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A Proposed Digital Unit in the Geography of Risks according to the STSE Approach for Developing Geographical Reasoning among the First Year Students of Secondary School

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Abstract

The aim of the present study is to investigate the effectiveness of a proposed digital unit in risk geography according to the Science, Technology, and Society and Environment (STSE) approach for developing geographical reasoning among first-year secondary school students. To achieve this goal, the semi-experimental approach was employed: one-group pretest-posttest design. In addition, the research sample was selected randomly, which included 30 female students in the first year of secondary school. The findings of the research have proved the effectiveness of the proposed digital unit in risk geography, according to the STSE approach, in developing geographical reasoning among the students of the first year of secondary school. Accordingly, the research has recommended that the researcher need to design training programs to practice geographical reasoning skills, targeting first-year secondary school students.

Keywords

Geography of Risks, STSE Approach, Geographical Reasoning.

Introduction

Geographic reasoning generally is a type of thinking closely linked to intelligence. Hence, it requires the involvement of higher mental processes such as imagination, insight, reasoning, and criticism for problem-solving or decision-making. Accordingly, geographical reasoning is a means not only to understand spatial relationships and interactions between humans and the environment, but also to understand decisions that affect and are affected by the environment. Basically, the process of teaching and learning geography aims to help students to develop their abilities to grasp spatial reality and analyze it. This scientific knowledge is referred to as Geographical Reasoning. It is one of the higher mental skills that students of geography must be armed with in the twenty-first century.

Specifically speaking, Good Geography calls scholars for deeper insights into our world and human decision-making. Through geographical reasoning, geography - as a system - has peculiar methods and rules to generate knowledge. Geography is in place when we use geographical tools to understand Earth's surface phenomena, as well as organize information in other disciplines through a spatial lens. According to Rosenstein, geographical reasoning becomes a means not only for understanding spatial relationships and interaction between humans and the environment, but also for decision-making that affects the environment and interacts with it. Moreover, these visions can be used to better understand other disciplines, and to Know the World and humanity Rosenstein (2016: 12). Therefore, many scholars pay attention to developing geographical reasoning among learners including: Richter and Decanini (2012), Chiang et al (2014), Hooghuis et al (2014), Rosenstein (2016), Allam and Al-Adawi (2020), and Al-Helbawy (2022).

Simandan (2012) and Allam and Al-Adawi (2020) state that one of the most important characteristics of geographic reasoning is recalling a plethora of concepts that guide applied geographers' findings about the world, and the link between time, place, environment, and humans. This aims at understanding geographical phenomena, their impact, and using modern geographical

techniques such as GIS. Similarly, Hooghuis et al. (2014) identify the requirements of Geo-inference, including an open and curious attitude towards the situation to explore arguments and reasons, thinking skills, geographical knowledge, and the use of metacognition. Metacognition is “organizing and recognizing cognitive activities for the sake of the individual`s learning and problem-solving". In addition, Hooghuis et al.(2014, 247) recognize the dimensions of geographical reasoning in identifying geographical concepts, describing geographical concepts, analyzing spatial problems, pictures, maps, and graphs, interpreting them, forming an opinion, making geographic decisions, and justifying them .

Moreover, Allam and Al-Adawi (2020) manifest the dimensions of geographical reasoning as asking geographical questions about place, regions, and culture, spatial patterns and movement, location, using geographic-contextual tools, and rational explanations. Learning geographical reasoning underlies two goals: training on scientific geography, and facilitating the cultural formation of students to develop their logical thinking. Additionally, Richer et al. suggest a variety of pedagogical methods to employ the students' geographical reasoning (Richter & Decanini, 2012).

It is noted that geographical reasoning receives notable interest in Western studies. For instance, Richter and Decanini (2012) aimed to investigate the process of geographical reasoning among secondary school students. Moreover, Chiang et al. (2014) sought to investigate how geographic reasoning is used and decisions are made. Hooghusia et al. (2014) sought to investigate the importance that geography teachers in Dutch secondary schools pay to different aspects of geographical reasoning in different grades at the secondary level revealing the used strategies for developing geographical reasoning among their students. Rosenstein (2016) also aimed to track students' perspectives on geography and geographical reasoning in two sixth-grade classrooms. Conversely, only a limited number of Arabic studies were conducted to develop geographical reasoning among learners. For example, Allam and Al-Adawi (2020) aimed to determine the effectiveness of a program based on the Pentagram theory in developing the geographical and

historical heuristics among Student teachers in the fourth year, Social Studies Department, Faculty of Education, Alexandria University.

As a consequence of the recent natural and human risks that threaten the environment, which requires challenging them or adapting to them, countries have therefore taken an interest in including geographical risks in educational curricula to raise awareness of them. Hence, geography is one of the most appropriate curricula to fit this goal, for its nature and its preventive role against risks and disasters, and their effects. This contributes to explaining the human relationship with the environment and the natural and human phenomena and risks related to it. Geographical risks occur as a result of purely natural factors; geological such as earthquakes and volcanoes; meteorological such as tropical cyclones; hydrological such as floods; and biological such as pests and diseases that affect plants and animals. In addition, it may result from human factors such as economic crises, industrial and technical events, fires, and other dangerous events. Risks may result from an interaction between natural and human factors, such as desertification and environmental pollution (Aqilan, 2015).

Many countries have tended to include the concepts of geographical risks in educational curricula in general and in geography curricula particularly to challenge and reduce geographical risks, and to build a high degree of scientific awareness in future generations. Geography is appropriate, because it is concerned with studying natural and human phenomena, which is consistent with Al-Sherbini and Marwad (2019) and Slim and Ibrahim (2022).

