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A Survey Review Report on the Math Mindset: Attitudes and Approaches to Learning Mathematics

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Abstract: ***This study explores how student attitudes, beliefs, and learning strategies influence mathematical understanding and achievement. Drawing on Carol Dweck's mindset theory, the research highlights the positive impact of a growth mindset on reducing math anxiety, enhancing problem-solving ability, and improving classroom engagement. A mixed-method approach, including surveys, interviews, and classroom observations, was used to analyze responses from 73 students. Findings suggest that most students believe in effort-based success in mathematics and view mistakes as learning opportunities, though a small percentage still hold fixed beliefs. The role of teachers and parents in shaping the math mindset is also emphasized.***

Keywords: Math mindset, growth mindset, math anxiety, mathematics education, student attitudes, classroom strategies, math at home, problem solving.

1. Introduction & Literature Review

The ability to understand and engage with mathematics has long been regarded as a key component of educational success. However, beyond cognitive ability, learners' attitudes and mindsets significantly influence how they approach mathematics. The concept of a "math mindset" refers to the attitudes, beliefs, emotions, and approaches students develop towards learning mathematics. These affective dimensions not only shape motivation and effort but also impact overall achievement and long-term interest in the subject. The foundation for understanding these attitudes lies in decades of research in educational psychology and pedagogy. Dweck's (2006) work on the growth mindset revolutionized the way educators view student potential, emphasizing the belief that abilities can be developed through effort and persistence. Boaler (2016) expanded this view within the mathematics domain, showing that creative, open-ended approaches to teaching math can help break down fixed mindsets and math anxiety. These studies suggest that cultivating positive mathematical mindsets can lead to improved engagement, resilience, and academic success. This dissertation aims to explore the various dimensions of students' attitudes and approaches to learning mathematics, focusing on how mindset, teacher practices, cultural context, and affective factors interrelate to influence outcomes.

Attitudes towards mathematics have been extensively studied due to their correlation with student performance. Ma and Kishor (1997) conducted a comprehensive meta-analysis and found a statistically significant relationship between positive attitude and higher achievement in mathematics. Hannula (2002) further explored how emotions, expectations, and values interplay in shaping students' mathematical attitudes. Ajzen (1993) and Ajzen & Fishbein (1977) provided a theoretical foundation for attitude-behavior relations, suggesting that positive attitudes are predictive of more favorable behaviors and outcomes. This theory helps explain why students with more positive dispositions towards math are often more engaged and persistent. A seminal work by Schoenfeld (1992) introduced the role of metacognition and sense-making in mathematics, suggesting that student success involves more than procedural knowledge. Thinking strategies, confidence, and self-awareness are central components of mathematical learning. In classroom settings, teacher instructional methods are vital. Akinsola and Olowojaiye (2008) highlighted that student attitudes are significantly influenced by how mathematics is taught. Constructivist and student-centered teaching methods tend to generate more positive attitudes compared to traditional, rote-based approaches. The influence of cultural and systemic differences in math education has also been explored by Leung (1994, 1995), who compared mathematics classrooms in Beijing, Hong Kong, and London, revealing stark differences in pedagogical practices and student mindsets. These findings reinforce the idea that sociocultural context is integral to how students form mathematical attitudes. Further, Kilpatrick et al. (2001) in Adding It Up, emphasized five key strands of mathematical proficiency—conceptual understanding, procedural fluency, strategic competence, adaptive reasoning, and productive disposition. The latter, closely tied to mindset, underscores the importance of a student's belief in their own capacity to succeed in math. Instruments for measuring attitudes, such as the "Math and Me" survey developed by Adelson and McCoach (2011), provide empirical tools to assess students' perceptions, enjoyment, and anxiety related to mathematics. These tools help validate claims that affective factors play a central role in math learning. Studies from Sub-Saharan Africa (Bethell, 2016; Mensah et al., 2013; Getahun et al., 2016) reinforce global concerns about low math achievement being tied to negative attitudes and ineffective teaching practices. These reports advocate for teacher development, curriculum reform, and focus on student psychology. Lastly, several studies address the affective domain in learning mathematics. Ignacio et al. (2006) stress that motivation, enjoyment, and belief in one's ability critically shape learning experiences. Lipnevich et al. (2011) compared

students from the US and Belarus, showing that cultural values and educational expectations significantly influence students' math attitudes.

