Learning context matters in maths performance

PISA collects background information to understand contextual factors that affect the performance of students. Building on the evidence, Jeny Raphael discusses the impact of the learning environment on the character strengths of students, and its connection to their maths performance.
The Programme for International Student Assessment, more commonly known as PISA, takes place every three years. Fifteen year-old students from various nations participate in the assessment, and are tested in three key areas — reading, mathematics, and science. PISA focuses on the application skills of the student population — ‘How well can students apply what they learn in school to real-life situations?’ This is the fundamental yardstick for the assessment.

The beauty of PISA lies in the fact that it is not indifferent to the causes behind the consequences. After the formal PISA exam, the participants are given questionnaires to describe their domestic learning context. PISA collects information about socio-economic status, the psycho-social atmosphere at home, learning climate and culture in school, etc. The data is analysed to develop an understanding of the factors influencing learning.

Mind set matters

The findings from PISA have significance for educators who are interested in motivational aspects of science and maths learning. PISA’s background analysis does not focus on the intellectual capacity of an individual student. Rather, it is interested in the extent of difference exhibited by students in their attitudes and beliefs about intelligence, their ability to persist despite difficulties, capacity for self-regulation in learning, etc.

Studies in educational research have been published in the hundreds to claim that academic backwardness or excellence can be a direct consequence of student beliefs and attitudes rather than any inherited or innate quality. Increasing evidence refutes the age-old belief that intelligence is an inherited fixed entity. The same conclusions resurface in the outcomes of contextual analysis of PISA.

Let us look at the data about maths learning from PISA 2012.

- Forty four per cent of students reported they ‘continue working on a task until everything is perfect’ but sixty three per cent reported that they tend to ‘put off difficult problems’.
- Three out of four students agreed or strongly agreed that learning maths will improve their career prospects.
- Fifty three per cent of students agreed or strongly agreed that they are ‘interested in the things they learn in mathematics’.
- Students who were more ‘open to problem-solving’ and those who believed that they could handle a lot of information were quick to understand the content to be learned.
- Students who sought an explanation for things could easily link facts together and enjoyed solving complex problems. Such students scored 30 points higher
in mathematics than those who were less open to problem-solving.

PISA probes various traits, characteristics, and psychological dispositions of students. According to the data, apart from solid teaching and learning strategies, some character strengths are essential to excel in mathematics. The analysis acknowledges four character strengths that facilitate excellence in maths learning and performance. These are perseverance, openness to problem-solving, locus of control, and motivation. Moreover, these character strengths share a bi-directional relationship with various aspects of the context of learning. Student-teacher interpersonal transactions taking place at the micro level, within the four walls of the classroom, matter a lot in this regard.

Perseverance
Perseverance is indispensable for maths learning. Perseverance is the willingness of students to work on problems even when they encounter complex situations and challenges. Intelligent students who lack this quality may suffer setbacks in their performance.

This willingness to stay in problem-solving mode until one gets the right solution is a quality that can be inculcated. Tutors can demonstrate this by enacting situations in which alternatives are tried and tested repeatedly to solve a problem. They can show how one must learn to discover the joy involved in the process of solving problems. Helping a student to experience the element of adventure and excitement involved in the act of exploration is the crux. Appropriate teaching methods and strategies can help to seed and sustain perseverance in students.

Openness to problem-solving
There is considerable variation among students with regard to their approach to dealing with challenges. Some move towards challenging situations, some shy away, and others wait for someone else to resolve them. But PISA asserts that only those who have the mental disposition to step into an unresolved situation deliberately can fall in love with problems or challenges in mathematics; this is a quality rarely noticed in students. In the 21st century job market, openness to problem-solving is valued in recruitment drives. Unfortunately, many miss the opportunity to develop this quality during their school life.

But who are the students with an ‘openness for problem-solving’? What is needed to develop this quality in a student? In the first place, we must know that it is the self-belief of an individual which makes ‘openness’ possible. Belief in self must be strong enough to ward off the fear of uncertainty.

