Assessing Children's Acquisition of Basic Numeracy Skills Using the Early Grade Mathematics Assessment (EGMA)

Sayasree Bordoloi. [1], Prof. Nikme S.C. Momin[2]

[1]Research scholar, NEHU, Tura Campus

[2]Professor, NEHU, Tura Campus

DOI: https://dx.doi.org/10.47772/IJRISS.2026.100300347

Received: 20 March 2026; Accepted: 25 March 2026; Published: 08 April 2026

ABSTRACT

The present study used the EGMA toolkit to evaluate the numeracy skills of Grade II students enrolled in "Assamese medium" government schools in Kamrup Metropolitan of Assam. A descriptive survey design was used and a sample of 50 students was obtained via purposive and simple random sampling techniques. The modified form of the adapted Early Grade Math Assessment (EGMA), created using the state curriculum and translated into Assamese had been piloted and had acceptable reliability (Cronbach's Alpha = 0.768). The analysis of the data indicated that the students showed good ability in the number identification task, 93.60%, and in the number discrimination task, 92.20%. While Addition Level 1 (87.50%), Subtraction Level 1 (79.10%) and Word Problems (79.33%) were moderate, Missing Number (69.40%), Addition Level 2 (59.60%) and Subtraction Level 2 (55.60%) were difficult. Mental calculation was the most used strategy for all problem types, while paper-pencil method was the second and physical ways were the least preferred. This suggests that at least some children who struggle with complex numeracy tasks may not do so only because they lack certain knowledge or skills, but rather because they struggle to employ particular strategies in order to achieve a particular conceptual understanding.

Keywords: Numeracy skills**,** Early Grade Mathematics Assessment**,** Grade 2 students, Mathematics

INTRODUCTION: ORIGINS AND CONTEXT

The early grade math assessment or EGMA is a one-on-one oral assessment designed to measure students' foundational mathematics and numeracy skills in the early grades. The tool was originally developed by RTI International with support from USAID.

It is widely recognized that the formation of basic mathematical skills at early grades is a crucial predictor of later mathematical achievement. Mathematics proficiency allows individuals to be academically and occupationally successful, but it also helps them function effectively in everyday life. More generally, a country's development in science and technology, which are two of the main drivers of long-term economic growth and innovation, is predicated on having a workforce trained in mathematics and similar fields (Global Partnership for Education, 2014; Hanushek & Wößmann, 2007; U.S. Department of Education, 2008).

But international educational assessments such as TIMSS and PISA show that the majority of low-income countries are poorly performing in terms of levels of numeracy learning (UNESCO Institute for Statistics, 2012). A large proportion of children who do attend primary school in the developing world do not achieve any basic level of numeracy skills. The real issue is that data from large international studies does not give any clarity specifically on the skills and weaknesses of early grade students, and on the reasons why they perform so poorly on Mathematics.

Drawing from the experience of the Early Grade Reading Assessment (EGRA), RTI has developed the EGMA tool as a means of assessing knowledge of basic math skills acquired by students in grades 1-3. The development of the instrument was funded by USAID and completed by RTI International in 2008. As of July 2015- the time

of the last round of data collection in this study- EGMA 2 had been or was in the process of being implemented in 22 developing countries (RTI International, 2014a). The original version of the EGMA was updated in 2011 and is referred to as the Core EGMA.

Purpose:

EGMA is intended to be used as a diagnostic tool at the national level to assess how well a nation's students are performing overall in relation to its declared curriculum and as a program evaluation tool to assess the efficacy of particular curricula, interventions, or teacher training initiatives (RTI International, 2014c).

However, it is not advised to use EGMA for high-stakes testing, cross-country comparison, student report card input, or program evaluation AND country-level diagnostics at the same time (RTI International, 2014c).

Content of the EGMA:

Counting, subitizing, one-to-one correspondence, magnitude comparison, quantity discrimination, identifying number patterns, quantity estimation, and carrying out basic number transformations are examples of early mathematical concepts (Geary, 2011; Jordan, Kaplan, Ramineni, & Locuniak, 2009). Through a variety of formal and informal mathematical experiences, students gain mastery of these ideas. Children acquire informal mathematical skills such as number knowledge, quantity relations, and early arithmetic operations through play and interactions with their surroundings (Purpura & Lonigan, 2012). Students in formal educational settings learn to solve increasingly difficult problems, comprehend the idea of place value, and associate quantities with abstract numerical representations. Students' capacity to use numbers nimbly and flexibly to solve and reason through problems grows as they participate in progressively more complex mathematical experiences.