2. Causes of the Math Mindset, Attitude, and Approach to Learning Mathematics

The way students perceive and engage with mathematics is deeply influenced by various psychological, social, and educational factors. These factors form the foundation of their math mindset a set of beliefs and attitudes toward learning mathematics. Below are the main causes:

1) **Parental Influence:** Children often mirror the attitudes of their parents toward mathematics. If parents demonstrate anxiety or dislike for math, children are more likely to develop negative attitudes. Parental support, encouragement, and involvement in homework or math-related discussions can build confidence and a growth mindset.
2) **Teacher Expectations and Behavior:** Teachers who believe in students' ability to improve through effort foster a growth mindset. Supportive feedback, engaging teaching methods, and positive reinforcement enhance students' attitudes. In contrast, labeling students as "weak in math" or focusing only on correct answers can lead to a fixed mindset.
3) **Peer Influence and Classroom Environment:** Collaborative learning and positive peer interactions can improve students' comfort with math. Negative experiences like peer comparison or ridicule during mistakes can cause math anxiety and a poor approach to learning.
4) **Past Experiences and Achievement:** A history of repeated failures in mathematics often leads to low self-esteem and learned helplessness. On the other hand, consistent success and praise can cultivate self-efficacy and a positive attitude.
5) **Teaching Methods and Curriculum Design:** Traditional, lecture-based teaching that emphasizes rote memorization often fails to engage students meaningfully. Innovative methods like project-based learning, real-life application, and use of technology make math more relatable and enjoyable.

3. Research Design

The present study adopts a descriptive survey research design to investigate the attitudes and approaches students hold toward learning mathematics, often referred to as their "maths mindset. " This design is appropriate because it allows for the collection of both quantitative and qualitative data to describe trends, patterns, and relationships among variables such as mindset, motivation, and learning strategies in mathematics education.

1) **Quantitative and Descriptive in nature:** It uses structured tools (such as questionnaires) to gather numerical data and analyze responses statistically. Qualitative elements (like open-ended responses) may also be included to explore students' thoughts and beliefs more deeply.
2) **Population and Sample:** Population: Secondary school or undergraduate students, depending on the scope of the study.
   Sample Size: A representative sample of 73 students.
   Sampling Technique: Stratified random sampling is used to ensure representation across gender, academic performance levels, and types of institutions (e. g., government vs. private schools).
3) **Research Variables:**
   - **Independent Variable**: Students' attitude and mindset toward mathematics.
   - **Dependent Variable**: Their approach to learning mathematics (problem-solving style, study habits, persistence, etc.).
   - **Control Variables**: Age, gender, academic level, socio-economic background.
4) **Tools for Data Collection:** A structured questionnaire is the primary data collection tool. It includes: Likert-scale items measuring fixed mindset vs. growth mindset beliefs. Questions on mathematics anxiety, motivation, effort, and learning preferences. Open-ended questions to collect qualitative insights. The questionnaire is validated by subject experts and a pilot study is conducted to ensure reliability.
5) **Data Collection Procedure:** Data is collected through both offline (printed forms) and online platforms (Google Forms, etc.), depending on participant access. Ethical considerations such as informed consent, voluntary participation, and confidentiality are strictly followed.

4. Research Methodology

A mixed-method design was used involving quantitative surveys, qualitative interviews, and classroom observations. The participants (n = 73) responded to structured questionnaires measuring attitudes, emotions, and learning strategies. Chi-square tests were conducted to assess the relationship between mindset variables and learning outcomes. Statistical tools like SPSS and Excel supported the analysis.

5. Data Analysis

List of Survey questions: (**1)** What is your Gender? (**2)** What is your attitude towards mathematics? (**3)** Do you believe anyone can improve at maths with practice? (**4)** In your opinion, What is the most important factor for success in maths? (**5)** How do you feel when you get a wrong answer in maths? (**6)** Which statement best describes your maths mindset? (**7)** How do you usually prepare for a maths test? (**8)** How often do you use real life examples to understand maths concepts? (**9)** What emotion do you most commonly feel in maths class? (**10)** When you see a complex math problem, What is your first reaction? (**11)** Do you think asking question in class helps improve maths learning? (**12)** How often do students engage in reflective math discussions in your classroom? (**13)** How do you promote a positive attitude towards math at home?