The current era is also characterized by rapid scientific and technical progress in all fields. Hence, those responsible for education face a great challenge to prepare generations capable of keeping pace with progress and knowing its effects on individuals and societies. Even though technological progress has addressed many problems of individuals and societies, it is a double-edged weapon. It has resulted in many problems that negatively affect the environment and the safety of communities. Thus, many global movements have emerged to reform curricula to keep

pace with scientific and technological development (Al-Marashi, 2021). Al-Asmari and Al-Anazi (2016) point out the emergence of the approach to science, technology and society in the early 1980s, as a result of the criticism directed to the curricula in the fifties and sixties for ignoring the mutual relationship between science, technology and society, as well as the existence of a conflict between what the student learns and the reality. Moreover, Al-Naimi (2016) suggests that the essence of the STS approach is to link experiences to students' lives and their real environment. It focuses on scientific culture through providing the student with knowledge, skills, and understanding of the mutual relationship between science and technology, and technology and Society (STS); to become Science, Technology, Society and Environment (STSE).

Accordingly, the inclusion of science, technology, society, and environment (STSE) issues into the curriculum proves effectiveness, since it is concerned with scientific and technological issues of a social-environmental nature, and seeks to link the lives of learners to their environment, employ information, knowledge, and scientific concepts, and technology in solving problems related to their daily lives and their local environment (Al-Moussawi, 2019). Moreover, the STSE approach links science, technology, society, and the environment with the knowledge, skills, inclinations, and attitudes that the learner acquires to help him achieve comprehensive and integrated growth and be able to adapt to the social environment. Through studying STSE relationships, students can obtain multiple opportunities to study the impact of scientific and technological development on their lives from a critical cultural perspective in depth. This will help develop their ability to solve problems, think critically, and make responsible decisions regarding some scientific and technological issues. According to Al-Jubouri, Curricula based on the STSE approach also help students acquire the appropriate knowledge and experiences to understand the complementary relationship between science, technology, and society, implant a spirit of social responsibility in them, and make the right decisions about current and future social issues that arise from the influence of science and technology. Technology has an impact on society and the

environment, in addition to acquiring various skills when dealing with technological technologies Al Jubouri (2019). Hence, modelling education in the light of the STSE approach in the field of risk geography is compatible with modern educational trends. Such trends aim to increase the effectiveness of teaching and learning, and develop students' geographical reasoning in line with the findings of related studies.

The researcher investigates the problem of the current research in the light of her belief in the importance of developing a spatial reading of reality and its analysis, with deeper insights into understanding spatial relationships, the interaction between humans and the environment, and making decisions that affect the environment among first- year secondary school students through geographical reasoning (geographical logic).

To verify the problem of the current research, the researcher reviewed previous studies and research, which emphasized the importance of:

- Geographic reasoning among geography students such as Richter and Decanini. (2012), Chiang et al. (2014), Hooghuis et al. (2014), Rosenstein (2016), Allam and Al-Adawi (2020), Waer et al. (2021), Al-Helbawy (2022).
- The Inclusion of geographical risks in educational curricula such as El-Sherbiny and Marwad (2019), And Slim and Ibrahim (2022).
- An Approach to Science, Technology, Society and Environment (STSE) issues in the curriculum. That is it pays attention to scientific and technological issues of a social-environmental nature, and seeks to link students' lives with their environment, and employ information, knowledge, and scientific and technological concepts in solving related problems in their daily lives and their local environment such as: Al-Mukhtar (2016), Al-Naimi (2016), Al-Mousawi (2016), Al-Jubouri (2019), Alnaaqa. And Abu Fayyad (2022).

Through reviewing the differences and the similarities in the previous studies, it is become clear that the current study is consistent with the previous studies in their subjects and the general goal, but it differs from them in the knowledge gap and research-community.

Additionally, the researcher conducted an exploratory study on a sample of (20) female students in the first year of secondary school at Umm Al-Muminin Secondary School for Girls / West Tanta Educational Administration - Gharbia Governorate on 11/6/2022. An exploratory test- prepared by the researcher- has been performed to determine the extent to which first-year secondary school students possess geographical reasoning skills. The results demonstrated a low level of geographical reasoning among first-year secondary school students (exploratory study sample) in responding to the test items. The following table shows the findings:

Table 1

Results of the exploratory experiment on geographic reasoning.

Number of students	Total score	Highest score	Lowest score	Medium
20	60	23	12	16. 8

According to the previous table, the average score of the students was (16.8), which is equivalent to only (28%) of the total test score.

Accordingly, the current research seems a must in light of the afore-mentioned data, the scarcity of educational studies in the field of risk geography, the low level of geographical reasoning among first- year secondary school students, and in response to what many previous studies and research have called for to bridge the rift. Hence, the present research aims to reveal the effectiveness of a proposed digital unit in risk geography, according to the STSE approach, in developing geographical reasoning among first-year secondary school students.

The problem of the Research

The problem of the present research is crystalized in the low level of geographical reasoning among first- year secondary school students. Hence, exploring new visions and modern trends can contribute to developing geographical reasoning among first-year secondary school students To address this problem, the present research attempts to answer the following main question:

How can geographical reasoning among first-year secondary school students be developed through a proposed digital unit in the geography of risks based on the STSE approach?

The main question is divided into the following:

1. What are the dimensions of geographical reasoning and the associated sub-skills that are required to be developed among first-year secondary school students?
2. What is the procedural model for preparing a proposed digital unit in the geography of risks based on the STSE Approach among first- year secondary school students?
3. What is the effectiveness of a proposed digital unit in risk geography, based on the STSE approach, in developing geographical reasoning among first-year secondary school students?

Objectives of the Study

The study aims at

- Preparing a list of the dimensions of geographical reasoning, and the associated sub-skills that must be possessed by first-year secondary school students.
- Developing a procedural model for preparing a proposed digital unit in the geography of risks based on the STSE Approach among first year secondary school students.

- Exploring the effectiveness of a proposed digital unit in the geography of risks, according to the STSE approach, in developing geographical reasoning among first-year secondary school students.