The EGMA targets predictive mathematical abilities because they comprise number sense, a crucial body of knowledge and skills that serve as the basis for subsequent mathematical abilities and skills. Number sense is developed by a child's capacity to manipulate and comprehend numbers (Gersten & Chard, 1999). Basic counting, magnitude comparisons, and simple operations are among the specific abilities that work together to help students' number sense (National Mathematics Advisory Panel, 2008). The five EGMA subtests are based on these abilities.

Table 1: EGMA Subtests Information *(RTI International, 2013; Table modified from Perry, 2016)*

Subtest	**Number of Items**	**Task**	**Time Limit**	**Stopping Rule**	**Standard Test Scoring Procedure**
Number Identification	20	Read numbers	60 seconds	None	Number correct per minute
Quantity Discrimination	10	Determine the larger of two numbers	No time limit	Stop the subtest if the child has four successive incorrect answers	Total number of items correct
Missing Number	10	Determine the missing number in a sequence of numbers	No time limit	Stop the subtest if the child has four successive incorrect answers	Total number of items correct
Addition – Level 1	20	Add two one-digit numbers	60 seconds	None	Number correct per minute

Subtraction – Level 1	20	Subtract two one-digit numbers	60 seconds	None	Number correct per minute
Addition – Level 2	5	Add a one-digit or two-digit number to a two-digit number	No time limit. This subtest is not administered to students who did not answer any items correctly on Level 1.	Stop the subtest if the child has four successive incorrect answers	Total number of items correct
Subtraction – Level 2	5	Subtract a one-digit or a two-digit number from a two-digit number	No time limit. This subtest is not administered to students who did not answer any items correctly on Level 1.	Stop the subtest if the child has four successive incorrect answers	Total number of items correct
Word Problems	6	Respond to a word problem read out loud	No time limit	Stop the subtest if the child has four successive incorrect answers	Total number of items correct

Source: "Early Grade Mathematics Assessment (EGMA) Toolkit" by RTI International, 2014. {International, 2011 #2; International, 2011 #2@@author-year}

Administration of EGMA:

The EGMA must be contextualized to the setting before administering. This includes translation into language, culture, and national mathematics curriculum. Other items, for example word problems or numerical tasks, need to be checked in terms of cultural relevance, language appropriateness, and age fairness in the population of interest. The revised instruments are usually pilot-tested for appropriateness and difficulty and may be revised further.

At this phase, a sampling framework is also developed. The framework identifies the population of interest, which usually consists of students in grades 1-3; the sample size and selection processes. The use of random or stratified sampling tends to be the norm in order to guarantee representativeness of the sample to the larger student population in regions, types of schools, or social classes.

In many large-scale assessments of mathematics, students are required to read in order to solve problems that are presented in a written format. Different to this, EGMA is administered orally by trained assessors. Because EGMA is designed for the early grades, which is when children are just beginning to learn how to read, the oral administration is considered to be important to avoid confounding a child's ability to do mathematics with a child's ability to read or write (RTI International, 2014c). The approximate administration length of EGMA is 20 minutes. This length of time generally prevents test fatigue, yet is considered to be long enough to allow for a sufficient number of items to measure each subtest (RTI International, 2014c). EGMA is orally and individually administered. For the untimed subtests, test assessors were instructed to ask students to move to the next item if they had not responded in 5 seconds. Items that resulted in no response were left blank and were scored as

incorrect. In EGMA, data can be collected through paper-based instruments or on mobile devices such as tablets, using the RTI-developed Tangerine software (RTI International, n.d). The frequency of assessment varies from one application to another, depending on the purpose of carrying it out.

Scoring and Data Management:

Enumerators verify that all responses are recorded immediately after the administration. Paper-based or electronic data collection tools, such as tablets with forms programmed into them may be used for data collection depending on the mode of administration. When assessments are completed on paper, the data is subsequently entered into a standardized template to reduce data entry errors. Scoring is usually simple; correct/incorrect data are recorded in binary fashion, and in timed subtasks the number of items attempted as well as correct is notated within the time limits. Raw scores are transformed to scaled scores or proficiency bands according to predetermined cut scores.