6. Statistics Analysis

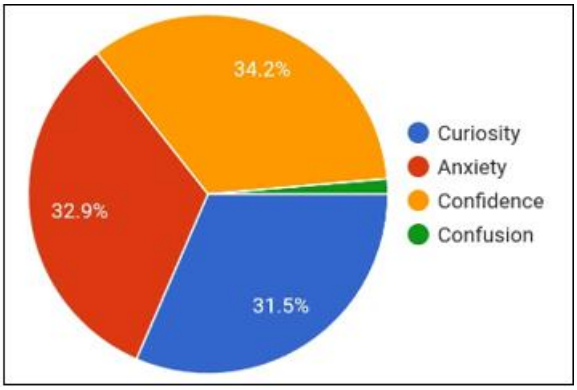
To support the investigation of students' mathematics mindset, a statistical analysis was conducted using data from 73 survey responses. The data were categorized based on students' attitudes (such as interest and confidence in math)

and learning approaches (such as problem-solving strategies and participation). Descriptive statistics, including percentages and mean scores, were used to identify general trends. Additionally, graphs such as pie charts and bar diagrams visually represented key findings related to students' motivation, anxiety, and learning behavior. The analysis highlighted significant variations in mindset, indicating that both emotional and cognitive factors play a crucial role in shaping students' mathematical learning experiences.

Survey table with their pie diagram:

1) What emotion do you most commonly feel in math class?

S. No.	Particulars	Output
1.	Curiosity	23
2.	Anxiety	24
3.	Confidence	25
4.	Confusion	1

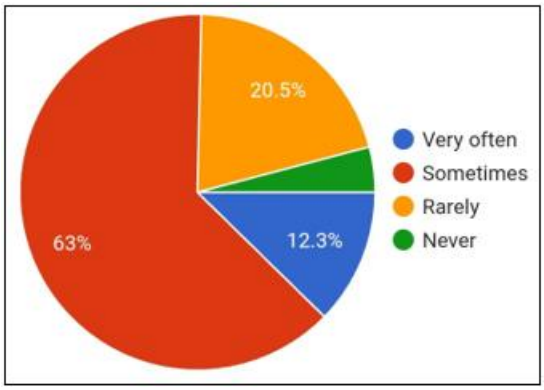


Interpretation: This pie chart represents the emotions students experience when engaging with mathematics 34.2% feel confidence (orange) 32.9% experience anxiety (red) 31.5% feel curiosity (blue) Only 1.4% experience confusion (green).

Inference: This pie chart reveals the emotional responses students associate with learning mathematics. Confidence (34.2%) emerges as the most common feeling, closely followed by Anxiety (32.9%) and Curiosity (31.5%), indicating a balanced mix of positive and negative mindsets. Notably, Confusion (1.4%) is minimal, suggesting that while students may feel pressured or curious, they generally understand the material. This highlights the importance of nurturing confidence while reducing anxiety to foster a healthy and motivated math mindset.

2) How often do you use real life examples to understand math concept?

S. No.	Particulars	Output
1.	Very often	9
2.	Sometimes	46
3.	Rarely	15
4.	Never	3

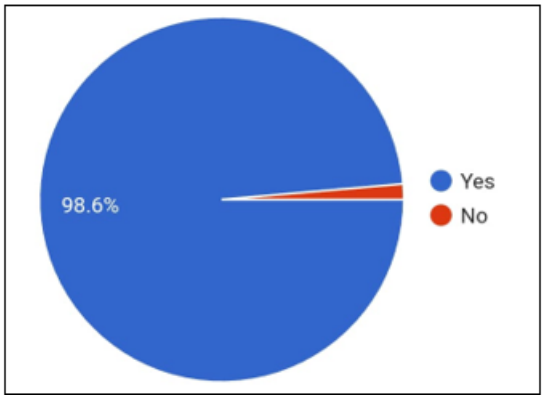


Interpretation: This pie chart shows how frequently students engage in a certain activity (likely related to mathematics, such as asking questions, solving problems, or revising) 63% of students engage in the activity "Sometimes" (red).20.5% do it "Rarely" (orange).12.3% engage "Very often" (blue).4.2% "Never" participate (green).

