ANALYSIS OF SCIENCE INTENDED CURRICULUM BASED ON TOPICS RECURRENT

Masoud Kabiri **Mahmood Ghazi Tabatabaei**

University of Tehran, Iran

Abstract: Analysis of intended curriculum in science was main focus of this study. One aspect of intended curriculum relates to number of grades that each topic repeated in the curriculum. To quantify, a measure was introduced to facilitate comparative analysis and computations was done in eighth grade of TIMSS 2007. It was entitled to topic recurrence rate which showed average of recurrence of topics per countries. Furthermore, role of the index on science average scale point was examined. Result revealed relationship was not significant, so recurrence of topics was not interpreted as important predictor of science achievement.

Keywords: intended curriculum, science achievement, topic recurrence index.

Introduction

Curriculum is the most important element for formulating educational experiences. It is assumed that there are same opportunities for students who received educational experiences in certain grade. In that case educational acquirements are predictable and all students likely access to fair opportunities. Knowledge how curriculum leads to regularize experiences of students in formal education is an important issue in curricular and intended curriculum was proposed in the similar stream of thinking.

TIMSS is designed to provide information for many audiences in order to change and imply policies in their countries (Beaton, Martin and Mullis, 1997). It curriculum perspective, it learn us which topics are taught and when they start and finish in other countries? And how national curriculums relate to

performance of students. Furthermore, some terms such as world class standards do not mean without information of other countries.

According to TIMSS frameworks, triplet curriculums formulate students learning. They are intended, implemented and attained curriculums. The intended curriculum is official set of learning expectations as described in local, state or national curriculum frameworks, the implemented curriculum is who topics is presented to students by teachers and the attained curriculum is actual learning of students (Tarr et al., 2008; Zuzovsky, 2003). The importance of intended curriculum and its role in achievement of students has highlighted in present study. Among many aspects of intended curriculum, recurrent of attained topics was considered as a center of focus.

Intended curriculum is defined to "intended courses of study and sequences of learning opportunities in formal schooling" (J. C. Chen, Reys, & Reys, 2009). It relates students what to know and what to do in the certain point of schooling. Intended curriculum has distinguished meaning from the textbook (Tarr et al, 2008). In decentralized systems the textbook adopted by a school or a district is often not perfectly aligned with intended curriculum, consequently, intended curriculum may differs from textbook.

Opportunity to learn is related issue with intended curriculum. In TIMSS, opportunity to learn is considered as encountering students to a situation or potential experience to learn a topic. To operationalize opportunity to learn, two concepts are considered, but time is unit of measurement of opportunity to learn and was regarded as the critical factor determining degree of learning:

Degree of learning = time actual spent / time needed (Bin Jaafar, 2006)

It is assumed in this model that all students could success in their tasks if there is certain time has been spent to engage actively relatively their aptitude. In TIMMS assumed that when students have chance to learn an object, they probably response items correctly (Houang & Schmidt, 2008). Stivens (1999, cited by Bin Jaafar, 2006) stated that opportunity to learn is a multidimensial construct including: content coverage (coverage of topics or opportunity to learn in grade), content exposure (attention to learning outcomes), content emphasis and quality of instructional delivery.

Knowledge about adequateness of intended curriculum is one of main problems in curricular. So, some techniques have been proposed to explore intended curriculum. Topic trace mapping is one of them. In this method, two pieces of information are asked: first, all grades in which that topic were covered

and second, which grade the topic was focused (Huang and Smidt, 2008). Topic trace mapping can provide following information.

- A Description of concentrate to topics by grade level,
- Grade that topic is intended to be first introduced to student,
- Spread of grades that each topics is instructed,
- Any grade for which the topic was to be a special emphasis (J.-C. Chen & Hsieh, 2008).

In addition, some other concepts such as breath, depth and recurrence are investigated by this method. Breath is considered as number of included topics, depth is degree of focus on topics and recurrence is number of years that a topic remain in curriculum

Traditionally, it is assumed that recurrence of topics in curriculum leads to better achievement of students. However, Birenbaum, Tatsuoka, and Xin (2005) with comparing curricula of USA, Israel and Singapore discussed Singapore's curriculum is non-repetitive and focused, consequently better achievement is emerged.