Ethical Considerations:

Throughout the administration of the EGMA, ethical considerations should be of primary importance. Informed consent should be obtained prior to data collection from school officials, parents/guardians, and where applicable, the students themselves. Students are also informed that participation is voluntary and they can withdraw at any point without consequence. Enumerators undergo training in child protection protocols and are also briefed to create an environment in which children are encouraged to try their best and do not feel they will be told they are wrong or punished for incorrect answers. The EGMA process is multi-faceted but is organized and fairly simple once prepared and trained adequately. EGMA produces reliable information on early grade learners' mathematics foundational skills because its administration and scoring are standardized and associated with sound ethical and quality standards. Such data is much needed to support evidence-based policies, teaching practices, and other initiatives to enhance learning in low- and middle- income countries.

Adaptation of Early Grade Mathematics Assessment (EGMA):

EGMA toolkits adapted was utilized to ensure local language, and curriculum context, without losing validity of the instrument. This study has served the purpose of assessing numeracy skills of Grade II learners of Assam. The Textbook cum workbook on Mathematics for Class II has been created by the State Council of Educational Research and Training (SCERT), Assam following the state curriculum and syllabus for the elementary level of school education. Nipun Axom further develops the learning outcome. The mathematics curriculum for grade II students focuses on reading and writing the numbers up to 100 and teaches addition and subtraction of numbers up to 99, with sums not exceeding 99 in real life situations. So, the core EGMA was adopted in Task 1: Number identification, Task 2: Number discrimination, and Task 3: missing number. As the tool is used for the Assamese Medium Schools so it was translated into Assamese language. After the adaptation of the EGMA Tool the reliability and validity of the tool was established. The Internal consistency reliability of the test was studied by using Cronbach's Alpha methods. The Cronbach's Alpha estimates greater than .70 is acceptable for making educational decisions.

Reliability:

Table 2: Reliability Statistics for EGMA subtests

Cronbach's Alpha	Cronbach's Alpha based on Standardized Items	N number of items
0.768	0.816	8

Validity: Content and construct validity of the Early Grade Mathematics Assessment (EGMA) Tool of the study was completed by obtaining expert opinion and employing the Pearson correlation. Expert feedback was integrated and revisions were made into a final draft. A pilot testing of the expert opinions was conducted. It was considered valid as it was approved by the experts.

Content Validity: The items in the EGMA were reviewed by a panel of three subject experts, two head teachers and 2 DIET lectures. The items were then checked against the Assam state curriculum guidelines for Class II to ensure conformity to expected learning outcomes in number sense, operations, and problem solving. Thus, excellent content validity was established by the fact that feedback received on the items in the EGMA was that they were both appropriate as well as exhaustive**.**

Construct Validity:

Evidence of construct validity was provided by the theoretical consistency of the measure with existing frameworks of early grade numeracy. A Pearson correlation was also performed between EGMA sub scores and total scores, displaying high internal consistency of subdomains (r ranging between 0.68 and 0.81), thus confirming that the tool measures a single construct of numeracy skills. All subdomains correlate moderately to highly positive with total EGMA score, indicating a good level of internal consistency. These correlations show that the EGMA sub-domains are positively correlated with each other and support the high internal reliability of the test instrument.

Table 3: Correlation Coefficients for the EGMA Subsets

	Number Identifi-cation	**Number Discrimi-nation**	**Missing Number**	**Add L1**	**Add L2**	**Sub L1**	**Sub L2**	**Word Problem**
Number Identification	1	___	___	___	___	___	___	___
Number Discrimination	.181	1	___	___	___	___	___	___
Missing Number	.199	.527**	1	___	___	___	___	___
Addition L1	.543**	.225	.346*	1	___	___	___	___
Addition L2	.229	.378**	.374**	.275	1	___	___	___
Subtraction L1	.359*	.000	.206	.547**	.310*	1	___	___
Subtraction L2	.443**	.302*	.339*	.499**	.353*	.352*	1	___
Word Problem	.466**	.277	.410**	.519**	.307*	.491**	.532**	1

** Correlation is significant at the 0.01 level of significance (2 -tailed)

* Correlation is significant at the 0.05 level of significance (2 -tailed)

Note: Correlation were calculated using the examinee's raw scores

METHODOLOGY

Research Method: This study employed a quantitative research design to evaluate the numeracy skills of primary school students via the Early Grade Mathematics Assessment (EGMA) toolkit. It employed a descriptive survey design, which is appropriate for collecting countable data on students' abilities in early math skills.