Inference: The majority of students (63%) show occasional participation, indicating that while they are involved, it's not consistent. Only a small portion (12.3%) participate very regularly, suggesting room to increase active engagement. Around one-fourth (24.7%) of students participate rarely or never, highlighting a concern and a need for strategies to better motivate or include them. Overall, the data suggests a moderate engagement level, with opportunities to Encourage more regular involvement Identify and support less active students Foster an environment where consistent participation is valued and normalized.

3) Do you think asking question in class helps improve mathematics?

S. No.	Particulars	Output
1.	Yes	72
2.	No	1



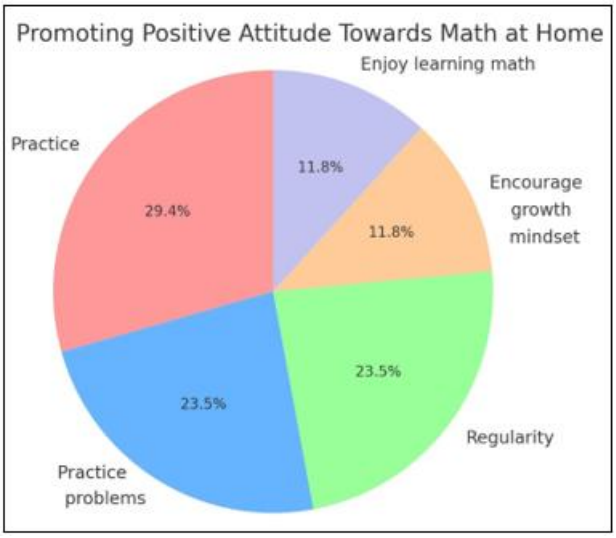
Interpretation: The pie chart displays responses to a Yes/No question. The blue segment ("Yes") represents 98.6% of the total responses. The red segment ("No") represents the remaining 1.4%. There is a clear majority favoring "Yes", with almost unanimous agreement.

Inference: The overwhelming majority of participants agree with the statement or question posed. There is very little

opposition or disagreement (only 1.4%). This indicates a strong consensus among respondents.

4) How do you promote a positive attitude towards math at home?

S. No.	Particulars	Output
1.	Practice	21
2.	Practice problems	17
3.	Regularity	17
4.	Encourage growth mindset	9
5.	Enjoy learning math	9

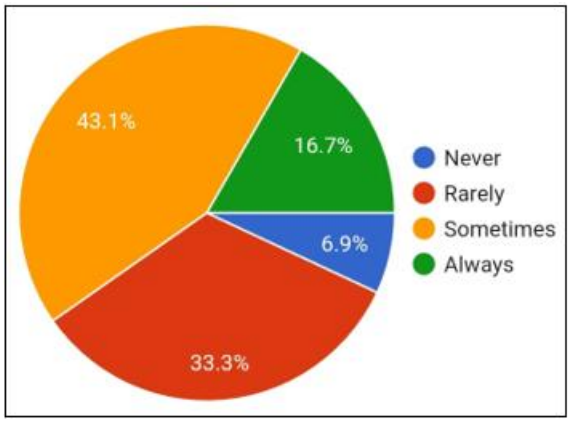


Interpretation: The pie chart illustrates various strategies used at home to promote a positive attitude towards mathematics. The most emphasized approach is Practice (29.4%), followed by Practice problems and Regularity (each 23.5%). Encouraging a growth mindset and fostering Enjoyment in learning math are given less focus, each accounting for only 11.8%.

Inference: This suggests that parents and educators primarily rely on repetition and consistency to build math confidence at home, while motivational and mindset-based strategies are less frequently implemented, indicating a potential area for growth in fostering a deeper love and resilience for math.

5) How often do students engage in reflective math discussions in your classroom?

S. No.	Particulars	Output
1.	Never	5
2.	Rarely	24
3.	Sometimes	31
4.	Always	12



Interpretation: This pie chart represents responses to a frequency-based question with four options: Never 6.9%, Rarely 33.3%, Sometimes 43.1%, Always 16.7%. Most common response: "Sometimes" (43.1%) and Least common response: "Never" (6.9%).

Inference: A majority of respondents (76.4%) fall between "Sometimes" and "Rarely," indicating inconsistent or occasional behavior regarding the action in question. Only 16.7% Always do it, suggesting that very few people are consistent. The low Never percentage (6.9%) shows that the action or behavior is at least somewhat familiar to almost all respondents.