Importance of the Study

The present research is important as follows:

1. Theoretical importance: The present research offers a theoretical review of geographical reasoning - risk geography - STSE approach.
2. Practical importance: The present research may practically benefit the following:
    a. First-year secondary school students: By helping them develop their geographical reasoning through the proposed digital unit on the geography of risks in accordance with the STSE approach.
    b. Those responsible for developing, reviewing, and amending (the Technical Amendment Committee) the geography curriculum in the first year of secondary school: by directing their attention to the importance of including risk geography in the student's book (Geography of Egypt) in the first year of secondary school, in addition to the importance of the STSE approach in the curriculum.
    c. Educational research (researchers): The importance of the present research concerning educational research stems from the following:
        - Addressing a multifaceted scientific gap by addressing the topic of present research.
        - A list of the dimensions of geographical reasoning and a procedural model for a proposed digital unit in the geography of risks in accordance with the STSE approach to developing geographical reasoning among first-year secondary school students.

- A set of recommendations and suggestions that may be useful in conducting further future studies related to the present field of research.

Terminology of the Study

Geography of risks

Hassanein (2016), El-Sherbiny and Marwad (2019), and Slim and Ibrahim (2022) defined risk geography as a branch of modern geography that aims to study natural and human risks that threaten the environment, its natural components, public and private property, and how to deal with them, prevent and reduce them.

Procedurally, the researcher defines risk geography as: one of the branches of modern geography that aims to study the natural and human risks that threaten the Egyptian environment. Such dangers can be highlighted through the topics of the proposed digital unit in accordance with the STSE approach to develop geographical reasoning among first- year secondary school students.

STSE Approach

Al-Mukhtar (2016), Al-Naimi (2016), Al-Mousawi (2019) and Al-Jubouri (2019) and Alnaaqa and Abu Fayyad (2022) defined the STSE approach as: an approach that seeks to constitute a comprehensive vision of the mutual interaction between science, technology, society, and the environment, and to recognize the resulting problems and issues in their various dimensions, and attempt to confront them through the acquired knowledge and skills.

Procedurally, the researcher defines the STSE approach as an approach that seeks to form a comprehensive vision of the mutual interaction between science and technology, society, and the environment among first- year secondary school students, simultaneous with being aware of a group of contemporary geographical issues that pose risks to the environment in Egypt. Moreover, it is an attempt to confront risks through the knowledge and skills related to geographical reasoning.

Geographical reasoning

Hooghuis et al. (2014: 244), and Waer et al (2021) define geographical reasoning as: reasonable reflective thinking about the relationship between humans and the environment that focuses on deciding the importance of location, and what is to be believed or not for solving problems, contributing to building geographical decisions through logical methods of thinking that lead to conclusions that are essentially based on assumptions and arguments for issuing a judgment.

Procedurally, the researcher defines geographical reasoning as acquiring a set of higher mental skills related to the geography of risks among first- year secondary school students such as their ability to ask geographic questions, provide plausible explanations, evidence, and contextual identification after studying a proposed digital unit in the geography of risks according to the STSE approach.

Statistical Hypotheses

The present research attempts to verify the validity of the following hypothesis: There is no statistically significant difference at the level ($05.0 \geq \alpha$) between the average scores of the experimental group students in the pre- and post-measurements in the geographical reasoning test.

Variables of the Study

- Independent variable: A proposed digital unit in the geography of risks according to the STSE approach.
- Dependent variable: geographical reasoning.

Delimitations of the Study

1. Objective limits

a. *Geography of Risks:* The present research was limited to three topics that fall within the scope of Geography of Risks, namely: Egypt and the issue of climate change - Egypt and the

issue of Nile water pollution - Egypt and the issue of water, according to the STSE approach. The topics are also consistent with the nature of the geography course in the grade (The first year-secondary school (Geography of Egypt).

b. *Geographical reasoning:* The current research was limited to 5 main dimensions of geographical reasoning, which are: asking geographical questions - location - claim - contextually – and evidence.

2. ***Human limits:*** A random sample of first-year secondary school students at Umm Al-Muminin Secondary School for Girls in the academic year 2022/2023.
3. ***Spatial Limits:*** Umm Al-Muminin Secondary School for Girls - West Tanta Educational Administration / Gharbia Governorate.
4. ***Temporal limits:*** The application took place during the second semester of the academic year 2022/2023.

Methodology of the Study

According to the research objectives, the quasi-experimental method was followed: one group – pretest posttest design.

Tools and Materials of the Study

Experimental processing materials:

- A list of the dimensions of geographical reasoning, and the associated sub-skills that must be available to first-year secondary school students. Appendix (3).
- A proposed unit in the geography of risks according to the STSE approach. Appendix (8).
- A guide to activities and exercises for the proposed unit for first-year secondary school students. Appendix (9).
- Teacher's guide for the proposed unit. Appendix (10).

For collecting data, the current study relied on a set of tools as follows:

- A questionnaire identifying the dimensions of geographical reasoning and the associated sub-skills, which must be available to first-year secondary school students. Appendix (2).
- Geographic reasoning test for first-year secondary school students. Appendix (4).
- An open-ended questionnaire to determine the largest number of STSE issues that can be studied by first-year secondary school students in geography. Appendix (6).
- A closed questionnaire to determine the largest number of STSE issues that can be studied by first-year secondary school students in geography. Appendix (7).
- A questionnaire to review the opinions of experts and practitioners about the validity of the proposed unit. Appendix (11).

Procedures of the Study

To achieve the objectives of the study, answer the questions, and verify the validity of the hypotheses, the following procedures were carried out:

1. Framing the theoretical and reference framework for the research.
2. Preparing a list of the dimensions of geographical reasoning, and the sub-skills associated with them that must be available to first-year secondary school students. Appendix (3).

