International Journal of Current Science Research and Review
ISSN: 2581-8341
Volume 07 Issue 07 July 2024
DOI: 10.47191/ijcsrr/V7-i7-100, Impact Factor: 7.943
IJCSRR @ 2024
www.ijcsrr.org

Perspectives of Teaching and Evaluation in Mathematics

Suryakanta Behera[1], Pratyush Pattnayak[2]
[1]Regional Centre Bhubaneswar, IGNOU, Delhi.
[2]Department of Education, Ravenshaw University.

ABSTRACT: Mathematics as a subject is quite unique in its processes and teaching in that it requires the least amount of memorization. Aside from the numbers and the functions of the operators themselves, not much needs to be memorized to do mathematics. This study is a review on all the different approaches of teaching the subject given by some famous educationists such as Bruner, Piaget, Vygotsky and Dewey in the past. Furthermore, various assessment methods for the subject have been discussed.

KEYWORDS: Assessment, Evaluation, Learning, Mathematics, Teaching.

INTRODUCTION

Teaching is an act that is personal to the teacher, as many teaching methods and perspectives would be found as many there are teachers. The role of a teacher is to organize socially relevant and resourceful learning environment for active participation if learners. Mathematics has historically been a subject where it is difficult to command the attention of students for any meaningful period of time. Often demarcated as too difficult and unpleasant, the general way of thinking being “Where are all these concept beyond the basic ones even applicable in real life?” This paper emphasizes on developing pedagogical and assessment paradigms to facilitate math learning for all and ensure that teaching at all levels in integrated with its applicability in real life.

THEORIES OF TEACHING AND LEARNING OF MATHEMATICS

I. EDUCATION ACCORDING TO DEWEY

Dewey's philosophy challenges the traditional notion of abstract knowledge as an end in itself, advocating instead for an education system that fosters critical thinking and active engagement with practical concerns. Education according to him must be one which is practically applicable in the real life and thus any mathematics taught in the classroom must be connected to life outside the classroom. Central to Dewey's educational philosophy is the idea that student interests should not be viewed as static entities but rather as dynamic pathways towards deeper understanding and growth. He argues against the notion of indulging or spoiling students by simply catering to their immediate desires, suggesting instead that educators should guide and scaffold students' interests towards more meaningful and productive ends. This requires teachers to possess a thorough understanding of both the subject matter and the individual needs of each student, a task that demands psychological insight and pedagogical skill. The Deweyan slogan of “Learning by Doing” points to just that - comprehending a concept by actually engaging in it rather than engaging with what others comprehend about it.

Furthermore, education should not be viewed merely as a means of transmitting knowledge but as a process of empowering individuals to think critically and actively participate in shaping their society. This vision underscores the importance of experiential learning and "learning by doing," wherein students engage directly with concrete tasks and real-world problems to develop practical skills and understanding. In the context of mathematics education, this approach entails starting with familiar, everyday examples and gradually progressing towards more abstract concepts, all while maintaining a connection to practical applications relevant to students' lives. Most importantly, Dewey emphasizes the interconnectedness of theoretical and practical aspects of mathematics education, rejecting the notion of a rigid dichotomy between them. He argues that both dimensions are essential for meaningful learning, with theoretical concepts providing a foundation for understanding and practical applications offering opportunities for relevance and application. Thus, educators must strive to integrate these aspects seamlessly in their teaching, ensuring that students see the value and significance of mathematics in both theoretical and practical contexts.

International Journal of Current Science Research and Review
ISSN: 2581-8341
Volume 07 Issue 07 July 2024
DOI: 10.47191/ijcsrr/V7-i7-100, Impact Factor: 7.943
IJCSRR @ 2024
www.ijcsrr.org

II. EDUCATION ACCORDING TO BRUNER

Bruner 's learning theory still has theoretical guiding significance and practical value for today's mathematics teaching. Mathematics teaching should take students' original development characteristics and state as the starting point, give students appropriate tasks, and fully tap the potentials of students, so that every student can reach the maximum development at the original cognitive level. In classroom teaching, the relationship between teachers and students has changed from "authority-obedience" to "value guidance-active participation". Through this process of independent inquiry and joint discovery of knowledge, students acquire a successful experience and realize their sense of self-value. Therefore, teachers should actively create conditions to guide students to change their learning styles. From passive acceptance of knowledge to active discovery and independent inquiry, learning will really become their own independent activities.

