A REMEDIAL ACTION BASED ON TAIWANESE STUDENTS' RESULTS OF TIMSS

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Abstract

Shrinking achievement gaps is very important in educational and social progress. The TIMSS provides information on the achievement gaps among different countries in mathematics and science. For Taiwan, Based on the result of TIMSS 2003, there was an excellent average performance in Taiwan. However, the proportion of low achievers was high and the overall students' learning interest and self-efficacy were quite low. In order to narrow the achievement gaps in Taiwan, the policy of After School Alternative Program [ASAP],] was proposed by Ministry of Education [MoE] and National Science Council [NSC], which aimed at ensuring both academic excellence and equity by providing new opportunities and challenges for Taiwan to advance the goal of closing narrow the achievement gap. The purpose of this study was to offer precisely analyse ASAP 4th and 8th graders' math achievement results during 2009-2010. By comparing ASAP students' math achievements and affect profiles of 3 time points, the results showed that the effects of ASAP not only improve academic performance but also reduce negative goal orientation about mathematics learning. However, there were still 12% of Taiwanese 8th grade participants identified as low-achievers in TIMSS-2011, the result showed we still need to make more efforts and to figured out a more considerate policy in facilitating the proportion of low-achievers.

Keywords: TIMSS, mathematics achievement gap, low achiever, remedial program, After School Alternative Program

INTRODUCTION

Achievement gaps constitute important barometers in educational and social progress. About 5% to 10% of the students in schools for elementary general education have difficulties with mathematics (Rivera, 1997). The seriousness of these difficulties can vary from temporary difficulties in one domain (i.e., a particular area of the math curriculum) to severe learning disabilities affecting several different domains. The difficulties can also manifest themselves at different points in a child's school career, not only in the learning of basic facts or in learning to apply previously acquired knowledge but also in the learning of such preliminary mathematics skills (Kroesbergen, Van Lui,2003; Van de Rijt & Van Luit, 1998).

Students in Taiwan have participated in TIMSS since 1999. The overall performance results of Taiwanese students were above the scale average. The results seemed fine at the first glance; however, some problems were observed after detailed review. According to both TIMSS-2003 and TIMSS-2007 results, there are 8% of 4th graders and 14% of 8th graders, who did not reach TIMSS intermediate benchmark (i.e., students scored below 475) (Mullis, Martin, Foy, 2008; Mullis, Martin, Gonzalez, & Chrostowski, 2004). These 14% of Taiwanese 8th grade participants were identified as low-achievers, which was the highest proportion among all five leading nations. The percentage of low achievers showed a "quantum jump" from grade 4 to 8 in Taiwan (Lin, 2008). Both TIMSS-2003 and TIMSS-2007 results showed that the variances of 8th grade in Taiwan were higher than many other countries which indicated that achievement gaps between high- and low-achievers were larger. Moreover, scores of 8th graders were more distracted than that of 4th graders. It seemed that achievement gaps grew serious with the years.

Students' interests and self-confidences in mathematics and science learning were also revealed in both reports, in TIMSS-2007, only 36% of 4th graders feel confident in their mathematics abilities, which was second to last among all participating countries; 27% of 4th graders self-reported at low level of this index. Only 27% of 8th graders were at high level of this index, and 46% were dissatisfied with their mathematics abilities. These results indicated that students became less confident in their mathematics abilities as they grew.

Many countries have concerned the learning of low-achieving students in mathematics and propose reforms in the mathematics curricula (e.g. No Child Left Behind, 2001; national Report on Schooling in Australia, 1999). Many research resources are invested in investigation of the influential factors such as the professional development of in-serving teachers, or the participation of parents, etc.. Research regarding academic interventions is gaining increased attention presumably due to external influences of these reforms. Several reviews, research syntheses, and meta-analyses have been published on the topic of math intervention (e.g., Jitendra & Xin , 1997; Kroesbergen & Van Luit, 2003; Mastropieri, Bakken, & Scruggs, 1991; Miller, Butler, & Lee, 1998; Swanson & Carson, 1996; Swanson & Hoskyn, 1998, 1999; Xin & Jitendra, 1999; etc.). These studies not only suggested the effects of math intervention, but also proven the impacts of the students' characteristics (eg, grade, IQ, motivation) on the effects of studies. In addition, the characteristics of the intervention (such as group or individual teaching, different teaching orientation, length of teaching time) are also very important and has a wealth of explanatory power. Xin and Jitendra (1999) also indicated that long-term (> 1 month) intervention effects were significantly higher than short- or intermediate-term interventions for group-design studies, whereas both long-term and intermediate treatments were seen to be more effective than short-term treatments for single-subject studies.