Population and Sampling: The study was conducted in Kamrup Metro which has a high number of government schools that are in the Assamese medium. In addition to being located in Kamrup Metro, the study site also has a large presence of government Assamese-medium primary schools. The region is an appropriate place to study early numeracy skills in this context.

The study was conducted in all government Assamese-medium primary schools of the Kamrup Metropolitan district of Assam.

Purposive sampling, determined by factors including willingness of school administration, geographical location within the district, and accessibility for research purposes, was used to select five schools from this population. These schools are believed to be representative of other students and other schools.

A total of 50 students participated in the study, out of which 10 students from lower primary grade, class II in each of the selected schools were randomly chosen through simple random sampling.

Tool for Data Collection: Data was collected using the adopted Early Grade Mathematics Assessment **(EGMA)** toolkit, a standardized instrument designed to measure key numeracy competencies in early primary grades.

Procedure for Data Collection: Before data collection, necessary permissions were obtained from school authorities and informed consent was secured from parents/guardians. The assessment was administered individually to each student in a quiet setting within the school premises. The researcher conducted the sessions following the EGMA guidelines to ensure consistency and reliability.

Statistical Analysis: Collected data were analyzed by employing descriptive statistics including mean, percentage, and standard deviation to summarize student performance in each numeracy area.

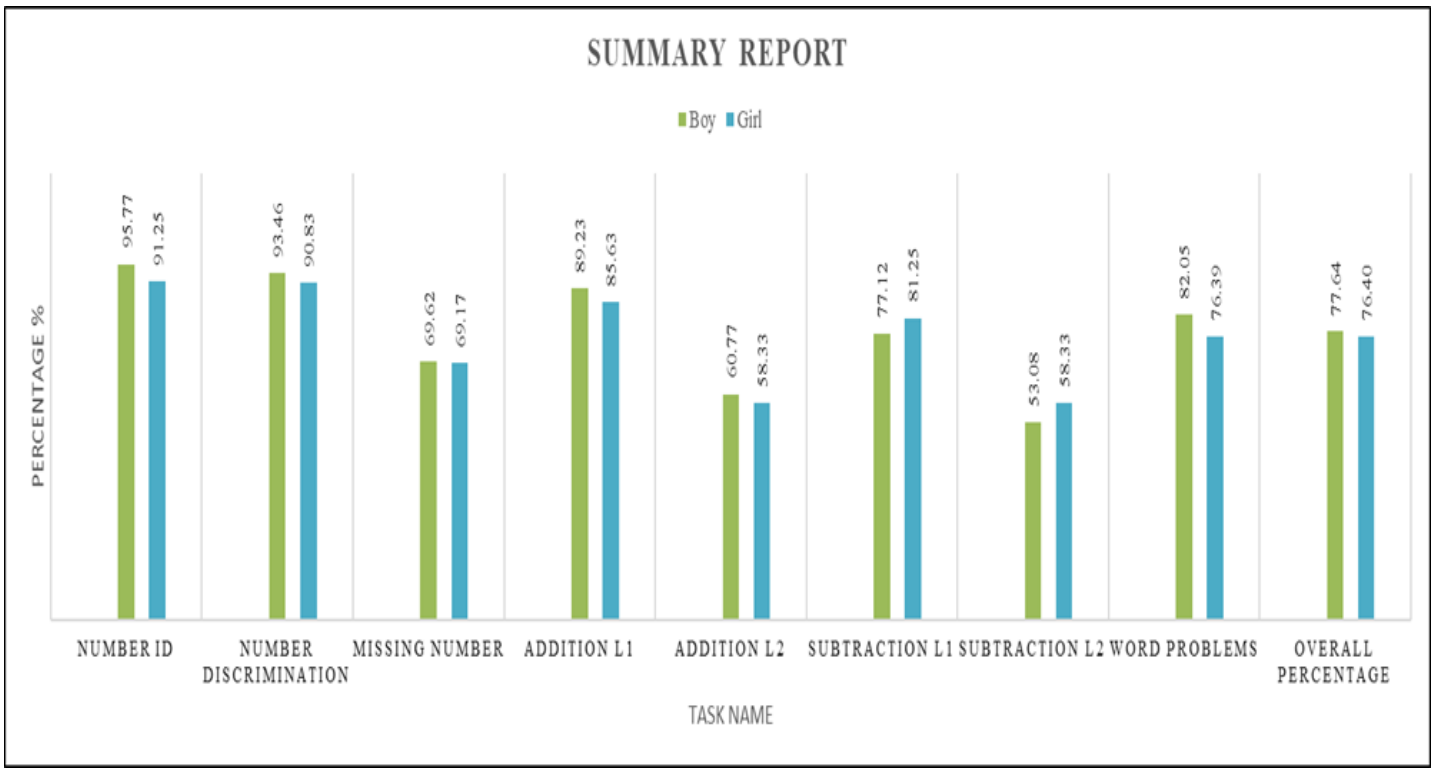
Analysis & Interpretation of Data:

Scoring: Items on the subtests were scored using each subtest's standard scoring procedure (see Table 1). The five untimed subtests were scored as the total number correct, and the three timed subtests were scored as the number correct per minute. Table 4 provides a summary of the subtest scores. As expected, there is greater variance in the scores for the timed subtests, since students could receive scores greater than the total number of items based on how much time remained when they completed the subtest.

Table 4: Summary of EGMA Subset Score

Subtest	**No of Items**	**Standard Scoring Procedure**	***N***	**Mean**	**SD**	**Maximum Score**	**Percentage (%)**
Number Identification	20	NCPM	50	18.72	1.34	30	93.60
Number Discrimination	10	Total correct	50	9.22	1.18	10	92.20
Missing Number	10	Total correct	50	6.94	1.46	10	69.40
Addition Level 1	20	NCPM	50	17.5	2.71	21.82	87.50

Subtraction Level 1	20	NCPM	50	15.8	3.28	20	79.10
Addition Level 2	5	Total correct	50	2.98	1.37	5	59.60
Subtraction Level 2	5	Total correct	50	2.78	1.16	5	55.60
Word Problems	6	Total correct	50	4.76	1.09	6	79.33



Students' scores on various subtests of the Early Grade Mathematics Assessment EGMA were analysed in order to look at basic numeracy skills. Fifty students took part and were all analysed according to the number of correct responses, standard scoring process, and percent average scores.

- **Number Identification**: Students scored an average of 18.72 points (SD= 1.34) out of a possible 30 points, which indicates an average performance level of 93.60 % (boys:95.77% & girls:91.25%). This suggests that students had a good level of number recognition. Boys outscored girls by 4.52 percentage points. Number identification refers to the ability to recognize and name numbers and is one of the more basic skills within early mathematics learning. Boys and girls scored highly, revealing good early numeracy foundations. Boys scored slightly higher, probably because they had been more exposed or were more confident in such number recognition games.

- **Number Discrimination**: The average number of correct answers, from a possible score of 10, was 9.22 (SD=1.18) corresponding to an average performance of 92.20%. From which the score of the boys was 93.46% and the score of the girls was 90.83%, showing that the boys scored higher (+2.63 percentage points) than the girls. This indicates that students were good at differentiating numbers. Number discrimination is defined as the ability to perceive number size, to order numbers, or to compare numbers. Scores from both groups indicated that they had a good level of performance on simple forms of numerical comparison. This small performance difference indicates that there is not a large gender learning gap in this field.

- **Missing Number**: Students obtained an average score of 6.94 (SD= 1.46) out of 10 which represented a 69.40% (Boys: 69.62%& Girls: 69.17%) Missing performance level. This latter subtest seems to be more difficult than identification and/ or discrimination tasks. These also evaluate a student's capability of finding the target number within a sequence, which is related to numeric patterns and place value

understanding. Here, both groups performed significantly lower than they did in identification or in discrimination tasks. The almost identical low score suggests that both boys and girls have problems sequencing and making sense with numbers in these domains.