Jerome Bruner, a prominent educational psychologist, contributed significantly to our understanding of how people learn, including mathematics. One of his most influential theories relevant to the teaching and learning of mathematics is his theory of "scaffolding" and the idea of "modes of representation". Let's delve into these concepts and explore how they can inform teaching strategies in mathematics:

1) **Theory of Scaffolding -** Bruner proposed the concept of scaffolding, which suggests that learners should be provided with structured support that gradually fades away as they gain mastery of a new concept or skill. In the context of mathematics, scaffolding can involve breaking down complex problems into smaller, more manageable steps, providing prompts, hints, and examples to guide students through the problem-solving process.
2) **Teaching Strategy -** Teachers can employ scaffolding techniques such as providing worked examples, offering hints or prompts when students encounter difficulties, and gradually reducing support as students become more proficient in solving mathematical problems independently.
3) **Modes of Representation -** Bruner emphasized the importance of different modes of representing mathematical concepts, such as concrete, iconic, and symbolic representations. Concrete representations involve using physical objects or manipulatives to illustrate mathematical concepts, iconic representations involve visual or pictorial representations, and symbolic representations involve mathematical symbols and notation.
4) **Teaching Strategy** - Teachers can employ a variety of representations to cater to different learning styles and enhance students' understanding of mathematical concepts. For example, they can use manipulatives like blocks or counters to demonstrate addition and subtraction for younger students, draw diagrams or graphs to represent geometric concepts, and introduce algebraic symbols and equations to represent mathematical relationships.
5) **Spiral Curriculum -** Bruner also advocated for a "spiral curriculum" in which key concepts are revisited and reinforced over time, with increasing complexity and depth at each encounter. This approach allows students to build upon their prior knowledge and develop a deeper understanding of mathematical concepts over time.
6) **Teaching Strategy** - Teachers can design curriculum and lesson plans that incorporate spiral learning, ensuring that key mathematical concepts are revisited and reinforced at regular intervals. This can help students consolidate their understanding and retain information more effectively.
7) **Discovery Learning -** Bruner also supported the idea of discovery learning, where students are encouraged to actively explore and construct their own understanding of mathematical concepts through hands-on experiences and problem-solving activities.
8) **Teaching Strategy** - Teachers can facilitate discovery learning by providing students with opportunities to explore mathematical concepts through inquiry-based tasks, open-ended problem-solving activities, and real-world applications. This approach can foster students' curiosity, critical thinking skills, and deeper understanding of mathematics.
9) By incorporating these principles and strategies inspired by Bruner's theories into their teaching practices, educators can create engaging and effective learning experiences that promote students' mathematical understanding and proficiency.

III. EDUCATION ACCORDING TO PIAGET

Piaget's proposed stages of child cognition are relevant to the development of elementary school mathematics curricula as children only comprehend concepts as their age progresses. It is almost impossible to truly make a child understand a concept that their brain has not matured enough to truly understand. According to Piaget, every person undergoes four distinct phases of intellectual development. According to chapter I, the four periods are as follows:

International Journal of Current Science Research and Review
ISSN: 2581-8341
Volume 07 Issue 07 July 2024
DOI: 10.47191/ijcsrr/V7-i7-100, Impact Factor: 7.943
IJCSRR @ 2024
www.ijcsrr.org

1) **Sensory-motor period** (0–2 years) - This stage is achieved by children up to the age of 2 years. Even though a baby is still very dependent and helpless when he is born, some of his sensory organs can function immediately. A clear example can be seen in the baby's "ability" to cry, the sucking motion when the mouth is touched by something (e.g., the mother's nipple). Babies not only passively receive stimulation of their sensory organs, but can also provide answers to stimuli, which are movements, as a result of direct reactions. It is clear that the direct reaction shown by the baby is not an ability that arises from learning outcomes in relation to the environment. In this period, the child does not yet have awareness of the concept of a fixed object. With the functioning of the sensory organs and the ability to perform motor movements in the form of reflexes, the baby is ready to make contact with the world. In other words, the abilities developed at the sensori-motor stage are the basis for later cognitive development.
2) **Pre-operational period** (2–7 years) - Compared to the previous period, the child's intellect is qualitatively more developed during this stage. This period is also referred to as the symbolization stage because the capacity to utilize symbols distinguishes it from the previous period. This time period was marked by significant advancements. For instance, language has been used to express an object.
3) **Concrete operational period** (7–11 years) - This period is distinguished by the emergence of logical mathematical thinking. The basis of their logical reasoning is the tangible manipulation of objects. In other terms, the operational period is a bridge between the pre-operational period and the operational period. Children in the concrete operational period begin to embrace the perspectives of others, their language is communicative, and they are capable of transformation (composition, conservation of groupings).
4) **Formal operating period** (11-adult) - This period is distinguished by the ability to formulate hypotheses regarding any problems and then work on it in a systematic manner to solve them. This is the final level of intellectual development according to Piaget and many people never truly get to this stage. This stage employs all the faculties of the mind and a person reaching this stage is able to think critically and come up with creative solutions to new problems they encounter in their lives.