For Taiwan, the result of TIMSS showed that there was an excellent average performance. However, the proportion of low achievers was high and the overall students' learning interest and self-efficacy were quite low. Many researchers tried to find solutions that might narrow these gaps. Given that socioeconomic status [SES] has been proven to be one of the factors affecting students' achievements (Lubienski & Crane, 2010; McConney & Perry, 2010), providing extra resources for low-SES students might be one way to overcome students' background disadvantage.

During 2006, MoE and NSC examined the results of TIMSS-2003, and they finally proposed ASAP. The goals of this program are: (1) to reduce low-achievers from 15% to 10% in future TIMSS

survey, wishing for even lower percentage in the future, and (2) to increase students' interests in learning mathematics (Lin, 2008).

Supported by MoE, the ASAP program has been implemented in Taiwan since 2007. In order to evaluate students' progresses and the effectiveness of the program, a technology-based testing system has been developed since 2008. Figure 1 illustrated the implement procedure of ASAP. Students' progresses are also monitored regularly. Based on the schools' reports in the first year, the results seemed promising. Ninety percent of participants reported that they could not finish their homework before attending this program, but they could now after one year (with supervisions). Eighty percent of participants had developed more positive learning attitudes. In addition, 60% of participants had improved on their school test scores (Lin, 2008).