The researcher used the questionnaire as a tool to determine a list of the dimensions of geographical reasoning, and the sub-skills associated with them. Preparing the list includes the following steps:

a. Defining a list of geographical reasoning dimensions, and their associated sub-skills:

Sources for preparing the initial list: In preparing the list, the researcher relied on the following sources:

- References, sources, and specialized literature in the field of geographical reasoning.

- Previous studies related to geographical reasoning.
- Interviewing some experts and specialists in the field of curricula and teaching methods of geography.
- The nature of contemporary geography in general, and the geography of risks in particular.

b. Preparing a questionnaire to determine the dimensions of geographical reasoning, and the sub-skills associated with it. Preparing the questionnaire includes the following steps:
   - Determining the goal of the questionnaire: which is to arrive at a fixed and valid list of the dimensions of geographic reasoning and the sub-skills associated with them, and to determine their level of importance and suitability for first-year secondary school students.
   - Determining the dimensions of the questionnaire: The researcher defined the dimensions of geographical reasoning as follows:
     - The first dimension: Asking Geographical Questions.
     - The second dimension: Location.
     - The third dimension: Claim.
     - The fourth dimension: Contextualization.
     - The fifth dimension: Evidence.

c. Establishing a grading system: The Likert method was chosen to estimate grades according to a five-graded scale, and arrive at the final list of dimensions of geographical reasoning and the sub-skills associated with them from the point of view of experts and specialists in curricula and methods of teaching geography, and educational psychology.

d. Modifying the questionnaire: The arbitrators reviewed the initial image of the questionnaire, see Appendix (1), to express their views on the extent of:
   - Accuracy of the technical and scientific formulation of these main dimensions and the sub-skills associated with them.

- The inclusion of the list of all dimensions of geographical reasoning, and the sub-skills associated with them.
- The integrity of the sub-skills tabulation for each dimension of geographical reasoning.
- The importance of each sub-skill associated with each dimension of geographical reasoning.
- Suitability of the dimensions of geographical reasoning and the sub-skills associated with them among students of the Geography Department at the College of Education.
- Addition, deletion, or modification

Considering the arbitrators opinions, the list of dimensions of geographical reasoning and the sub-skills associated with them are characterized by validity. Thus, it was possible to obtain the final list of dimensions of geographical reasoning and the sub-skills associated with them.

e. Validity of the questionnaire: In calculating the validity of the questionnaire, the list was modified considering the opinions and suggestions of the arbitrators.
f. Reliability of the questionnaire: The alpha coefficient of the questionnaire reached (89%). Hence, it is reliable to access the list of dimensions of geographical reasoning and the sub-skills associated with them.

3. Designing a proposed digital unit in risk geography according to the STSE approach using Google Classroom platform

The Dick and Carey model was selected to design the proposed unit, then reviewed by a group of specialists to ensure its suitability for application and performing the necessary amendments. The content of the proposed unit was structured in three main topics. In addition, the researcher determined the number of proposed hours necessary for teaching each topic. For calculating the hours of the timeline for the proposed unit, the researcher relied on the amount of knowledge and skills included within each topic, the used strategies in teaching each topic, and the

activities that require implementation. Hence, the researcher concluded the features of the timeline for implementing the proposed unit as follows:

Table 2

Timeline for implementing the proposed unit.

Topics	Unit lessons.	Number of lessons	Class techniques and methods	Strategies used in teaching the unit lessons	Class time
1	An introduction to the proposed unit, its purpose, and how to access and use Google Classroom	1	Visual display Dialogue and discussion Brainstorming Co-operative learning	KWWLHA mental map Problem-centered learning	60 minutes
2	Egypt and the issue of climate change.	2			90 minutes
3	Egypt and the issue of Nile water pollution.	2			90 minutes
4	Egypt and the water issue.	2			90 minutes
Total	3 lessons	7 sessions	10 hours (600 minutes)		

4. Preparing the teacher guide for teaching the proposed unit: It includes an introduction to the guide, directions for the teacher when teaching the unit via Google Classroom, strategies used in teaching the unit, timeline for implementing the unit, the necessary procedures before initiating to teach, how to use the platform Google Classroom, and the general steps followed while teaching the unit lessons. The guide was reviewed by a group of specialists to ensure its suitability for application and to make the necessary modifications.
5. Preparing a guide for activities and exercises for the proposed unit for first-year secondary school students: the researcher designed the educational activities according to the nature of each lesson in the unit, which aimed to develop geographical reasoning among first-year secondary school students. The guide included 14 activities and 6 exercises. The guide was

reviewed by a group of specialists to ensure its suitability for application and make the necessary modifications.

6. Preparing a geographical reasoning test for first -year secondary school students and modifying it scientifically. Appendix (4)

For preparing the geographical reasoning test, the following steps were followed:

- Determining the goal of the test: This test aims to find a consistent and valid measurement to generate data showing the extent to which first-year secondary school students possess geographic reasoning skills in the field of risk geography.
- Determining the dimensions of the test: the researcher adhered to the final list of dimensions of geographical reasoning, and the sub-skills associated with them.
- Determining the type of test: Considering the opinions of the arbitrators, the researcher chose the multiple-choice type, as it is the most appropriate type of objective tests in achieving objectivity in the measurement process, in addition to its ease of application and speed of correction. The student is free to choose only one alternative out of four alternatives (A-B-C-D).
- Test content: The test consists of (20) multiple-choice questions, four options/alternatives (A-B-C-D) for each that measure the specific dimensions of geographical reasoning and the sub-skills associated with them, according to the following table:

Table 3

Test specifications by distributing questions along the test dimensions.

Dimensions of the test	Number of questions	Total marks of each dimension
Asking Geographical Questions	1-8-18	6
Location	9-11-16	6
Claim	4-10-13-19-20	10
Contextualization	2-5-6-7-14	10
Evidence	3-12-15-17	8
Total	20	40

Formulating items of the test

In light of the final list of geographical reasoning dimensions and the sub-skills associated with them, the items of the test were formulated.