IV. EDUCATION ACCORDING TO VYGOTSKY

Vygotsky's theory on learning highlights the importance that the environment and society plays in the process of learning of a child. Vygotsky relays the importance of guidance in the process of learning through the theories of Scaffolding and The Zone Of Proximal Development. Although, the theory of Vygotsky may come off as one which undermines the individual in favour of society, one has to recognize that the theory is meant for the "**Learning of the Individual**" but as the individual is always a part of society, the societal aspect of education cannot be overlooked or undermined either.

In order to completely understand Vygotsky's theory, one needs to understand how Vygotsky used the term 'word'. Vygotsky regarded a word as embodying a generalization and hence a concept. As such, Vygotsky postulated that the child uses a word for communication purposes before that child has a fully developed understanding of that word. As a result of this use in communication, the meaning of that word (i.e., the concept) evolves for the child: Words take over the function of concepts and may serve as means of communication long before they reach the level of concepts characteristic of fully developed thought. The use of a word or sign to refer to an object (real or virtual) prior to 'full' understanding resonates with how a student makes a new mathematical object meaningful to themself. In practice, the student starts communicating with peers, with teachers or the potential other (when writing) using the signs of the new mathematical objects (symbols and words) before they have full comprehension of the mathematical sign. It is this communication with signs that gives initial access to the new object. It is a functional use of the word, or any other sign, as a means of focusing one's attention, selecting distinctive features and analyzing and synthesizing them, that plays a central role in concept formation (Vygotsky, 1986: 106). Secondly but closely linked to the above notion, is Vygotsky's argument that the child does not spontaneously develop concepts independent of their meaning in the social world: He does not choose the meaning of his words… The meaning of the words is given to him in his conversations with adults (Vygotsky, 1986: 122). That is, the meaning of a concept (as expressed by words or a mathematical sign) is 'imposed' upon the child and this meaning is not assimilated in a ready‒made form. Rather it undergoes substantial development for the child as they use the word or sign in her communication with more socialized others. Thus the social world, with its already established definitions (as given in dictionaries or books) of different words, determines the way in which the child's generalizations need to develop. Analogously, It can be argued that in mathematics, a student is expected to construct a concept whose use and meaning is compatible with its use in the mathematics community. To do this, that student needs to use the mathematical signs in communication with more socialized others (including the use of textbooks which embody the knowledge of more learned others). In this way, concept construction becomes socially regulated.

ASSESSMENT FOR ACTIVE MATHEMATICS LEARNING

Assessment in active mathematics learning is integral for gauging student progress, informing instruction, and promoting deeper understanding of mathematical concepts. Various models of assessment are employed to cater to different stages of the learning process. In this section, we'll explore three key models of assessment along with examples illustrating their implementation in active mathematics learning.

TYPES OF ASSESSMENT

ON THE BASIS OF PURPOSE

1. **Formative Assessment** - Formative assessment is conducted during the learning process to provide ongoing feedback to both students and teachers. It helps identify areas of strength and weakness, guide instructional decisions, and foster student learning and improvement. **Example:** Unit tests and Class tests
2. ***Summative Assessment*** - Summative assessment takes place at the end of a learning period to evaluate students' overall achievement or mastery of specific mathematical concepts or skills. It often involves formal assessments such as tests, exams, projects, or presentations. **Example:** Annual examinations and Matriculation exams
3. ***Diagnostic Assessment*** - Diagnostic assessment is administered at the beginning of instruction to assess students' prior knowledge, skills, and misconceptions. It helps teachers understand students' starting points and tailor instruction to meet their needs effectively. **Example :** Mock tests