Hypothesis:

H_o: All emotion (Curiosity, Anxiety, Confidence, Confusion) are likely to be felt by students in maths class.

H_1: All emotion are not equally likely to be felt by students in maths class.

S. No.	Particulars	Output
1.	Curiosity	31.5%
2.	Anxiety	32.9%
3.	Confidence	34.2%
4.	Confusion	1.4%

S. No.	O_i	E_i	(O_i-E_i)	$(O_i-E_i)^2$	$(O_i-E_i)^2/E_i$
1.	23	18.25	4.75	22.56	1.23
2.	24	18.25	5.75	33.06	1.81
3.	25	18.25	6.75	45.56	2.49
4.	1	18.25	-17.25	315.06	17.26
Total	73	73			22.79

Calculating the Observe Frequency:

$(X_o)^2 = \sum [O_i-E_i]^2/E_i$

$= (23-18.25)^2/18.25 + (24-18.25)^2/18.25 + (25-18.25)^2/18.25 + (1-18.25)^2/18.25$

$= 1.23 + 1.81 + 2.49 + 17.26$

$= 22.79$

Degree of Freedom 5% level of significance.

df = (r-1) (r = number of column)

= (4-1)

= 3

Value of P form Table at 0.05

$(X_e)^2 = 7.815$

And $(X_0)^2 > (X_e)^2$

Calculated value > Tabulated value

We reject the null hypothesis
Then that not all emotion are equally felt in math class. Some emotions (like confidence) are more common while other (like confusion) are much less common.

7. Findings

1) **Positive Impact of Growth Mindset on Achievement**: Research consistently demonstrates that students with a growth mindset the belief that mathematical ability can be developed through effort and practice achieve higher outcomes than those with a fixed mindset. Dweck (2006) emphasizes that students who believe in malleable intelligence persist longer and perform better in mathematics, even after failure.
2) **Influence of Teacher and Parent Attitudes**: Teacher's and parent's beliefs about math ability play a pivotal role in shaping student's attitudes. Classrooms that emphasize effort based praise, conceptual understanding, and collaborative learning support the development of a growth mindset. Likewise, parental involvement that encourages perseverance and values learning over performance improves students' confidence.
3) **Reduction of Math Anxiety**: Students with a positive math mindset experience lower levels of math anxiety. Studies show that when learners perceive challenges as part of the growth process rather than signs of failure, their emotional response becomes more productive, leading to improved cognitive performance.

8. Limitations

1) **Self-Report and Response Bias**: Many studies rely on questionnaires and surveys to assess mindset and attitudes, which can be influenced by social desirability bias. Students may respond in ways they believe are expected rather than providing authentic reflections.
2) **Lack of Longitudinal Evidence**: While short-term improvements in mindset and engagement are frequently reported, longitudinal studies that track lasting effects on academic achievement and mindset over several years are limited.
3) **Contextual and Cultural Constraints**: Findings from one country or educational setting may not generalize globally. Cultural norms, language of instruction, classroom environment, and national curriculum policies all influence how mindset and math learning are experienced and understood.

9. Conclusion

Emotions play a crucial yet often overlooked role in mathematics learning. Positive emotions like confidence and curiosity typically emerge when students succeed, while negative feelings such as frustration or anxiety are often hidden due to fear of judgment. This imbalance can hinder learning, as students may avoid seeking help. A supportive classroom that acknowledges all emotions can foster resilience, deeper engagement, and improved academic performance. Similarly, using real-life examples in teaching math enhances understanding and retention but is inconsistently applied. When used regularly, such examples make abstract concepts relatable and meaningful. Also, encouraging students to ask questions promotes critical thinking, clarifies doubts, and builds confidence. A classroom culture that values inquiry helps both students and teachers identify learning gaps and create a more effective, inclusive educational environment.