In this perspective, there are attempts to keep topics in curriculum. Two issues were studied in present study: first, a quantitative index was introduced to indicate topics recurrent in science curriculum. The index was calculated on the basis of curriculum questionnaire. Second, an exploration of relationship between topic recurrent rate and science achievement was done as a measure of congruency of intended and attained curricular. So, comparison of participated countries of TIMSS by topics recurrent in curriculum is main purpose of this study. Furthermore, an investigation of relationship between topic recurrent rate and science achievement in participated countries in grade eight of TIMSS 2007 is another point of focus in present study.

Method

Data source

Topic recurrent rate was calculated based on chapter 5 (the science curriculum) of TIMSS Science International Report (Martin, Mullis, Foy, & Olson, 2008Martin, Mullis, Foy, & Olson, 2008) which originally was referred to curriculum questionnaire. Again, science average scale scores were determined from the same source.

Measures

Main measure that is used for presented paper is topic recurrent rate. In order to calculate it, the number of covered grades in each topic was counted. Then, average of recurrence of topics was calculated per country. Theoretically, the index extents from 1 to 12. The index equal to 1 shows that each topic introduces in just one grade and it does not any continuity in curriculum. Higher index shows intended topics maintain more than one grade in curriculum.

Sample

The investigation was limited in science course of TIMSS 2007. Grade eight was choice and all countries were covered in a comparative study.

Results

The first part of finding has been allocated to comparison of topic recurrent rate of participating countries of TIMSS 2007 in grade eight. It should point out that in commutating of recurrent rate, some topics that have not taught in certain countries were not considered. The results were provided in following table.

Table 1. Science topic recurrent rate of participating counties in TIMSS 2007

Country	Average scale score	Topic recurrent rate	Number of covered topics	Country	Average scale score	Topic recurrent rate	Number of covered topics
Singapore	567	2.07	33	Bahrain	467	1	40
Chinese Taipei	561	3.33	41	Bosnia and Herzegovina	466	2.07	46
Japan	554	6.12	33	Romania	462	3.75	36
Korea, Rep. of	553	1.1	27	Iran, Islamic Rep. of	459	1.11	34
England	542	1.45	40	Malta	457	1.25	29
Czech Republic	539	4	46	Turkey	454	1.59	43
Hungary	539	1.61	43	Syrian Arab Republic	452	5.33	35
Slovenia	538	1.67	38	Cyprus	452	2	23

Table 1. (Continued)

Country	Average scale score	Topic recurrent rate	Number of covered topics
Russian Federation	530	2.13	40
Hong Kong SAR	530	2.93	32
United States	520	4.24	43
Lithuania	519	1.04	35
Australia	515	5.5	25
Sweden	511	4.03	40
Scotland	496	1.09	35
Italy	495	2.37	46
Armenia	488	1	40
Norway	487	4.54	29
Ukraine	485	2.35	39
Jordan	482	7.2	46
Thailand	471	3.15	32
Malaysia	471	1.09	38
Bulgaria	470	1.44	38
Serbia	470	1.52	46
Israel	468	4.12	35

Country	Average scale score	Topic recurrent rate	Number of covered topics
Tunisia	445	1	14
Indonesia	427	1	17
Oman	423	1.89	24
Georgia	421	2.47	28
Kuwait	418	2.5	25
Colombia	417	2.02	38
Lebanon	414	3	28
Algeria	408	1.39	24
Egypt	408	3.09	17
Palestinian Nat'l Auth.	404	3.4	45
Saudi Arabia	403	1.16	31
Morocco	402	1.71	29
El Salvador	387	3.89	35
Botswana	355	1.6	16
Qatar	319	1.5	25
Ghana	303	4.89	35
Mongolia		3.83	36