ON THE BASIS OF TIMING

Assessment for Learning - Assessment for Learning is a continuous process that empowers students to take ownership of their learning journey through ongoing feedback and self-reflection. Its characteristics include:

1. **Continuous Feedback**: Feedback is provided regularly and promptly to guide students' progress and inform their next steps. It focuses on specific strengths and areas for improvement, offering actionable insights for growth.
2. **Student Involvement:** Students actively participate in the assessment process, setting learning goals, monitoring their progress, and reflecting on their learning experiences. They become partners in their own education, taking ownership of their learning journey.
3. **Formative Nature:** Assessment for Learning emphasizes formative assessment practices, where assessment is integrated seamlessly into everyday classroom activities. It serves as a tool for learning, shaping instruction, guiding interventions, and promoting deeper understanding.
4. **Differentiated Instruction:** Assessment for Learning allows for differentiated instruction, catering to the diverse needs and learning styles of students. Educators use assessment data to tailor instruction, providing targeted support and enrichment opportunities as needed.
5. **Metacognitive Development:** Assessment for Learning promotes metacognitive development by encouraging students to reflect on their learning processes, identify effective strategies, and adapt their approaches based on feedback. It fosters self-regulation and critical thinking skills.

ASSESSMENT OF LEARNING - Assessment of Learning provides a summative evaluation of students' achievements and competencies at the conclusion of a learning period. Its characteristics include:

1. **Summative Evaluation:** Assessment of Learning involves summative assessment practices, where assessment serves as a final evaluation of students' learning outcomes. It provides a snapshot of students' achievement at a specific point in time.
2. **Accountability:** Assessment results in Assessment of Learning serve as a basis for accountability, informing decisions related to grading, progression, and academic recognition. Grades, rankings, and progress reports offer tangible evidence of students' academic performance.

International Journal of Current Science Research and Review
ISSN: 2581-8341
Volume 07 Issue 07 July 2024
DOI: 10.47191/ijcsrr/V7-i7-100, Impact Factor: 7.943
IJCSRR @ 2024
www.ijcsrr.org

3. **Feedback for Improvement**: While primarily focused on evaluation, Assessment of Learning also offers feedback for improvement. Insights gleaned from assessment results inform future instruction, curriculum development, and intervention strategies, facilitating continuous improvement.
4. **Standardization**: In some contexts, Assessment of Learning may involve standardized testing, where students' performance is measured against predetermined criteria or benchmarks. These assessments provide a standardized measure of student achievement and inform educational policy.
5. **External Benchmarking**: Assessment of Learning may involve external benchmarking, where students' performance is compared to national or international standards. This allows for meaningful comparisons and helps identify areas for improvement at the system level.

Assessment for Teaching - Assessment for Teaching involves using assessment data to inform instructional decisions, adapt teaching strategies, and address the needs of individual students. It provides educators with insights into students' strengths, weaknesses, and learning preferences, guiding them in designing effective instruction. Its characteristics include:

1. **Data-Informed Instruction**: Educators use assessment data to identify students' misconceptions, learning gaps, and areas of proficiency. This information guides the selection of instructional strategies, resources, and interventions tailored to meet students' needs.
2. **Differentiated Instruction**: Assessment for Teaching allows educators to differentiate instruction based on students' diverse learning profiles. They modify content, process, and product to accommodate varying readiness levels, interests, and learning styles.
3. **Feedback Loop**: Assessment data serves as a feedback loop, enabling educators to monitor the effectiveness of their teaching strategies and make adjustments as needed. Continuous reflection on assessment results informs ongoing instructional improvement.

Interpreting Assessment

Interpreting assessment data involves analyzing, synthesizing, and making meaning of assessment results to inform instructional decisions, evaluate student progress, and guide educational interventions. It requires educators to understand assessment instruments, interpret scores, and draw meaningful conclusions about student learning.

CHARACTERISTICS OF INTERPRETING ASSESSMENT:

1. **Data Analysis Skills**: Educators possess the skills to analyze assessment data, including proficiency in statistical analysis, data visualization techniques, and interpretation of psychometric properties of assessment instruments.
2. **Contextual Understanding**: Interpreting assessment requires considering the broader context of student learning, including factors such as classroom environment, instructional practices, and students' socio-economic backgrounds.
3. **Evidence-Based Decision-Making**: Educators use assessment data as evidence to inform decision-making processes related to instructional planning, curriculum development, and student support services.