Students who have developed some belief in their abilities will often spontaneously develop the quality of openness to problem-solving. The absence of pro-active self-belief leads to aversion or even anxiety towards maths. Imprints of self-satisfaction and the pleasure of discovery experienced in past learning contexts encourage students to solve challenging problems.

Past experience of failure and feedback received from significant others shapes students’ attitudes towards challenges. Thus, the classroom environment must be sensitive to this fact. Teachers should be sensitised about the far-reaching consequences of the feedback they give to the students. Feedback received from others after dealing with a challenging situation has the power to strengthen or weaken the openness towards future challenges.

Locus of control
Interest in any activity gradually fades when an individual feels that the consequences of her actions are not within her control. Learning is enhanced when a student feels that the reins of success and failure are in her hands. An unwavering belief in persistence and effort stems from this feeling.

There is a threshold for a ‘sense of control’ for each student. To explore any problem and think of possible solutions one must reach this threshold. Repeated failures in problem-solving slacken this sense of control and the student starts attributing the cause of failure to factors which are not in her control – luck, inherited intelligence, the gene with mathematical ability, nature of questions, the quality of teaching, not so
interesting classroom climate, etc. Autonomy is at stake when students attribute quality performance to factors outside her. Experiencing autonomy is essential for developing a sense of control in maths learning.

An inability to attribute the cause of failure to something real and manageable will influence student beliefs about performance adversely. In other words, it is the attitude towards failures, and not the failure itself, which creates under-performing students.

In a learning atmosphere where failures are treated as an offence, students can feel insecure and develop a fear of failure. Students will develop a sense of control when failures and mistakes are treated as normal steps of the learning process. The tutors’ reaction and feedback to the mistakes matters a lot in this regard.

Feedback given in a mathematics classroom must have two strong messages. One would be to persist and work hard, and the other to instil a strong belief in the power of persistence. The first mistake must be celebrated but when the student makes the same mistake again, feedback should prompt the student to make a conscious effort. As a consequence, the third is less likely to happen. Students will gradually learn how to gain control over their maths skills.

Motivation to learn mathematics

Every action has a reason. The reason for initiating or prolonging an action is closely tied to a tangible or intangible personal need. For effective learning, students have to perceive a reason that is personally rewarding.

Based on the kind of reason for which students engage in maths learning, we can categorise them into two groups. One group likes to learn maths because it’s very interesting and exciting to them. And the other group of students learns maths to avoid failure in the examination, to ward off punishment from teachers, to get an adequate score in the examination so they can procure entry into their dream course or job, etc.

The first group of students is intrinsically motivated. And PISA analysis reveals that intrinsically motivated students perform better. For externally motivated students their reason for learning does not spring from within, hence, the motivation fluctuates. For example, students who do homework to dodge punishment are likely to show slackness if the teacher quits checking.

The intrinsic interest in mathematics is not an inherited quality. There is no maths gene that helps the maths topper to invest his energies in the subject. On the contrary, he has discovered the joy and excitement involved in the process of learning mathematics. Externally motivated students often miss experiencing this for one reason or another. Learning context and teaching strategies might not be conducive for kindling their intrinsic interest in maths. Intrinsic motivation can be triggered and sustained by constantly stimulating curiosity and the ‘seeking’ nature of students in the context of learning mathematics.

What next?
The learning environment and teaching practices have a considerable impact on the character strength of students and eventually on maths learning. Thus, teachers can help students to build their character strengths and mental disposition for better performance in mathematics. Teacher-student interactions have to be regulated consciously, the classroom environment should celebrate openness in thinking and communication, and careful feedback should be provided. While providing feedback, teachers have to be conscious of their words, attitudes, beliefs, and non-verbal responses. In summary, factors that affect students’ interest and intent for learning must be the prime concern.

What steps do you take to improve the learning environment in your class? What kind of feedback mechanisms do you use? Share them with us at commsindia@acer.org giving reference to the article.

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REFERENCES

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