2nd Term	$p = 0.233$
	Grade 6, 2nd Term vs. Grade 7, 1st Term	$p = 0.009^{**}$
	Grade 6, 2nd Term vs. Grade 7, 2nd Term	$p = 0.951$
	Grade 7, 1st Term vs. Grade 7, 2nd Term	$p = 0.038^{*}$

Note: $^{*}p < 0.05$; $^{**}p < 0.01$.

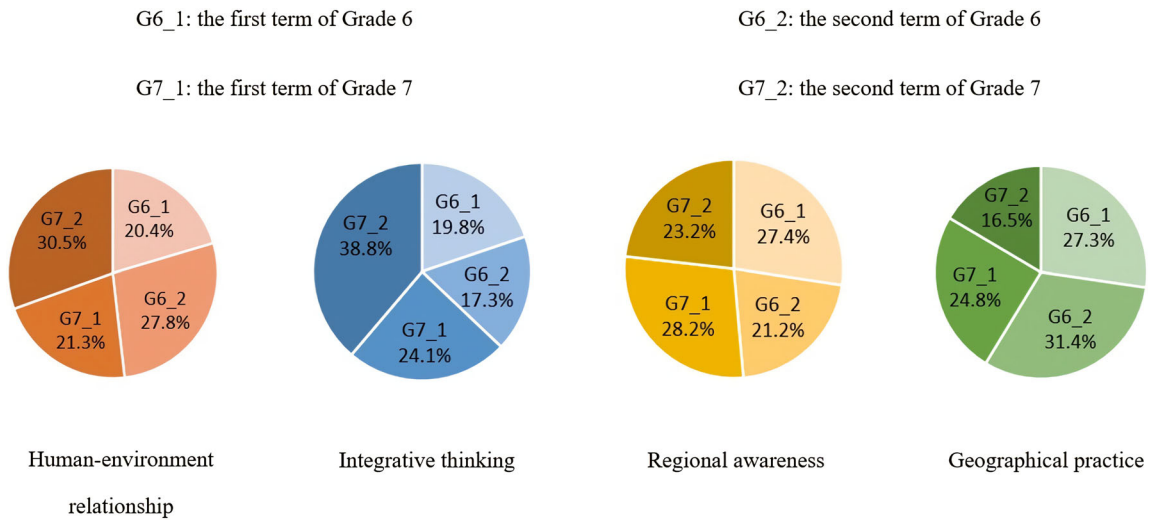

Figure 3. Progression of key competencies in secondary geography textbooks across school terms.

Discussion

This study used content analysis to draw empirical conclusions about the characteristics of secondary school geography textbooks in the context of competency-based learning. The results provide pedagogical ideas for educational practitioners to make the best use of textbook series activities to implement the big idea of key competencies in the classroom.

Key competencies in the "activities" sections of geography textbooks for secondary schools

The first research question of the current study aimed to investigate how well the activities in junior high school geography textbooks in Shanghai align with the KCS framework. The results showed that the "activities" sections of these textbooks focus on improving regional awareness. This feature reflects the regional approach that emphasizes spatial patterns, characteristics of regions, similarities and differences in the conditions of places (Heffron and Downs 2012). Most current geography textbooks still follow such a traditional approach for the discipline of geography (Mishra 2015). At the same time, the three competencies of human-environment relations, integrative thinking, and geographic practice were evenly addressed. This study is intended for teachers to determine the level of key competencies that students should develop through high school geography textbooks. In addition, the data also show students' academic readiness for key skills and can be used by high school teachers to support their plans for student learning experiences.

The study of regional geography is an important learning objective for lower secondary students as required by the national geography curriculum, but there is an overwhelming emphasis on regional awareness reflected in the activities in geography textbooks. It is suggested that the proportion of this competency be reduced in future textbooks and that the other three competencies be emphasized more. Moreover, the activities in these textbooks mainly stimulate learning of the lower thinking dimensions of the competencies (Trahorsch and Knecht 2021), such as understanding regions from a spatial perspective, collecting and processing geographic information. To promote high-level student learning, textbook revisions could consider increasing the proportion of activities that encourage students to evaluate regional development decisions, implement action plans and suggest how they might be improved, both of which represent the third dimension of regional awareness/geographic practice.

The effect of school term on the level of key competencies within geography textbooks for secondary school

The results for the second research question showed that the prefabricated activities in middle school geography textbooks promoted key competencies differently depending on the school year. The relationship between the school semester

factor and the level of key competencies does not appear to be linear and is highly context dependent. This is because the differences in key competencies associated with the completion of learning activities by school semester are largely due to the nature of the geographic problems addressed in the activities themselves. In particular, the completion of tasks scheduled for the second semester of 6th and 7th grade requires the use of several key competencies, as these tasks tend to involve solving complicated environmental problems involving the interactions between physical and human components. In the first semester of 7th grade, students are more exposed to activities that focus on examining features of geographic regions, so they tend to use a single competency, regional awareness, to strengthen place knowledge and expand spatial understanding. The results are contrary to the expectation that activities related to geographic competencies show a linear progression of complexity with grade levels (Simon, Budke, and Schäbitz 2020). One possibility is that previous research has chosen "grade level" as a categorical variable, which has a longer duration compared to the "school year" we have chosen. Considering that competencies mature over time, a broader temporal scale for textbook analysis might lead to different results, which needs to be explored in depth.