- **Addition Level 1**: When analysing performance using a Number Correct Per Minute (NCPM) calculation, the average score was 17.5 (SD = 2.71) with a range at the higher end of 21.82 which reflects an average of 87.50% (Boys 89.23% & Girls 85.63%) which indicates good fluency in basic addition facts.

- **Subtraction Level 1**: Using NCPM as well, students' average obtained score was 15.8 (SD 2.8) out of 20, which was equivalent to 79.10% (Boys: 77.12% & Girls: 81.25%). This is indicative of medium subtraction fluency.

- **Addition Level 2**: Once again, this more advanced, addition subtest has an even lower means score of 2.98 (SD = 1.37) out of 5, which is 59.60% (boys: 60.77% & girls: 58.33%) indicating that the subtest was even more difficult than Level 1.

- **Subtraction Level 2**: In the same direction, students had a mean of 2.78 (SD= 1.16) on a scale of 5, corresponding to the 55.60% (boys 53.08% & girls 58.33%), which indicates that this was more difficult for them to manage more complicated subtraction problems. Subtraction is thought to be harder than addition within early mathematics learning. Curiously, girls did significantly better than boys, which might indicate better conceptual understanding from girls or even more skills in the use of strategies for subtraction. This may represent a teaching style that emphasizes careful computation and understanding, an area in which girls may do better.

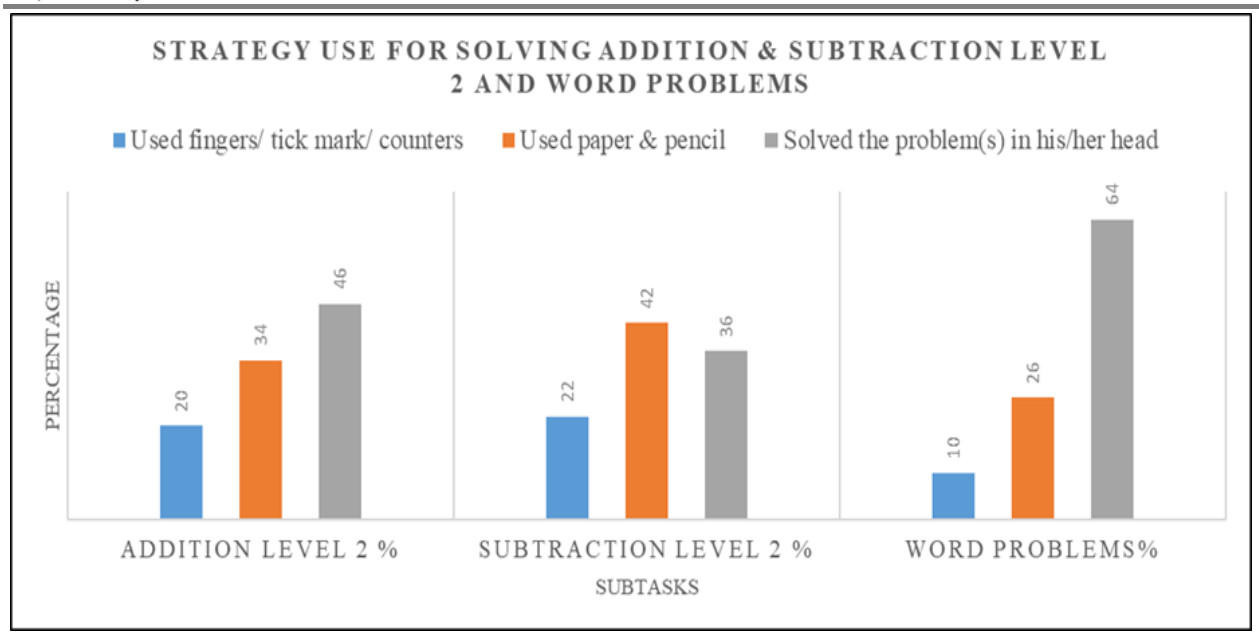
- **Word Problems**: Overall, students' performance was relatively good in this type of applied problem-solving, with an average score of 4.76 (SD=1.09) out of 6, which translates into a 79.33% of success (82.05% boys & 76.39% girls), but was slightly better than in a basic identification task. On top of that, word problems integrate reading comprehension and math reasoning because application of math in situational contexts is needed. On top of that, boys outperformed girls significantly, indicating that girls may struggle more than boys in relating mathematics concepts to language-based problems. This is a relatively big performance gap, a particular area of concern.