When formulating the test items, the researcher avoided the ambiguity of the test items, and the consistency of the items with the objectives of the test.

Each question of the test consisted of

- Introduction to the question: in the form of a phrase, or a complete paragraph, followed by a question. The introductions to some questions included illustrative graphs, maps, or pictures.
- Answer`s alternatives: there are four alternatives (A-B-C-D) for the answer, with only one correct answer and three incorrect alternatives. In turn, there is a small possibility of reaching the correct answer by guessing.
- Specifying the test instructions: After completing the formulation of the items, a page was prepared in the introduction to the test that addresses the instructions. These instructions are clear and precise, enabling the students to do what is required of them without confusion or ambiguity. The test questions - preceded by the test instructions - are organized as follows: A question booklet consisting of (20) questions.
- Preparing the sample answer sheet for the test questions: The answer sheet for the test questions has been prepared to facilitate the procedures for answering questions for the student; in addition to the speed of the researcher’s correction of test questions.
- Preparing the test key answers sheet (answer form and grade distribution): The test key answers sheet was prepared by marking the boxes that express the correct answers to the test questions with a mark (√); In order to help the researcher ease and speed up the correction process, Appendix (5) is attached.

- Grading and test marking system: The test marks were distributed in the test marking key (answer form and grade distribution) at a rate of (2) marks for each question in case that the correct alternative was chosen, and nothing in case that the correct alternative was not chosen.
- The initial version of the test: The test was prepared in its initial form including (20) items/questions that measure the skills included in the list of dimensions of geographic reasoning, and the sub-skills associated with them. The initial form of the test consisted of:
    - Title page.
    - Instructions page.
    - Items/ questions booklet.
    - key answers sheet.
- Validity of the initial form of the test: to verify the extent to which the test represents its specified objectives, it was reviewed by a group of arbitrators specialized in the field of curricula and teaching methods of geography to express their opinions in terms of:
- Accuracy and soundness of the scientific and linguistic formulation of the test questions.
- The validity of the questions to measure the specific dimensions of geographical reasoning, and the sub-skills associated with them.
- Each question is suitable for the level of first-year secondary school students.
- Addition, deletion, or modification.

The Results

The Majority of the arbitrators agreed on the validity of the questions to measure the specific dimensions of geographical reasoning and the sub-skills associated with them, and the suitability of each question for the level of first-year secondary school students. Some arbitrators also agreed on the difficulty of the test questions and the necessity of rephrasing some items for their vague phraseology. Considering the opinions of the arbitrators, some amendments were

implemented and some of the test questions were changed and reformulated. After ensuring the validity of its content, the test becomes ready for conducting the exploratory experiment.

Stages of Test Modification:

1. Calculating the validity of the test: The validity of the test was verified through several methods as follows:
    a. Face validity: During the application of the test on the exploratory sample, the face validity of the test was verified through the clarity of the test items, the students' understanding of its wording, and each question`s requirement.
    b. Content validity: To ensure the content validity of the test, the researcher asked the arbitrators the following questions:
        - Does the test contain enough questions to cover what it is supposed to measure?
        - Are the test questions appropriate for first-year secondary school students?
        - Does the test measure what it was designed to measure?

Through the arbitrators' answers to the previous questions, it was noted that all arbitrators agreed on the validity of that test for application.

    c. Construct Validity: The self- validity coefficient was calculated by finding the square root of the test's reliability coefficient, using the following equation: Self- validity coefficient = square root of the reliability coefficient = (0.92). It is an acceptable validity coefficient in using the test. Then it is possible to pronounce the validity of the test.

2. Calculating test reliability: The test reliability coefficient was calculated using the Kuder and Richardson analysis of variance. For easiness of use, the obtained reliability coefficient method indicates the minimum reliability coefficient, while other methods give the upper limit of the

stability coefficient, and its value reached (0.85). That is, the test has an acceptable degree of reliability.

3. Determining the test time: By calculating the average time of the students who represent the lowest quartile of time, and the average time of the students who represent the highest quartile of time, then calculating the average of the two times. Accordingly, the time specified for the test became (40) minutes.
4. The final form of the test: After ensuring the validity and reliability of the test, and verifying the appropriateness of its items, the test - in its final form - became valid for application, including (20) items/questions with a total of 40 marks, and a (40) minutes- test.
5. Choosing the research sample by applying random sampling mechanisms, where the sample consisted of 30 female students in the first year of secondary school at Umm Al-Mu'minin Secondary School for Girls in the academic year 2022/2023.
6. Application of the proposed digital unit.
7. Post-application of the research tools to the research sample.
8. Performing statistical processing of the data a shown in the following table (3):