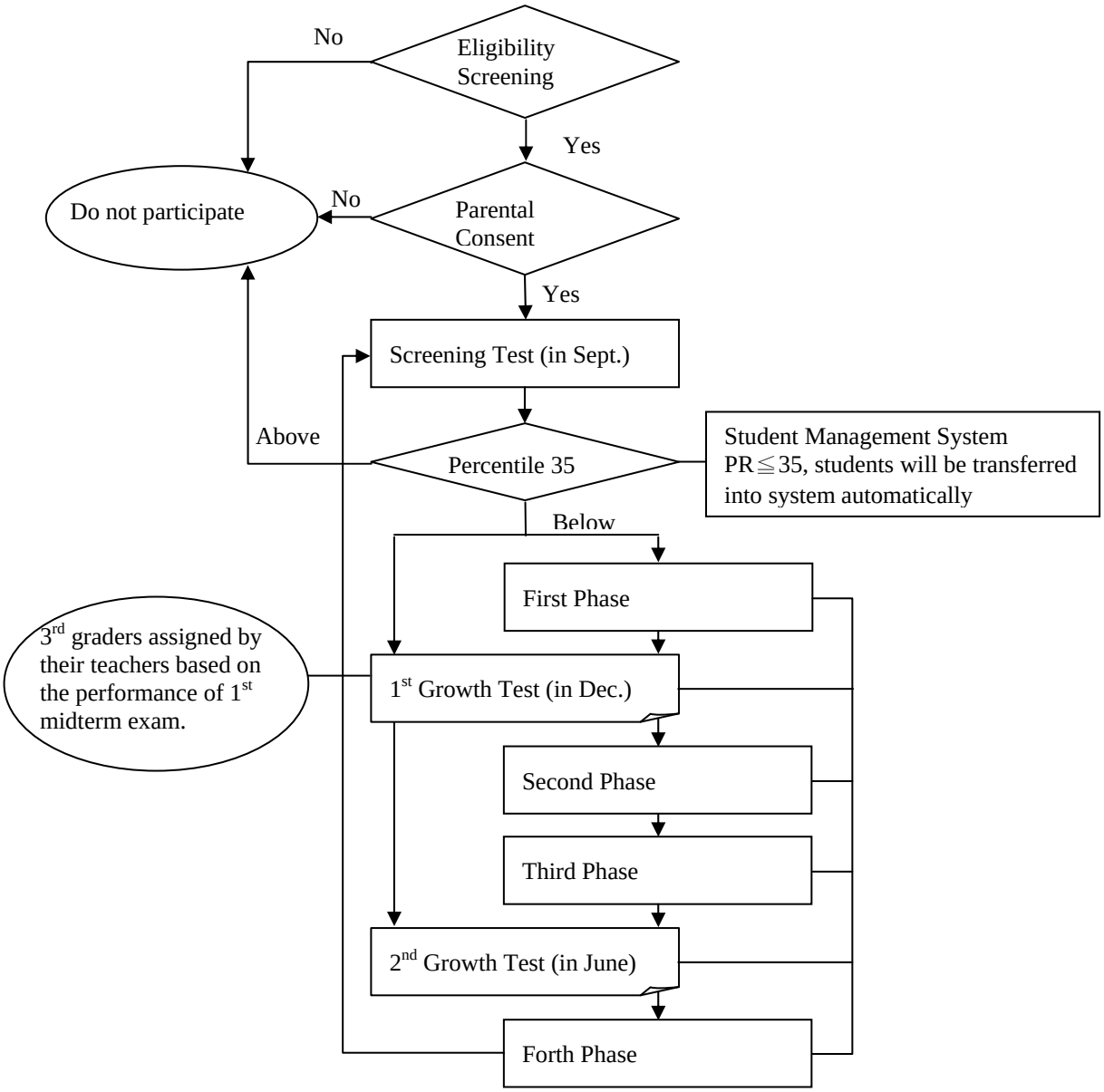

Figure 1. *Implement procedure of ASAP*

Research findings on the effects on improving academic performance have been mixed, generating controversy over the policy's usefulness. Assessing ASAP's impact requires more rigorous scrutiny of new evidence from assessment results. The After School Alternative Program technology-based testing project (ASAP-tbt) is proposed to play a confirmatory role as an independent assessment to validate the ASAP remedial effects, by examining whether and how recent math assessment trends in average achievement as well as achievement gaps are systematically related to Taiwan accountability policies under ASAP.

PURPOSE

The purpose of this study is to offer precise analyses of ASAP fourth and eighth graders' math achievement results during 2009-2010. Beside, we also concern the change of the proportion of negative learning approach in mathematics for these students. In order to have a precise understanding about ASAP effect on low achievers' learning. There are two reference groups, norm and low achievers that do not participate in ASAP, are involved in this study.

METHOD

Participants:

In this study, 3441 fourth-grade ASAP students were invloved in this study, and there 1559 and 386 norm and low-achieving learners respectively were as the referece groups. For 8th grade, there were 655, 1210, and 403 ASAP, norm and low-achieving students involved in the analysis of this study.

Measures:

Mathematics achievement. For assessing the student's mathematics achievement and learning approach, there are two parts included in the assessment system of ASAP-tbt. The first part is mathematics achievement assessment system, the tasks challenge students to apply their mathemaitcal knowledge and skills. The Mathematics Achievement Assessment of ASAP-tbt is a standardized achievement test that is aligned with the Taiwan Grade 1-9 Curriculum Guidelines. Norms for the entire 1–9 ASAP-tbt are based on the students throughout Tiawan, and the sampling includes students with low-achieving and disabilities. The math portion of the ASAP-tbt contains mainly select response formats,. The select response items use the three-parameter logistic model of Item Response Theory (IRT) models: item difficulty, item discrimination, and probability of a correct response by a low-scoring student. It is not easy to understand IRT scores, in order to communicate with in-service teachers who do not understand IRT, we converted IRT scores to T scores. The ASAP-tbt enabled us to determine students on a range of grade-level skills and concepts. It was also an independent measure of growth over time. The test contained computational problems (e.g., operations on whole numbers, fractions, decimals), short word problems,measurement, and geometry concepts. ASAP-tbt capitalizes on the precision and efficiency of computer adaptive testing (CAT). This approach represents a significant improvement over traditional paper-and-pencil assessments used in many states today, providing more accurate scores for all students across the full range of the achievement continuum. This measure was administered in September, December and again in June.

Learning Approach toward Mathemaitcs. The second part is the mathematical learning approach assessment system. After the student complete the achievement assessment, they have to respond the questions about their learning approach. Students' learning approachs can be divided into four categories: (1) Mastery orientation: Students wish to become proficient in a topic to the best of their ability; (2)Performance orientation: Students focus on demonstrating competence in relation to others; (3)Abandon orientation: Students possess a negative attitude towards learning; and (4) Multiple orientations:Students possess both mastery and performance orientation. The second part tasks is also taken on a computer, but is not computer adaptive. The ASAP student will take one class periods to complete these two parts assessment.

Data Analysis:

In this study, ASAP Students who have taken three tests (which are on the same scale).We adopted Hierarchical Linear Model to obtain the slop of the learning growth by comparing 3 times profile in math achievement of ASAP students. And using SPSS to conduct the descriptive analysis.