Above table shows Comparison of participated countries in TIMSS 2007 based on topic recurrent rate. Results reveal topic recurrent rate for four countries including Armenia, Indonesia, Bahrain and Tunisia was 1 which show that each topic introduced only in one grade. In other side, countries that had highest index were Jordan, Japan, Australia, Syria, Ghana, Norway, United States, Sweden, and Czech Republic, respectively. Most of the countries, but not all, have science average scale score higher than TIMSS international average. So, it can be concluded that although most top-countries had high topic recurrent rate, but high topic recurrent rate does not lead on to proper performance of students as a single factor. Therefore, high topic recurrent rate can not considered as a perfect predictor of achievement of students, but quality of presentation of topics must be notice along with some other curriculum consideration.

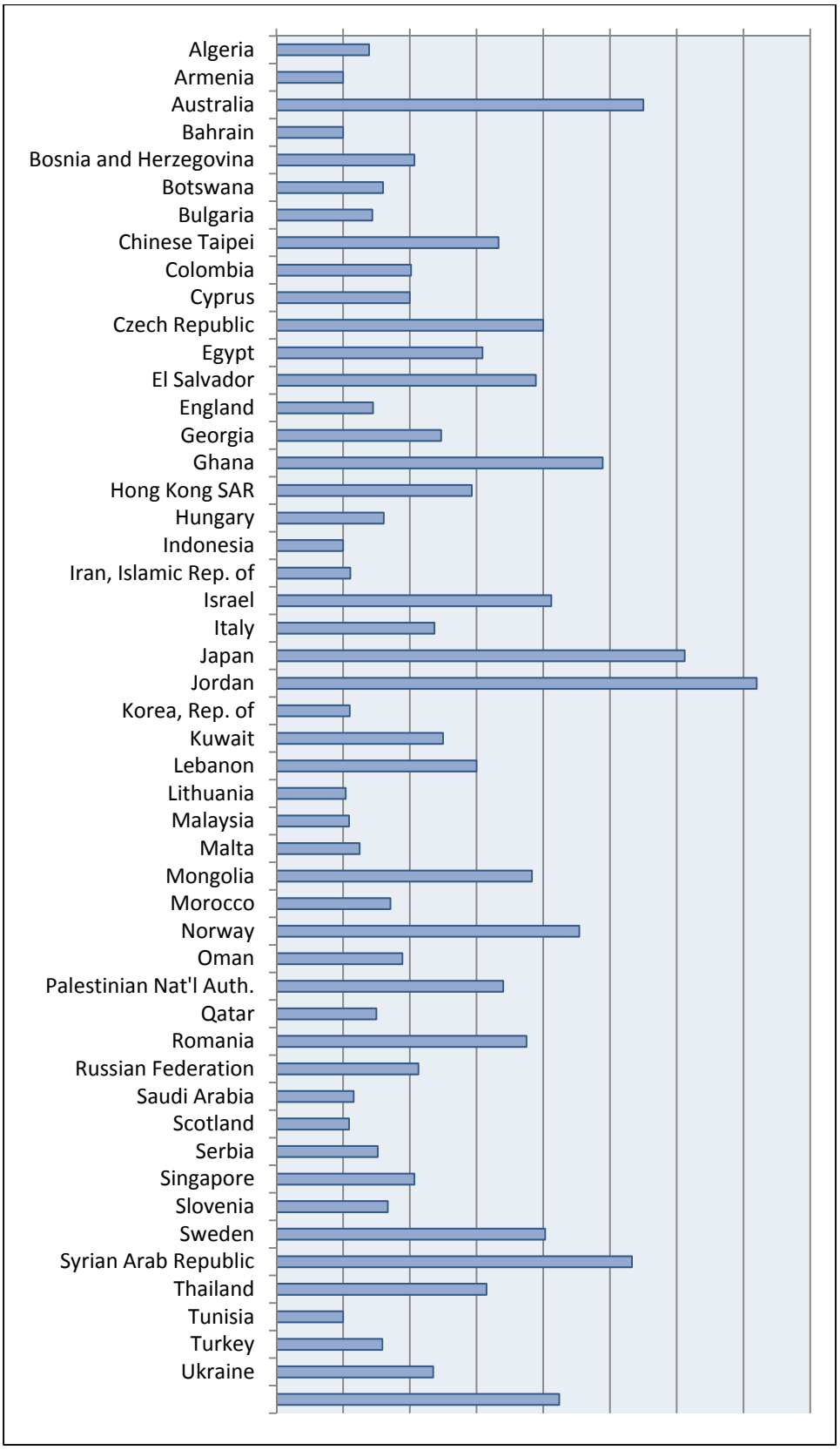

Figure 1. Science topic recurrent rate of participating counties in TIMSS 2007

In order to more exploration in topic level, topic recurrent rate have been compared in science eight top countries with other participated countries in TIMSS 2007. In other words, eight top countries compared with all remaining participating countries in grade eight. Top countries were Singapore, Chinese Taipei, Republic of Korea, Japan, England, Hungry, Czech Republic and Slovenia. The computation was done in all 46 science topics for grade eight which nested in 19 topic areas. The results were presented in following table.

Table 2. Comparison of eight-top countries and all remaining countries in topic recurrent rate

Topic area	Topic	All countries	Top countries
Characteristic and life process of living things	Classification of organisms	2.88	3.25
	Major organ systems in humans and other organisms	3.48	2.88
	How organ systems maintain stable bodily conditions	2.67	3
Cells and their functions	Cell structures and functions	2.46	2.13
	Photosynthesis and respiration	2.52	2.75
Life cycles, reproduction and heredity	Life cycles of organisms, including humans, plants, birds, insects	3.28	3.63
	Reproduction and heredity	2.88	2.88
Diversity, adaptation, and natural selection	Role of variation and adaptation in survival/extinction of species	2.93	2.38
Ecosystems	Interaction of living organisms in an ecosystem	2.67	2.5