Table 4

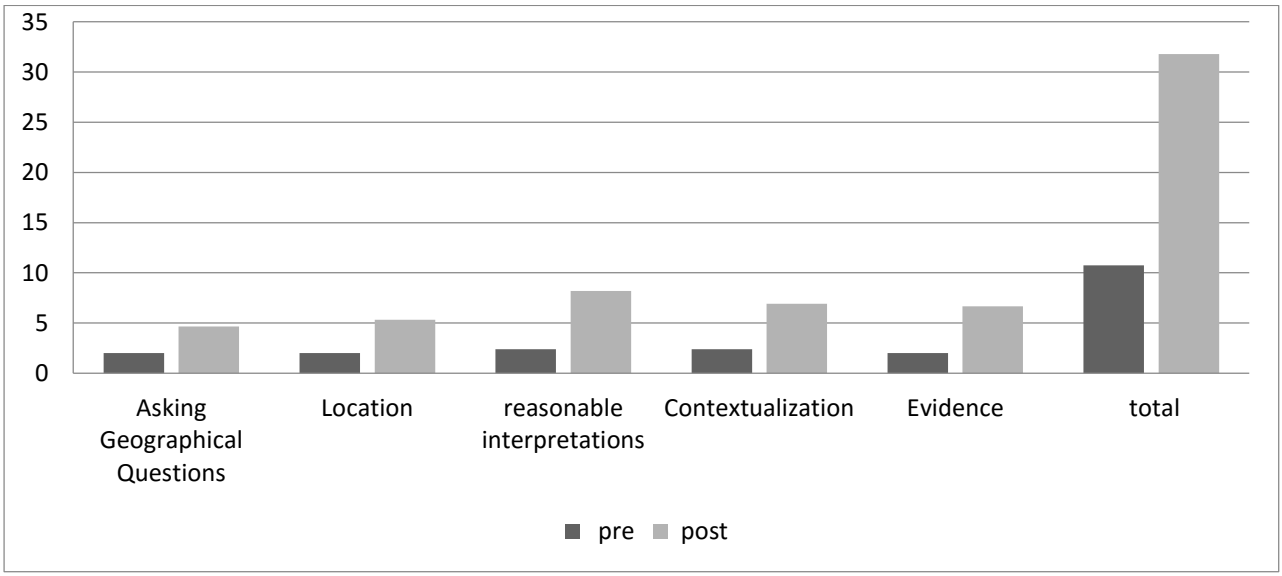
Arithmetic means, standard deviations, and "T" values for the experimental group's scores in the pre- and post-applications of the geographical reasoning test as a whole and its sub-skills.

Skills	Application	No. of sample	No. of questions	Mean	Standard deviation	T value	Sig. level	Sig. (2-tailed)
Asking Geographical Questions	Pre		3	2,000	,00000	15,23		,000
	Post		3	4,6667	,95893			
Location	Pre		3	2,0000	,0000	19,03		,000
	Post		3	5,3333	.95893			
reasonable interpretations	Pre		5	2,4000	.81368	52,05		,000
	Post	30	5	8,2000	1.09545		.05	
Contextualization	Pre		5	2,4000	.81368	15,81		,000
	Post		5	6,9333	1.01483			
Evidence	Pre		4	2,0000	.00000	26,65		,0019
	Post		4	6,6667	.95893			
The test as a whole	Pre		20	10,7333	.98027	55,38		,000
	Post		20	31,8000	1.98963			

Table (4) illustrates that there are statistically significant differences between the average scores of the two applications (pre- and post) for the research sample in the sub-levels of the geographical reasoning test and the total score of the test in favor of the post-application with the highest average. All “T” values were greater than the tabular value, where the tabular “T” is at the level of (0.05) and degrees of freedom (29) = (2.045). That is there has been a development in geographical reasoning in the test as a whole and its sub-levels among the research sample. Considering these results, the null hypothesis can be rejected, which states: There is no statistically significant difference at the level (05.0 ≥ α) between the average scores of the experimental group students in the pre- and post-measurements in the geographical reasoning test. The alternative hypothesis was accepted, which indicates That There is a statistically significant difference at the level (05.0 ≥ α) between the average scores of the experimental group students in the pre- and post-measurements in the geographical reasoning test in favor of the post-application as well as accepting the first research hypothesis, which stated that geographical reasoning can be developed through a proposed digital unit in the geography of risks, according to the Approach of STSE.

Figure 1

The differences between the average scores of the research sample (experimental) in the two applications (pre and post) of the geographical reasoning test as a whole and its sub-practices.



In light of figure (1), it is noted that there are clear differences between the averages of the research sample in the pre- and post-applications of the test to the test of geographical reasoning as a whole, as well as in the sub-levels of the test. To determine the effectiveness of experimental treatment in developing geographical reasoning, the Kohei D equation was used and calculated to determine the size of the treatment effect in developing each sub-practice of the geographical reasoning test, as well as the total score based on the calculated "T" value when determining the significance of the differences between the two applications (pre and post) for the research sample. Such findings are shown in the following table:

Table 5

Values of Eta square (η2), d and the size of the effect of the experimental treatment in developing geographical reasoning in the two applications (pre and post) of the geographical reasoning test in the research sample.

Practices of geographical reasoning	T values	D	Size of effect
Asking Geographical Questions	15,23	2,78	Great
Location	19,03	3,74	Great
Claim	52,05	9,50	Great
Contextualization	15,81	2,88	Great
Evidence	26,5	4,83	Great
Total	55,38	10,11	Great

According Table (5), Cohen's values ranged between (2.78 - 9.50) for the sub-levels of the test. This indicates a large effect size for the experimental treatment and its effectiveness in developing geographical reasoning among the research sample. Cohen's value for the test as a whole was (10.11), which means that the experimental treatment contributes significantly to the variance occurring in the test as a whole indicating a large effect size of the experimental treatment and its effectiveness in developing deductive thinking among individuals in the research sample.

Discussion

The afore-mentioned findings manifested an improvement in the performance of the experimental research group on the geographical reasoning test. Such improvement can be attributed to several factors as follows:

- The sound preparation of the proposed digital unit in the geography of risks in accordance with the STSE approach concerning the objectives of each topic in the proposed unit, the activities, methods and sources of learning included in each topic, provided multiple opportunities among first-year secondary school students to meet various experiences with the proposed unit.
- The clear, precise, sequential and logically-organized content of the proposed unit, considers the characteristics of first-year secondary school students and their professional needs, in addition to the contemporary global trends in teaching methods and evaluation.
- The proposed unit is rich in illustrative figures and supporting the unit with geographical maps made it easier to remember and consolidate information among first-year secondary school students. Moreover, this made learning more fun interesting, and motivational.
- Using an electronic platform in the proposed unit is a new method. Such method is consistent with contemporary global trends to integrate technology into the educational process, in addition to being compatible with the interests of first-year secondary school students.
- The proposed unit contains novel practical skills and presents them in an organized, sequential manner.
- Ensuring that all students in the research sample participate positively in performing the required tasks during classes to increase their motivation.