RESULTS AND DISCUSSION

Mathematics Achievement

Table 1 presents the descriptive ane alysis summaries of mathematics achievement among ASAP students and two reference groups. The results indicated, for both 4^{th} and 8^{th} grade, the scores of ASAP students increased more rapidly, compared to the two reference groups. It is worth noting that the slow learners in norm showed a little decline in their math competencies from the beginning to the end of the school year. The results of HLM showed that the slop of achievement growth for fourth-grade ASAP students was 3.30, and the slop of eighth-grade ASAP students was 3.41, both the slops are significant. It showed that the intervention of ASAP indeed exist the effects to facilitate the low achieving students mathematics learning.

Table 1.

The average scores of the ASAP program and reference groups

Grade	group	N	Screen Test	Growth Test I	Growth Test II
	ASAP	3441	42.82	45.81	49.42
4	Norm	1559	52.28	-	54.32
	Slow Learners in Norm	386	37.17	-	37.02
	ASAP	655	42.16	41.12	49.01
8	Norm	1210	50.08	-	53.35
	Slow Learners in Norm	403	39.55	-	38.14

Mathematical Learning Approach

Another concern regarding ASAP program is on the changes of participants' learning approaches. Utman (1997) argues that positive learning goals would lead to better task performance. In September, there were 708 (20.57%) 4th grade participants categorized as in the avoidance approach, and 788 (22.90%) in the mastery level. Two semesters later, only 446 students (12.96%) were reported in avoidance category, and 1,335 (38.80%) students were in mastery goal level (See Table 2). This finding showed that 4th graders' self-confidence changed from negative to positive. However, the impact on the 8th grade participants was unclear (See Table 3). In September, there were 144 (21.98%) 8th grade participants categorized as in the avoidance level, and 114 (17.40%) in the mastery level. But two semesters later, there were 109 students (16.64%) still in avoidance category, and 189 (28.85%) students were in mastery level.

Table 2.

The change of goal orientation for 4th graders

June(third test) Sept. (first test)	Avoidance Orientation	Performance Orientation	Multiple Orientation	Mastery Orientation	Total (%)
Avoidance Orientation	220	299	109	80	708 (20.57%)
Performance Orientation	190	478	363	190	1221 (35.48%)
Multiple Orientation	26	121	208	369	724 (21.04%)
Mastery Orientation	10	16	66	696	788 (22.90%)
Total (%)	446 (12.96%)	914 (26.56%)	746 (21.68%)	1335 (38.80%)	3441

Table 3.

The change of goal orientation for 8th graders

June(third test) Sept. (first test)	Avoidance Orientation	Performance Orientation	Multiple Orientation	Mastery Orientation	Total (%)
Avoidance Orientation	58	48	13	25	144 (21.98%)
Performance Orientation	50	110	50	39	249 (38.02%)
Multiple Orientation	1	62	22	63	148 (22.60%)
Mastery Orientation	0	0	52	62	114 (17.40%)
Total (%)	109 (16.64%)	220 (33.59%)	137 (20.92%)	189 (28.85%)	655

CONCLUSIONS

The purpose of this study is to examine the effects of ASAP on math achievement and learning approach in mathematics for fourth and eighth graders' during 2009-2010. From this study, a few interesting conclusions can be drawn with regard to ASAP math interventions. When choosing and organizing an intervention, one should keep in mind the following findings. The results show that intervention of ASAP for promoting the slow learners is effective. But according the change of learning approach toward mathematics, the effects of ASAP are required further clarification. The impact on the 8th grade participants was unclear. Compare with fourth graders, eighth-grade students with specific learning difficulties may already have a history of failure in the mathematics and, as a result, have motivational problems. As we know, the basic math skills is large and plays an important role in the development of students' later math skills (Mercer & Miller, 1992; Van Luit & Naglieri, 1999). Creating opportunities for success in mathematics is important, especially for the low-achieving learners. Teachers have to recognize the importance of that child develops his or her intellect through internalizing concepts based his or her own interpretation of an activity that occurs in a social setting. If teachers can pay attention to the positive benefits of students' background knowledge and beliefs in the face of the mathematics learning, and cooperate the students' cognitive and affective state into teaching planning considerations, then continuously monitor the students' knowledge and the process of concept change, learning intervention is to be expected. Research indicates that achieving a balance between sufficient opportunities for success and tasks that require considerable effort and that may need to be solved through small-group efforts, rather than individually, requires carefully designed curricular materials and instructional practices (Woodward, 1999).

The initiation of ASAP was based on the results of TIMSS-2003, the follow-up TIMSS results are the consequential indicators of the effects of ASAP. The motto of ASAP is: "taking care of every student so that all children progress academically". Based on the results of TIMSS-2011, there are still 12% of Taiwanese 8th grade participants identified as low-achievers; the effects of this remedial program are not proven. This means that we still need more comprehensive consideration for remedial instruction. The ASAP currently is renamed as "Project for Implementation of Remedial Instruction [PRIORI]", however, this project is still under evaluation. Hopefully, students will continue to benefit from the policy based on TIMSS results.

