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A Proposal for a Geography Assessment Module in the Trends in International Mathematics and Science Study (TIMSS)

Prepared for:
The International Association for the Evaluation of Educational Achievement (IEA)

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INTRODUCTION

The National Center for Research in Geography Education proposes to develop an international assessment of geographic literacy in lower secondary education (8th-grade). The geography assessment is being proposed as a TIMSS module available for subscription in 2023, with the aim of adding an important subject to the existing IEA portfolio of international school-based assessment studies.

This proposal has been updated to address questions and suggestions that were made at the 2019 IEA General Assembly (GA) meeting in Ljubljana, Slovenia. The geography proposal may also be viewed online at this link:

IEA international geography assessment presentation

Why a Geography Assessment is Necessary

Geography education provides students with powerful ways of thinking about the world using spatial concepts such as location, place, scale, region, and interconnection. In geography classrooms, students learn to apply these concepts for geographic inquiry, analysis, and problem solving, often with the support of 21st-century mapping technologies including geographic information systems (GIS) and the Global Positioning System (GPS).

Geographic literacy is important for life, work, and citizenship in the modern complex world of global change and interdependence. Geography's spatial and integrative perspective of human and physical systems enables students to see meaning in the distribution of phenomena on Earth's surface, understand the relations between people, places, and environments, and act on issues that threaten the welfare of people and the planet, including climate change, poverty, water and food security, habitat loss, and resource depletion. For these reasons, the *International Charter on Geographical Education*, endorsed by over 120 country members, specifies the study of geography as a priority for the curriculum in all countries (IGU Commission on Geographical Education, 2016).

During the 2019 IEA GA, a question was raised about the extent to which the proposed geography assessment is **aligned with geography curricula in lower secondary education**. We will work to ensure that the assessment will reflect internationally shared goals for student achievement in geography. For example, the proposed content of the assessment is based on the *International Charter on Geographical Education* (IGU Commission on Geographical Education, 2016) and an international analysis of geography curriculum standards and documents gathered from countries in every major world region beginning in 2017. The information from

the *Charter* and the 2017 field analysis of curriculum documents informed the content and topics recommended for the geography assessment (Solem et al., 2018). This curriculum analysis can be updated as needed to support revisions to curriculum documents in the coming years.

A related question was raised about the **positioning of geography in the school curriculum**. Internationally, geography is sometimes taught as a standalone subject in lower secondary schools and at other times it is taught as a component of the social studies curriculum. Curriculum documents representing both types of inclusion of geography were reviewed by our study group in preparing this geography assessment proposal. The inclusion of geography in either format in the curriculum can be accommodated within the proposed assessment.

DOMAINS ASSESSED

The TIMSS science assessment for 8th-grade students has four content domains: biology, chemistry, physics, and earth science. The proposed geography assessment will add value to TIMSS by measuring **geographic content knowledge and spatial thinking** in the domains of human geography and environmental geography. Care will be taken to ensure that items in these geography domains will be developed without any duplication of TIMSS biology and earth science.

1. Human Geography. This domain of geography focuses on the characteristics, spatial distribution, networks, and complexity of human populations, activities, and settlements on Earth's surface. Topic areas in this domain will include:
    - Types, causes, patterns, and impacts of human population growth and migration (e.g., demographic transitions, resource depletion, war and famine refugees, temporary migration streams, chain migration).
    - Locations, patterns, and spatial dynamics and interconnections of economic activities (e.g., manufacturing, agriculture, sustainable use of natural resources, impact of direct foreign investment, economic trade and interdependence, free trade zones, diffusion of innovations).
    - Functions, patterns, and forms of human settlements (e.g., arrangement of commercial and residential areas in cities, influence of physical location on urban patterns, effects of transportation systems and networks on urban design).
    - Patterns of political control and division of Earth's surface resulting from cooperation and conflict among people (e.g., environmental treaties, border and territorial disputes arising from ethnic and religious nationalism, competition over rivers and subsurface water resources).

2. Environmental Geography. This domain of geography focuses on the core disciplinary idea of human-environment interaction: how human actions modify physical environments, how physical environments influence human activity, and spatial variations in the meaning, use, availability, and importance of resources. Topic areas in this domain will include:
    - How human-induced environmental changes in one place affect other places (e.g., the impact of dams on river systems, water diversion for agricultural projects,

introduction of exotic and invasive species, deforestation that results in downstream flooding, salinization, and soil erosion).

- Types, characteristics, causes, and spatial distributions of environmental hazards and how people mitigate their potential effects (e.g., changes in the scale and frequency of hurricanes, impact of rising sea levels on coastal communities and island nations, urban heat island effects, vulnerability of human developments to floods, tsunamis, and earthquakes, human adjustments to natural hazards).
- Spatial variation in human adaptations to local environments and the impacts of technology on the scale of resource extraction and consumption (e.g., agricultural systems and product distribution, irrigation practices, petroleum resources and consumption patterns, surface mining practices and land restoration, fracking, offshore mineral extraction).
- Positive and negative consequences of human-driven demands for natural resources at local, regional, and global scales (e.g., industrial/commercial uses for natural resources, species extinctions, marine conservation areas, conservation corridors and open green spaces, sustainability planning).

The three cognitive domains for geography will be consistent with the current TIMSS science assessment (Mullis & Martin, 2017):

- Knowing (e.g., describing geographic properties and features, recalling geographic information, providing examples of geographic facts or concepts).
- Applying (e.g., using geographic knowledge, concepts, maps, spatial data, spatial models, GIS, and other geographic representations to compare, interpret, and explain spatial patterns and processes).
- Reasoning (e.g., designing a geographic inquiry, making predictions, evaluating scenarios, generalizing from an analysis, and solving geographic problems).