DEVELOPING ASSESSMENT PLANS FOR DIVERSE LEARNERS

Developing an assessment plan for diverse learners involves creating inclusive assessment strategies that accommodate the varied needs, abilities, and backgrounds of students. It requires educators to consider factors such as cultural sensitivity, accessibility, and accommodations to ensure equitable assessment practices.

DEVELOPING ASSESSMENT PLAN FOR DIVERSE LEARNERS REQUIRES:

1) **Cultural Relevance**: Assessment tasks are culturally relevant and meaningful to students from diverse cultural and linguistic backgrounds. They reflect students' lived experiences and incorporate diverse perspectives to enhance engagement and motivation.
2) **Accessibility**: Assessment materials are accessible to all learners, including those with disabilities or special needs. Educators provide accommodations, modifications, and alternative assessment formats to ensure equitable access to assessment tasks.
3) **Flexibility**: Assessment plans are flexible and adaptable to meet the individualized needs of diverse learners. They allow for multiple means of expression, response, and engagement to accommodate varying learning styles and preferences.

International Journal of Current Science Research and Review
ISSN: 2581-8341
Volume 07 Issue 07 July 2024
DOI: 10.47191/ijcsrr/V7-i7-100, Impact Factor: 7.943
IJCSRR @ 2024
www.ijcsrr.org

CONCLUSION

Teaching is quite an interesting process in that it is considered as both an art and a science. Among all subjects, Mathematics stands apart as the most feared subject of all and one that is rarely ever truly enjoyed by students. While some of the fault may lie with students just not having an aptitude for the subject, much of it can be considered as a reaction to not being taught properly, the method to approach the subject itself. Compared to all other subjects, mathematics is highly logic driven and its applications in daily life are innumerable. Even before children learn counting, they are exposed to a world where mathematics is used everyday and in almost every instance. Therefore, to teach mathematics in a way that interests students and engages them is imperative to overall development of students. This project is an attempt at exposing the different methods to teach mathematics and the methods to then assess and evaluate student's performance of the subject. Assessment of whatever has been taught is a crucial process in order to see if the whole process of teaching and learning has been a success or a failure. Furthermore, assessment also serves as a method of preparation for the teacher and a measure of retention in the part of the students. The various methods and types of assessments mentioned in this project are an attempt to help educators better cater to the needs of their numerous and diverse learners.

REFERENCES

1. Mendonça, Samuel, et al. "Math education through the perspective of John Dewey's proposals: A possible path?" *Journal of Education and Human Development*, vol. 3, no. 4, 2014, https://doi.org/10.15640/jehd.v3n4a23.
2. Kurt Stemhagen, and Jason W. Smith. "Dewey, democracy, and Mathematics Education: Reconceptualizing the last bastion of curricular certainty." *Education and Culture*, vol. 24, no. 2, 2009, pp. 25–40, https://doi.org/10.1353/eac.0.0023.
3. Wen, Ping. "Application of Bruner's learning theory in Mathematics studies." *Proceedings of the International Conference on Contemporary Education, Social Sciences and Ecological Studies (CESSES 2018)*, 2018, https://doi.org/10.2991/cesses-18.2018.53.
4. "Spiral curriculum." *Encyclopedia of Curriculum Studies*, 2010, https://doi.org/10.4135/9781412958806.n427.
5. Piaget, Jean. "Piaget's theory." *Piaget and His School*, 1976, pp. 11–23, https://doi.org/10.1007/978-3-642-46323-5_2.
6. Gradini, Ega. (2013). TEACHING MATHEMATICS WITH PIAGET'S THEORY. Visipena Journal. 4. 1-7. 10.46244/visipena.v4i1.98.
7. Steele, Diana. (2001). Using Sociocultural Theory to Teach Mathematics: A Vygotskian Perspective. School Science and Mathematics. 101. 404 - 416. 10.1111/j.1949-8594.2001.tb17876.x.
8. Berger, Margot. (2005). VYGOTSKY'S THEORY OF CONCEPT FORMATION AND MATHEMATICS EDUCATION.