It is instructive to consider how the temporal dimension might affect the promotion of key competencies, a topic ignored in previous research. Because geography teachers play a fundamental role in promoting key competencies in their students, it is essential to convert the findings into pedagogical strategies for each school year. Using the textbooks, we analyzed as examples, focusing on regional awareness in the first semesters of 6th and 7th grade could help students better understand regions and places, leading to a more efficient learning transfer of regional awareness in a new situation. To make a difference, it would be good for students to combine integrative thinking with regional awareness to analyze the causes and consequences of environmental problems such as overpopulation, resource depletion, and pollution in the second semester of grade 6. Geography teachers could give students more guidance on integrating human-environment relationships and regional awareness in the second semester of grade 7 so that students can make wiser decisions for urban planning and regional development. To sum up, switching pedagogical strategies across the progression of grade levels is necessary to pave way for competency-based learning.

Learning progressions reflected by key competencies through learning activities in secondary geography textbooks

Regarding the third research question, we discovered different types of progress in key competencies reflected in the learning activities of secondary school geography textbooks. On the one hand, the percentages of regional awareness and the relationship between people and the environment fluctuated over time. To be precise, more learning activities dealt with environmental problem solving in the second semesters of 6th and 7th grade than in the first semesters. As a result, students focus more on analyzing human-environment interactions and evaluating their impact on regional development, which is classified as a human-environment relationship (Bagoly-Simó 2014; Wiek, Withycombe and Redman 2011). In addition, in the first semesters of 6th and 7th grade, students are exposed to more learning activities to explore countries and regions than in the other semesters, providing them with a richer learning environment in which to acquire and practice regional awareness. Some researchers believe that learning about different countries and regions would not provide learning gains because each place is taught to students at the same level of understanding (Schultze 1970). In contrast, we suggest that engaging in geographic topics with increasing breadth and a wider range of scales through learning activities can lead to the development of regional awareness due to the cumulative nature of learning, which is consistent with the arguments of Lee et al. (2021) and Steegen et al. (2016). Since the findings are congruent with previous research that key competencies cannot be separated from subject matter (Hipkins 2018), it is recommended that textbooks promote the human-environment relationship and regional awareness in the context of geography.

On the other hand, the changes in the percentages of integrative thinking and geographical practice showed significant learning gains. In particular, the percentage of integrative thinking in these textbooks gradually increased. This trend is consistent with the development of logical thinking, which leads students to deeper learning and more sophisticated understanding (Mohan, Mohan, and Uttal 2015). We suggest using a progressive approach to promote integrative thinking that encourages students to increase their use of generalized knowledge about the physical and human environment and to synthesize more complex information about space and place. In contrast, the percentage of geographic practice showed a declining trend. This means that learning activities fit well with the psychological transition from gaining direct experience in the field to acquiring indirect experience with participation in intellectual tasks (Weeden 2013). According to the results, the second semester of 6th grade could be a critical period for secondary students to develop geographic practice, which is in accordance with Callemeyn's (2007) research. Therefore, it is necessary to support students in this period by providing step-by-step instructions and appropriate assistance in carrying out learning activities. Based on the results, we conclude that the design of these textbooks is consistent with the principles of cognitive development, i.e., moving from familiar and concrete to unfamiliar and abstract concepts (Steegen et al. 2016).

This study found that current geography textbooks accommodate some degree of gradual progression. Having acknowledged the variety of progressions that key competencies exhibit, we articulate that adherence to a particular learning sequence is not essential in practice. Therefore, pathways from minimum levels to desired final levels are provided for each competency, with intermediate learning goals defined. Educators would benefit from the pie charts by strategically planning student learning by going beyond

the daily instructional basis and keeping annual academic goals in mind. They could also make decisions about the pedagogical strategies that fit the developmental trajectories that various key competencies follow to effectively implement competency-based education.

Limitations

We suggest three areas for future research. First, this study focused on the implementation of key competencies through the activity system in geography textbooks. Further research will conduct similar analyzes in other subsystems (e.g., main texts, visual images) to more fully interpret the value of textbooks. Second, only junior high school geography textbooks were selected as objects of study in this study. It is recommended that researchers expand the temporal scale for analysis and evaluate upper secondary textbooks using the same method to visualize learning progress in key skills throughout the secondary level. Third, the current study examined what geography textbooks might teach students about key competencies, but did not demonstrate their improvement from the activities that covered these competencies for each school term. We suggest that adopting a pre- and post-test design and track students' learning progress after using geography textbooks could be an avenue for future research.

Conclusion and implications

Knowledge of key competencies will enable students and lifelong learners to participate in society as informed citizens and to thrive in a rapidly changing world. Our study assessed the characteristics of junior high school geography textbooks in Shanghai using the analytical framework of key competencies. It makes two contributions. First, this study provides insight into competencies in a selected set of Chinese textbooks while also offering a framework for conducting this type of assessment in other parts of the world. The method used in our research can be applied to evaluate both printed textbooks and less structured learning materials, such as digital textbooks and online learning modules. Second, the results highlight the strengths and weaknesses of the geography textbooks used and offer some suggestions for future textbook authors who want to ensure that their activity sections meet the KCS framework. Finally, we suggest a number of pedagogical strategies to scaffold student learning within each grade level as well as across the linear progression of grade levels. This could help teachers make instructional choices and assist them in creating curricula using geography textbooks.

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