As the data show, students achieve above 90% abilities in basic number identification and discrimination. Performance drops as the complexity of the task increases, especially in missing number tasks and Level 2 operations where the scores are under the 60% threshold, indicating a relative area of difficulty.

Regarding contextual problems, word problems performed better than Level 2 but also performed below foundational skills indicating that interventions should focus on improving students' use of arithmetic reasoning applied to contextual problems.

Table 5: Strategy Use for Solving Addition & Subtraction level 2 and word problems

Strategy	**Addition level 2 %**	**Subtraction level 2 %**	**Word problems%**
Used fingers/ tick mark/ counters	20	22	10
Used paper & pencil	34	42	26
Solved the problem(s) in his/her head	46	36	64



The focus was on the strategies employed by students when working on addition and subtraction Level 2 items and on word problems. The highest percentage of students who responded to use of a particular strategy by type of problem solving stated they often solved in their head was 46% for addition, 36% for subtraction, and 64% for word problems.

Paper and pencil use was the second most common answer, with 34% of students using this method for addition, 42% for subtraction, and 26% for word problems. This means that calculation in written form is most depended on for written subtractions than for additions and word problems.

Counting aids like thumbs, hash marks, or tokens, were the least frequent strategy deployed, used by 20% of the students for addition, 22% for subtraction, and 10% for word problems. The low percentage dealing with word problems indicates that these are most often attempted more abstractly.

Such results indicate that there is a particular preference for mental solutions, particularly in the case of verbal word problems, and that there is a need for interventions aimed at promoting more balanced uses of strategies according to the problem at hand's degree of difficulty.

Findings of the study

EGMA was used to evaluate the early numeracy skills of a total of 50 students. These findings support the existence of distinct profiles of student performance on the various subtests.

- Excellent performance was achieved in number identification (93.60%) and number discrimination (92.20%), suggesting good abilities in basic number recognition and comparison.
- Average performance was also obtained in Addition Level 1 (87.50%), Subtraction Level 1 (79.10%) and Word Problems (79.33%) indicating good fluency with basic arithmetic and problem solving in a contextual setting.
- The tasks for which less performance was obtained were the Missing Number, Addition L2 and Subtraction L2 with 69.40 %; 59.60% and 55.60% respectively. These outcomes indicate struggles with higher order operations and more abstract thinking.
- In general, results were indicative of a strategy that was largely mental, and this was especially true for word problems. The advantage of mental computation as a sign of fluency and understanding, but, if the only strategy relying on, especially with complex, multi-steps problems such as word problems, may

lead to a greater risk of error if the student does not possess a solid conceptual grounding and working memory ability.

In general, the data seems to indicate that, regardless being able to perform basic numerical tasks, students would require support to enhance their abilities to solve more complex problems or apply arithmetic reasoning. Physical aids were the least commonly employed strategy for all problems. Physical aids are generally helpful in scaffolding of conceptual development for students who are not yet developed number sense or are weak in abstractions. These tendencies indicate the importance of strengthening flexibility in students' problem-solving approaches, particularly in promoting the use of concrete or written strategies while solving complex addition, subtraction and word problems.

RECOMMENDATIONS

- **Use Multi-strategy Instruction:** Teachers should promote the use of various problem-solving strategies, particularly concrete manipulative aids as well as written calculations, particularly when introducing complicated operations and word problems.

- **Remedial Programs:** Design of focused intervention programs in the specific areas in which students did not do well, especially Missing Number, Addition level 2, and Subtraction Level 2.

- **Teacher Professional Development:** Conduct workshops/training of teachers on diagnostic assessment use and strategic teaching practices that support the development of numeracy and reduce over-reliance on mental computation.

- **Curriculum and Support Materials:** Ensure there is a structured mathematics curriculum that focuses on a sequential development of number sense, problem solving strategies, and uses of mathematics in everyday life.