- The positive performance of first-year secondary school students and their interaction in learning the proposed unit topics, due to its relatedness to the reality of their professional lives and health problems.
- The diverse teaching strategies and methods used in teaching the proposed unit topics.
- The role of the teacher (researcher) in teaching the topics of the proposed unit, following up their performance in implementing the activities, and providing feedback.

Such factors have been assured through the improvement in the performance of the students of the experimental research group in the post-application of the geographical reasoning test. This result is partly consistent with previous studies highlighting developing Geographical Reasoning for students who are studying geography through technology, including Richter and Decanini (2012), Chiang et al (2014) , Hooghuis et al (2014), Rosenstein (2016), Hsiang (2018), Sumanti et al (2019), Allam and Al-Adawi (2020), Castellar(2021), Al-Helbawy (2022).

In addition to these studies, there are another studies which asserts the effectiveness of the STSE Approach in teaching, including Abu Hammed (2014), Lave, R. (2014), Karabedian(2014), , Surata et al (2014), Abdel-Al (2019) ,Abdel Halim, (2020), EL-Rayana (2022). Also, there are studies that highlighted the importance of studding Geography of risks including: Gouramanis and Ramirez (2021), Puspita et al (2021).

All of Previous studies are consistent with the result of the current study which points out to the effectiveness of using the digital unit in the geography of risks based on STSE Approach in developing Geographical Reasoning among first-year secondary school students**.**

Recommendations

Considering the results, the present study recommends the following:

1. Providing devices, laboratories, applications, and all necessary equipment to achieve the maximum benefit from using electronic platforms in the educational process.
2. The need to include geographical risks - an approach to science, technology, society and environment (STSE) issues in educational curricula.
3. Training pre- and in-service secondary school geography teachers to integrate geographical reasoning into secondary school geography curricula.
4. Designing training programs to practice geographical reasoning skills, targeting first year secondary school students.
5. Conducting further studies in the field of geographical inference from a qualitative approach.

Suggestions of the Study

The present research suggested conducting the following research:

1. The level of geographical reasoning and its relationship to academic achievement among first year secondary school students.
2. An educational environment based on geographic information systems technology to improve geographical reasoning among first-year secondary school students.
3. A proposed program in risk geography using geographic information systems to develop geographical reasoning among students of the Department of Geography at the College of Education.
4. A proposed program in the geography of risks according to the STSE approach to develop divergent thinking and some principles of environmental equity among second year secondary school students.

5. A digital module based on the geography of risks in the subject of social studies according to the STSE approach to develop geographical culture among sixth-grade primary school students.

References

Abdel Halim, Y. (2020). The effectiveness of a proposed course in environmental sciences based on the science, technology, society, and environment (STSE) approach to developing reflective thinking skills and environmental awareness among students of the Faculty of Education, Helwan University. *Arab Studies in Education and Psychology*, 126(2), 473-526. 10.21608/saep.2020.263150. Doi 10.21608/SAEP.2020.263150

Abdel-Al, R. (2019). *The effectiveness of a developed unit in science subject based on the approach of integration between science, technology, society and environment (STSE) in developing environmental awareness among first year middle school students*. [Unpublished Master's PhD. Helwan University]

Abu Hammed, M. (2014). *The Effectiveness of using an Educational Program Based on the Integration of Science, Technology, Society and Environment Approach (STSE) in teaching Science for prep school pupils to develop their critical thinking skills, the scientific attitude and retention of learning*. [Unpublished Master's PhD. Minia University].

Akbar, I., Maryani, E., Ningrum, E. (2021). The Contribution of Geography Learning to Disaster Preparedness of Students in Public Senior High Schools in Kendari. Journal Pendidikan Geografi Gea, 21(2).

Al-Asmari, M & Al-Anzi, M. (2016). *Analysis of the Content of the Middle School Mathematics Book in Light of the Dimensions of Scientific Enlightenment*. Journal of the College of Education in Assiut.15 (3), 419-461.

Al-Helbawy, S. (2022). *A Proposed Program in Medical Geography using Geographic Information Systems in Geographic Reasoning and its Relationship to Practicing Systematic Thinking Skills among Students of the Geography Department at the College of Education* [Unpublished Master's thesis, Tanta University].

Al-Jubouri, B. (2019). *Developing the Biology Curriculum in Light of the Science, Technology, Society, and Environment (STSE) Approach and its Effectiveness in Developing Achievement, deep Understanding, and Solving Biological Problems among middle School Students in Iraq*. [Unpublished Master's PHD, College Girls, Ain Shams University].

Allam, H. & Al-Adawi, M. (2020). *A Program based on the Pentagram Theory for Developing Geographical and Historical Inferences among Fourth year students in the Social Studies Department at the Faculty of Education*, Alexandria University. *Journal of Scientific Research in Education,* 21, 268-342. Doi 10.21608/jsre.2020.106010

Al-Marashi, Q. (2021). Science, Technology, Society and Environment "STSE" Issues Embeded in the Science Curriculum among the First Intermediate Grade in the Kingdom of Saudi Arabia. *Arab Journal of Specific Education*.5 (16), 67-94.DOI: 10.33850/ejev.2021.138595

Al-Mousawi, F. (2019). *Using the Science, Technology, Society, and Environment (STSE) Approach and its effects on Achievement and Developing future Thinking among first-year middle school female students*, [Unpublished Master's thesis, Jeddah University].

Al-Mukhtar, S. (2016). *The Effectiveness of a Developed Curriculum based on the Approach of Science, Technology, Society and the Environment in Developing Environmental Values and Some Geographical Thinking Skills among Middle School Students*. [Unpublished Master's PhD. Ain Shams University].