	Cycling of materials in nature	2.71	2.5
	Trends in human population and its effects on the environment	2.41	2.67
	Impact of natural hazards on humans, wildlife and the environment	2.79	3.5
Human health	Common infectious diseases	3.24	2.29
	Preventive medicine methods	3.12	2.17
Classification and composition of matter	Classification and composition of matter	2.67	3
	Particulate structure of matter	2.8	2.13
Properties of matter	Solutions	2.32	2.13
	Properties and uses of water	2.7	3.13
	Properties and uses of common acids and bases	2.34	2.25

Table 2. (Continued)

Topic area	Topic	All countries	Top countries
Chemical change	Nature of chemical change	2.69	2.75
	Common oxidation reactions	2.51	2.25
	Classification of chemical transformations	2.1	2.14
Physical states and changes in matter	Physical states and changes in matter	2.81	2.13
	Effects of density and pressure	2.1	2.13
Earth's structure and physical features	Earth's structure and physical characteristics	2.03	2.25
	Water on earth	2.32	2.29
	Earth's atmosphere	2.08	2
Earth's processes, cycles, and history	Earth's water cycle	2.34	2.13
	Processes in the rock cycle and the formation of rocks	2.32	1.63
	Weather data/maps, and changes in weather patterns	2.44	2.71
	Geological processes occurring over millions of years	2	2.25
	Formation of fossils and fossil fuels	2.05	2.43
Earth's resources, their use and conservation	Environmental concerns	2.66	2.75
	Earth's resources	2.49	3.43
	Relationship of land management to human use	2.19	4
	Supply and demand of fresh water resources	2.24	1.6
Earth in the solar system and the universe	Explanation of phenomena on earth in relation to the solar system	2.13	2.5
	Physical features of earth compared with other planets	2.53	2

Above table showed that none of groups (top countries and remaining countries) have higher recurrent rates in almost topics in biology domain. However, top countries have higher rates in chemistry and physics domains rather than remaining countries. Similar rates also was observed between top countries and remaining countries in earth science. Consequently, there is not increasing recurrent rates in most topics for top-countries rather than remaining countries. This table also illustrated that recurrence of topics cannot be considered alone as a predictor of students achievement relates to curriculum.