REFERENCES

Baker, D. P., Goesling, B., & Letendre, G. K. (2002). Socioeconomic status, school quality, and national economic development: A cross-national analysis of the "Heyneman-Loxley Effect" on mathematics and science achievement. *Comparative Education Review, 46*, 291-312.

Jitendra, A., & Xin, Y. P. (1997). Mathematical word-problem solving instruction for students with mild disabilities and students at risk for math failure: A research synthesis. *The Journal of Special Education, 30*,412-438.

Kroesbergen, E. H., Van Luit, J. E. H. (2003). Mathematics interventions for children with special educational needs: A meta-analysis. *Remedial and Special Education, 24* (2). 97-114.

Lin, F. L. (2008). *Policy making with IEA report*. Plenary keynote speech at the 3rd IEA IRC, September 16-20, 2008, Taipei, Taiwan. Retrieved from http://www.iea.nl/fileadmin/user_upload/IRC/IRC_2008/Papers/IRC2008_Lin.pdf

Lubienski, S. T., & Crane, C. C. (2010). Beyond Free Lunch: Which Family Background Measures Matter? *Education Policy Analysis Archives, 18*(11). Retrieved from http://epaa.asu.edu/ojs/article/view/756

Lubienski, S. T., & Crane, C. C. (2010). Beyond free lunch: Which family background measures matter? Education Policy Analysis Archives. 18(1), http://epaa.asu.edu/ojs/article/view/756.

Mastropieri, M. A., Bakken, J. P., & Scruggs, T. E. (1991). Mathematics instruction for individuals with mental retardation: A perspective and research synthesis. *Education and Training in Mental Retardation, 26*, 115-129.

McConney, A. and Perry, L.B. (2010). Socioeconomic status, self-efficacy, and mathematics achievement in Australia: a secondary analysis. *Educational Research for Policy and Practice, 9* (2). pp. 77-91.

McConney, A., & Perry, L. B. (2010). Socioeconomic status, self-efficacy, and mathematics achievement in Australia: A secondary analysis. *Educational Research for Policy and Practice, 9*(2), 77-91.

Miller, S. P., Butler, F. M., & Lee, K. (1998). Validated practices for teaching mathematics to students with learning disabilities: A review of literature. *Focus on Exceptional Children, 31* (1), 24-40.

Mullis, I. V. S., Martin, M. O., Foy, P., & (with Olson, J. F., Preuschoff, C., Erberber, E., Arora, A., & Galia, J.). (2008). *TIMSS 2007 International Mathematics Report: Findings from IEA's Trends in International Mathematics and Science Study at the Fourth and Eighth Grades*. Chestnut Hill, MA: TIMSS & PIRLS International Study Center, Boston College.

Mullis, I. V. S., Martin, M. O., Gonzalez, E. J., & Chrostowski, S. J. (2004). *TIMSS 2003 International Mathematics Report: Findings from IEA's Trends in International Mathematics and Science Study at the fourth and eighth grades*. Chestnut Hill, MA: TIMSS & PIRLS International Study Center, Boston College.

Rivera, D. P. (1997). Mathematics education and students with learning disabilities: Introduction to the special series. *Journal of Learning Disabilities, 30*, 2-19.

Swanson, H. L., & Carson, C. (1996). A selective synthesis of intervention research for students with learning disabilities. *School Psychology Review, 25*, 370-392.

Swanson, H. L., & Hoskyn, M. (1998). Experimental intervention research on students with learning disabilities: A meta-analysis of treatment outcomes. *Review of Educational Research, 68*, 277-321.

Swanson, H. L., & Hoskyn, M. (1999). Definition x treatment interaction for students with learning disabilities. *School Psychology Review, 28*, 644659.

Utman, C. H. (1997). Performance effects of motivational state: A meta-analysis. *Personality and Social Psychology Review, 1*, 170-182.

Van de Rijt, B. A. M., & Van Luit, J. E. H. (1998). Effectiveness of the Additional Early Mathematics program for teaching children early mathematics. *Instructional Science, 26*, 337-358.

Xin, Y. P., & Jitendra, A. K. (1999). The effects of instruction in solving mathematical word problems for students with learning problems: A meta-analysis. *The Journal of Special Education, 32*, 207-225.