Alnaaqa, S. & Abu Fayyad, H. (2022). The effectiveness of a teaching model based on the integrative approach (STSE) in developing health awareness among fifth-grade female students in science. *Journal of the Islamic University for Educational and Psychological Studies,* 30(5), 42-66.

Al-Naimi, R. (2016). *The Effectiveness of Science, Technology, and Society (STS) in the Academic Achievement of fourth-grade Students in Social Studies and their Attitudes*. [Unpublished Master's thesis, University of Damascus].

Aqilan, O. (2015). *The Extent of the Inclusion of Disaster Concepts in Geography Textbooks for the Basic Education Stage in the Republic of Yemen*. Al-Andalus Journal of Humanities and Social Sciences, Al-Andalus University of Science and Technology.2 (8), 344-376.

Castellar, S., Pereira,M., Lache,N.(2021). Geographical Reasoning and Learning Perspectives on Curriculum and Cartography from South America. Springer . https://link.springer.com/book/10.1007/978-3-030-79847-5

Chiang, N., Yen, N., Littauer, R. & Chen, H. (2014). Geographical Reasoning and Biases: the View from Taiwan. The Journal of Kaohsiung Behavior Sciences, research gate, 4, 57 – 93.

EL-Rayana,G.(2022). A Proposed Program in Biotechnology Based on the Integration of Science, Technology, Society and the Environment (STSE) forAcquiring Biotechnological Concepts, Developing Biotechnological Solving Problems skills for Students of the Second Year of Agricultural Secondary School. *The Journal of Research in Education and Psychology*, 37(3), 1231-1264. https://doi: 10.21608/mathj.2022.136110.1210

El-Sherbiny, D., & Marwad, A. (2019). A Proposed Unit on the Geography of Risks and Natural Disasters for First Year Middle School Students. *Egyptian Society for Reading and Knowledge,* 319-342.

Gouramanis, C., MoralesRamirez,C.,(2021). Deep Understanding of Natural Hazards Based on the Sendai Framework for Disaster Risk Reduction in a Higher Education Geography Module in

Singapore. *International Research in Geographical and Environmental Education*, 30(1), 4-23. https://doi.org/10.1080/10382046.2020.1751391

Hassanein, M. (2016). A Proposed Curriculum based on the Visual Approach to Develop Geographical Concepts and Visual Thinking Skills among Students in the First Three Grades of Basic Education [Unpublished Master's PhD, Ain-Shams University].

Hooghuis, F., Der Schee, J., Der Velde, M., Imants, J., & Volman, M. (2014). *The adoption of Thinking Through Geography Strategies and their impact on teaching geographical reasoning in Dutch secondary schools*, international Research in Geographical and Environmental Education, 23 (3), 242 – 258. DOI: 10.1080/10382046.2014.927168

Hsiang,M.(2018). Geographic Information Science and Spatial Reasoning. the Department of Geography, San Diego State University Available at: https://map.sdsu.edu/geog104/index.html. Doi 10.21608/MFES.2016.106642

Karabedian, S. (2014*). Effectiveness of (S.T.S.E.) issues approach strategy to provide a correct environmental concepts and assumptions and environmental problem solving skill in the college of education students/ Basrah University*. [Unpublished Master's PhD. Albasrah University].

Lave, R. (2014). Science and Technology Studies (STS) in Geography. *Oxford Bibliographies* https://doi 10.1093/obo/9780199874002-0103.

Puspita,A. Sugeng,U., Sumarmi,D., and Syahru,R.,(2021). An Evaluation of Changes to The Secondary School Geography Curriculum in Indonesia Disaster Risk Reduction Effort. IOP Conference Series Earth and Environmental Science, 630(1).doi 10.1088/1755-1315/630/1/012018

Richter, D. & Decanini, M. (2012). *The sketch maps as a language to analyze geographic reasoning. Procedia*. Social and Behavioral Sciences Published by Elsevier Ltd, 46, 5183 – 5186. https://doi.org/10.1016/j.sbspro.2012.06.405

Rosenstein, D. (2016). *Straddling the gap: A middle school teacher's journey towards good geography*. [Unpublished PhD, University of Maryland].

Simandan, D. (2012). Commentary the Logical status of applied geographical reasoning. *The Geographical Journal, Royal Geographical Society*, 178 (1), 9 – 12.https://doi: 10.1111/j.1475-4959.2011.00430.x

Slim, H. & Ibrahim's. (2022). A Program in the Geography of Risks for Developing Environmental Awareness and Some Life Skills among Kindergarten Children. *Journal of the College of Education in Ismailia*, 53(2), 173-218.https://doi.org/ 10.21608/JFES.2022.243774

Strutt,A.(2020). How can we think geographically? An investigation into designing reasoning tasks to promote geographical thinking at Key Stage 3. Research & Development Project, Oxford University, Available at: https://ora.ox.ac.uk/objects/uuid:e9e0654a-6da4-47c8-855b-e6425a475b50/files/dgh93h009k

Sumanti, Z. Effendi,M., Festiyed, A.(2019). Instructional Model of Group Investigation by Using Facebook in Improving Student's Reasoning on Geography Subject. Proceedings of the International Conference on Education Technology, Atlantis Press.

Surata, S., Putu, K., Putrid, I., Paramitha and ,Tariningsih, D.(2018). Enhancing Students' Environmental Concern of Their Cultural Landscape Heritage through STSE Education Approach. *Asia-Pacific Forum on Science Learning and Teaching*, 13(2), RIC Number**:** EJ1227975.

Waer, M., Al-Sayed, F., & Ibrahim, G. (2021). Using real teaching in teaching two geography units to develop some geographical reasoning skills among first year middle school students. Journal of the College of Education Assiut**,** 37(12), 203-229. https://doi: 10.21608/MFES.2021.210175