Exploration of relationship between recurrence of topics and average scale score of country was another objective of the study. Pearson correlation was calculated for this series of data. Correlation was 0.081 (degree of freedom = 49, Sig. = 0.51). It showed that there is no evidence, in a comparative perspective, to infer that keeping topics in the more grades affect better achievement of students.

Conclusion

Analysis of intended curriculum was main objective of present study. In order to investigate effect of recurrent topics on achievement of students, first, a quantitative index was proposed that showed mean of maintaining topics in science curriculum of country. It entitled as topic recurrent rate. In addition, recurrent rate for each science topic was computed. Relationship between recurrence of topic and average scale score was last object of present study.

Results of present study provide comparative evidences about recurrence of topics in curriculum and how it affects on achievement of students. According to results, although some of countries that had higher topic recurrent rate were top countries in TIMSS 2007, however, traditional assumption of the more recurrence, the better achievement is not confirmed. There are some countries with higher topic recurrent rate that were not achieved well. The straightforward inference is that there are some other variables that should be considered about achievement.

References

Arora, A. (2010). *Relationship among curriculum coverage, teacher preparedness, and student achievement in TIMSS Advanced 2008*. Paper presented at the The 4th IEA International Research Conference (IRC 2010).

Beaton, A. E., Martin, M. O., & Mullis, I. V. S. (1997). Providing data for educational policy in an international context: The Third International Mathematics and Science Study (TIMSS). *European Journal of Psychological Assessment, 13*(1), 49-58.

Bin Jaafar, S. (2006). An alternative approach to measuring opportunity-to-learn in high school classes. *Alberta Journal of Educational Research, 52*(2), 107-126.

Birenbaum, M., Tatsuoka, C., & Xin, T. (2005). Large-scale diagnostic assessment: comparison of eighth graders' mathematics performance in the United States, Singapore and Israel. *Assessment in Education, 12*(2), 167-181.

Chen, J.-C., & Hsieh, C.-J. (2008). *Comparison of the learning expectations for school mathematics across several Asian countries and U.S. states*. Paper presented at the The 3th IEA International Research Conference (IRC 2008).

Chen, J. C., Reys, B. J., & Reys, R. E. (2009). Analysis of the learning expectations related to grade 1-8 measurement in some countries. *International Journal of Science and Mathematics Education, 7*(5), 1013-1031.

Houang, R. T., & Schmidt, W. H. (2008). *TIMSS international curriculum analysis and measuring educational opportunities*. Paper presented at the The 3th IEA International Research Conference (IRC 2008).

Houang, R. T., Schmidt, W. H., & Cogan, L. (2004). *Curriculum and learning gains in mathematics: A cross-country analysis using TIMSS*. Paper presented at the The First IEA International Research Conference (IRC 2004).

Karvonen, M., Wakeman, S., & Flowers, C. (2006). *Alignment of standards, large-scale assessments, and curriculum: A review of the methodological and empirical literature.* Paper presented at the Annual meeting of American Education Research Association San Francisco, CA.

Martin, M. O., Mullis, I. V. S., Foy, P., & Olson, J. F. (2008). *TIMSS 2007: International science report: findings from IEA's trends in international mathematics and science study at the fourth and eighth Grades*. Lynch School of Education, Boston College: IEA TIMSS & PIRLS International Study Center.

Murdock, J. (2008). Comparison of curricular breadth, depth, and recurrence and physics achievement of TIMSS Population 3 countries. *International Journal of Science Education, 30*(9), 1135-1157.

Tarr, J. E., Reys, R. E., Reys, B. J., Chávez, Ó., Shih, J., & Osterlind, S. J. (2008). The impact of middle-grades mathematics curricula and the classroom learning environment on student achievement. *Journal for Research in Mathematics Education, 39*(3), 247.

Zuzovsky, R. (2003). Curriculum as a determinant of learning outcomes: What can be learned from international comparative studies - TIMSS-1999. *Studies in Educational Evaluation, 29*, 279-292.