ASSESSMENT DESIGN

Items for the geography assessment will be developed in collaboration with TIMSS National Research Coordinators. For the field test, we anticipate the geography assessment will be composed of approximately 144 test items, organized in 8 blocks of 18 items each. These 8 blocks could be arranged in 2 booklets of 4 blocks each. A field test sample of 400 students would provide the required 200 observations for each item.

For the main survey, we anticipate the geography assessment will be composed of about 72 assessment items, organized in 4 blocks of 18 items each. These will be organized in a single 4-block booklet. There will be several versions of the booklets with blocks arranged in different orders to control for administration order effects. These booklets would be rotated among the designated student sample within each country. With this booklet design, the geography booklets could be included in the TIMSS booklet rotation and administered in the TIMSS classrooms together with the TIMSS booklets, which would be very efficient from a sampling perspective. The survey items and the booklets will be designed for e-assessment administration.

Items in the main geography assessment will be distributed as follows:

Content domains	Distribution of items (72)
Human Geography	36
Environmental Geography	36

Cognitive domains	Distribution of items (72)
Knowing	30
Applying	24
Reasoning	18

During the 2019 IEA GA in Ljubljana, several NRCs asked for **more clarity on the time required** to participate in the geography assessment. A field tested pool of 72 questions could be structured in such a way that an individual student would respond to either 18 or 36 questions. We believe this would take no more than 20 to 25 minutes using an e-assessment format. However, this will depend on the fraction of constructed response (CR) and multiple choice (MC) items. Whereas MC items take on average 1 minute, CR items require about 2 or 3 minutes per item. 4 blocks of 18 items could rotated in a way that students respond with 2 blocks each.

During the 2019 IEA GA, delegates also expressed interest in matters of **validity**. The curricular validity of the geography assessment may be established by aligning item specifications and content with formal curriculum documents within a country. Variations in curricula may be accommodated through the types of items on the assessment, such as the preparation of items that require students to extend their background knowledge to applications of content. In cases where there may be differences between the 'official' and the 'taught' curriculum, then the selective scoring of the assessment is a practical solution. Selective scoring occurs after the initial scoring. It permits educational officials and researchers to check the face validity of items on the assessment for the national sample. Selective scoring permits the removal of items from the analysis for a country, or subsamples within a country that are not deemed valid. The result is a secondary score of student outcomes that is more closely in line with the taught curriculum. Those analyses may also be used for curriculum review and teacher professional development. This approach is consistent with what is done in IEA studies:

a) DIFF analysis of items: This results in finding items that are more or less difficult in a specific country and then might be removed from calculating scores in one country or -- if there are many countries showing DIFF for an item – for all countries.
b) Asking national research coordinators (NRCs) if the content of an item is covered in their curriculum (the development of items involves NRCs from participating countries). Items with questionable validity usually become evident in the item development phase.
c) List the items derived in b) to calculate scores based on different subsets of items that were deemed to be appropriate for each country (as a reference, see Appendix F of

the international TIMSS report available at http://timssandpirls.bc.edu/timss2015/international-results/wp-content/uploads/filebase/science/11.-appendices/F_science-test-curriculum-matching-analysis-science.pdf).

SURVEYS

TIMSS background questionnaires for students, teachers, and principals will be included in the geography assessment, with additional questions to request data directly related to geography education as follows:

- Access, exposure, and availability of geography in the curriculum.
- Teacher qualifications to teach geography.
- Curriculum offerings in geography.
- Opportunities to learn geography topics.
- Media and technologies used for teaching geography.
- Students' perceived utility of geography for everyday life and careers.
- Factors that motivate students to learn geography.

BENEFITS

Once the geography assessment module becomes operational with TIMSS, participating countries will benefit from the following products and resources:

- The availability of the geography assessment framework and sample released items.
- A detailed report on the iterative process used to develop the geography assessment, including field testing and processes for item revision.
- A geographic literacy database with assessment and background data that can be analyzed separately or in combination with other components of the TIMSS assessments.
- A report highlighting the main results from the international assessment of geographic literacy.
- National-level and international datasets providing opportunities for educational researchers to conduct research on student achievement in geography at the lower secondary level of the curriculum.

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The international geography assessment project is currently co-directed by Dr. Michael Solem (Professor of Geography, Texas State University and Co-Director of the National Center for Research in Geography Education) and Dr. Joseph Stoltman (Professor of Geography, Western Michigan University, USA). Its conceptualization involved extensive consultation with an international community of geography education and assessment researchers (Lane & Bourke, 2016). Members of the international geography assessment study group include Dr. Erik Bijsterbosch (Windesheim University of Applied Sciences, Netherlands), Dr. Theresa Bourke (Queensland University of Technology, Australia), Dr. Chew Hung Chang (Nanyang Technological University, Singapore), Dr. Injeong Jo (Texas State University, USA), Dr. Rod Lane (Macquarie University, Australia), Dr. Miroslav Marada (Charles University, Czechia), Dr.

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REFERENCES

IGU Commission on Geographical Education (2016) Charter on Geographical Education. http://www.igu-cge.org/2016-charter/

Lane, R., & Bourke, T. (2016) Possibilities for an international assessment in geography. *International Research in Geographical and Environmental Education*, 26(1), 71-85.

Mullis, I. V. S., & Martin, M. O. (Eds.). (2017). *TIMSS 2019 Assessment Frameworks*. Retrieved from Boston College, TIMSS & PIRLS International Study Center website: http://timssandpirls.bc.edu/timss2019/frameworks/

Solem, M., Stoltman, J., Lane, R., Bourke, T., Chang, C., and Viehrig, K. (2018). An Assessment Framework and Methodology for a Trends in International Geography Assessment Study (TIGAS). Geographical Education, 31: 7-15.