- **Conduct regular diagnostic assessments:** Use tools such as EGMA to conduct regular low-stakes assessments to track students' progress and adapt teaching accordingly.

CONCLUSIONS

The study found that Govt. school children of GRADE II studying in Assam medium in Kamrup Metropolitan district had good understanding of core numeracy skills of "number identification" and "number discrimination" with above 90% accuracy. Results indicated that average performance was shown on basic addition, subtraction and word problems, while more advanced problems such as missing number problem, level 2 addition and subtraction were found to be very difficult with scores lower than 60%. The use of physical aids was very limited, while mental computation proved to be the most prominent approach, particularly with regards to word problems. But, their implications suggest the importance of improving students' conceptual flexibility and ability to reflect on and shift strategies, through engagement with a concrete tool and written procedures, especially in the case of complex problems. Some small gender differences were also found, as boys tended to perform better than girls in most of the tasks, reinforcing the need to implement gender-sensitive teaching practices. In summary, numerical knowledge at an early stage may benefit from specific interventions and deliberate teaching practices that can enhance students' early numeracy skills and foster future mathematics learning.

REFERENCES

1. Gersten, R., & Chard, D. J. (1999). Number sense: Rethinking arithmetic instruction for students with mathematical disabilities. The Journal of Special Education, 33(1), 18–28. https://doi.org/10.1177/002246699903300102
2. Hanushek, E. A., & Wößmann, L. (2007). The role of education quality for economic growth. World Bank Policy Research Working Paper, (4122). https://doi.org/10.1596/1813-9450-4122

3. Purpura, D. J., & Lonigan, C. J. (2012). Informal numeracy skills: The structure and relations among numbering, counting, and basic arithmetic abilities in preschool children. Journal of Experimental Child Psychology, 113(3), 509–531. https://doi.org/10.1016/j.jecp.2012.06.004
4. Global Partnership for Education. (2014). Learning outcomes in early grades: Conceptual framework and implications for policy and practice. Retrieved from https://www.globalpartnership.org
5. Perry, M. (2016). Early Grade Mathematics Assessment (EGMA) Toolkit (Revised Edition). RTI International
6. Platas, L. M., Ketterlin-Geller, L. R., & Sitabkhan, Y. (2016). Using an assessment of early mathematical knowledge and skills to inform policy and practice: Examples from the early grade mathematics assessment. International Journal of Education in Mathematics, Science and Technology, 4(3), 163–173. https://doi.org/10.18404/ijemst.20881
7. Ketterlin-Geller, L. R., Perry, L., Platas, L. M., & Sitbakhan, Y. (2018). Aligning test scoring procedures with test uses of the early grade mathematics assessment: A balancing act. Global Education Review, 5(3), 143–164.
8. Australian Council for Educational Research. (2020). The early grade mathematics assessment: Assessing children's acquisition of basic numeracy skills in developing countries (Assessment GEM Series No. 16). https://www.acer.org/au/gem
9. Moloi, Q., & Roberts, N. (2021). A validation process towards the modification of the Grade 1 Early Grade Mathematics Assessment. In Z. Jojo & M. Du Plooy (Eds.), Proceedings of the 26th Annual National Congress of the Association for Mathematics Education of South Africa, 14th–16th July 2021, Muckleneuk Campus, University of South Africa: Pretoria (pp. 502–512). University of South Africa. https://isbnsearch.org/isbn/9780620947794
10. U.S. Department of Education. (2008). The importance of early math. Retrieved from https://www.ed.gov
11. National Mathematics Advisory Panel. (2008). Foundations for success: The final report of the National Mathematics Advisory Panel. U.S. Department of Education.
12. RTI International. (2011). Early Grade Mathematics Assessment Toolkit: Technical Report. Research Triangle Institute International
13. UNESCO Institute for Statistics. (2012). Global education digest 2012: Comparing education statistics across the world. UNESCO.
14. RTI International. (2013). Early Grade Mathematics Assessment (EGMA) Toolkit. USAID.
15. RTI International. (2014a). Early Grade Mathematics Assessment (EGMA) Toolkit: User Guide. USAID.
16. RTI International. (2014c). Early Grade Mathematics Assessment (EGMA): Core EGMA Technical Report. USAID.