References

[1] Leung, F. K. S. (1994). The frustum model. Paper submitted to the Joint Working Party for Revision of the Mathematics
[2] Leung, F. K. S. (1995c). The mathematics classroom in Beijing, Hong Kong and London. Educational Studies in Mathematics
[3] Ma, X., & Kishor, N. (1997). "Assessing the Relationship Between Attitude Toward Mathematics and Achievement in Mathematics: A Meta-analysis. " Journal for Research in Mathematics Education, 28 (1), 26-47
[4] Hannula, M. S. (2002). "Attitude Toward Mathematics: Emotions, Expectations, and Values. " Educational Studies in Mathematics, 49 (1), 25-46.
[5] Dweck, C. S. (2006). Mindset: The New Psychology of Success. Random House.
[6] Boaler, J. (2016). Mathematical Mindsets: Unleashing Students' Potential Through Creative Math, Inspiring Messages, and Innovative Teaching. Jossey-Bass.
[7] Kilpatrick, J., Swafford, J., & Findell, B. (Eds.). (2001). Adding It Up: Helping Children Learn Mathematics. National Academies Press.
[8] choenfeld, A. H. (1992). "Learning to Think Mathematically: Problem Solving, Metacognition, and Sense Making in Mathematics. " Handbook of Research on Mathematics Teaching and Learning. Macmillan, 334-370.
[9] Abe, T. O., & Gbenro, O. S. (2014). A Comparison of Students' Attitudinal Variables towards Mathematics between Private and Public Senior Secondary Schools. Journal of Educational Policy And Entrepreneurial Research, 1 (1), 32-39.
[10] Adelson, J. L., & McCoach, D. B. (2011). Development and psychometric properties of the math and me survey: Measuring third through sixth graders' attitudes toward mathematics. Measurement and Evaluation in Counselling and Development, 44 (4), 225-247.
[11] Ajzen, I. (1993). Attitude theory and the attitude-behavior relation. New directions in attitude measurement, 41-57.
[12] Ajzen, I., & Fishbein, M. (1977). Attitude-behavior relations: A theoretical analysis and review of empirical research. Psychological bulletin,
[13] Akinsola, M. K., & Olowojaiye, F. B. (2008). Teacher Instructional Methods and Student Attitudes towards Mathematics. International Electronic Journal of Mathematics Education.
[14] Bethell, G. (2016). Mathematics Education in Sub-Saharan Africa: Status, Challenges, and Opportunities. World Bank.
[15] Getahun, D. A., Adamu, G., Andargie, A., & Mebrat, J. D. (2016). Predicting mathematics performance from anxiety, enjoyment, value, and self-efficacy beliefs

towards mathematics among engineering majors. Bahir Dar j educ.

[16] Ignacio, N. G., Nieto, L. J., & Barona, E. G. (2006). The affective domain in mathematics learning. International Electronic Journal of Mathematics Education,

[17] Lipnevich, A. A., MacCann, C., Krumm, S., Burrus, J., & Roberts, R. D. (2011). Mathematics attitudes and mathematics outcomes of US and Belarusian middle school students. Journal of Educational Psychology, 103 (1),

[18] Mensah, J. K., Okyere, M., & Kuranchie, A. (2013). Student attitude towards Mathematics and performance: Does the teacher attitude matter?

[19] Ministry of Education and Vocational Training. (2007). Curriculum for ordinary level secondary education in Tanzania (2013 ed,). Dar es Salaam: Tanzania Institute of Education.

[20] Wong, N. Y. (1998d). Hi-tech, information society and mathematics education (in Chinese).

[21] Wong, N. Y., & Lam, C. C. (1997). Learning assessments of the mathematics Target Oriented Curriculum (in Chinese). In C. C. Lam (Ed.). The Design, Implementation and Assessment of the Target Oriented Curriculum, 135-158. Hong Kong: Cosmos Books Ltd.

[22] Wong, N. Y., & Tso, K. M. (1997). Evaluating on the design of the mathematics Target Oriented Curriculum (in Chinese). In C. C. Lam (Ed.). The Design, Implementation and Assessment of the Target Oriented Curriculum, 21-41. Hong Kong: Cosmos Books Ltd

[23] Zhang, D. (1993). Success and inadequacies of mathematics education in Chinese communities (in Chinese). In C. C. Lam, H. W. Wong, & Y. W. Fung (Ed. s). Proceedings of the International Symposium on Curriculum Changes for Chinese Communities in Southeast Asia: Challenges of the 21st Century, 93-95. Hong Kong: Department of Curriculum and Instruction, The Chinese University of Hong Kong.

[24] Zhang, D. (1998b). Comments to the draft 2001 secondary mathematics syllabus in Hong Kong. Private communication Wong, N. Y. (1996c). The latest development of the impact on the teaching of school mathematics. School Mathematics Newsletter, 14, 1-8. Latest published in N. Y.