The Place of Games in the Teaching of Mathematics and the Place of Numero Among Available Mathematics Games

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Is playing games a waste of time in a mathematics lesson?

Obviously, it depends on the game. Philosophically, however, is there a place for games in the mathematics curriculum?

Doug Clarke (quoted in "Early Maths Games Pay Off" 2000) and John Gough (2000) have recently argued persuasively for a change in our approach to mathematics teaching. Internationally, they are not alone, especially after mathematics educators have looked at the results of the Second International Maths Study (SIMS) and the Third International Mathematics and Science Study (TIMSS).

The Japanese system produced the best results in SIMS and was also very prominent in TIMSS. However, it also resulted in significantly negative attitudes toward mathematics, among students and teachers alike. The Japanese system allocates much more time to mathematics than does Australia, for instance, in several ways:

- Longer mathematics periods, in elementary schools especially
- Six-day school weeks
- Large amounts of homework
- The majority of students receiving private tuition outside school

Although there is no real evidence from these studies that one teaching method yields better results than another, there seems to be no doubt that, when more time is allocated to the subject, results improve. However, both SIMS and TIMSS reveal a clear negative correlation between performance and attitude: increased time allocation results in higher achievement but also causes students to be less confident and more antagonistic toward the subject.

In England, the National Curriculum that came into being after SIMS and before TIMSS placed a greater emphasis on science, especially at the primary level, with an average of 15 minutes more per week spent on science and 15 minutes less on mathematics. The subsequent TIMSS results showed that students' mathematics performance had deteriorated whereas science performance had improved. But even more interesting was a post-TIMSS survey that showed a rise in attitudes toward mathematics and a corresponding fall in attitudes toward science.

This negative correlation between attainment and attitude suggests that a curriculum placing greater emphasis on mathematics will almost inevitably result in widespread feelings of failure, lower self-confidence and more negative attitudes—with students much more ready to give up mathematics in favor of something less demanding.

It came, then, as no surprise when England's minister for education announced early in 2000 that mathematics was to be a national priority, with all students having at least an hour per day but, significantly, not "more of the same." In an attempt to break the negative correlation between attainment and attitude, he stated that they needed more and better mathematics games.

In Australia, Judy Anderson (1995a) said,

> Positive attitudes to learning mathematics must be fostered. Students will often develop a poor attitude if they see mathematics lessons as boring and if they continually fail assessments. Certainly, students need to become competent in carrying out basic numerical operations, but if these procedures are rehearsed daily, using the same teaching strategies, then it is not surprising that many students will describe mathematics lessons as boring. A variety of teaching strategies should be used, including games.

In a newspaper article titled "Early Maths Games Pay Off" (2000), Doug Clarke was quoted as saying, "Children whose mathematics skills were nurtured

by teachers as part of a structured but creative programme (including simple activities such as playing cards) did between 27 per cent and 79 per cent better than other students, in key [mathematics] areas."

In "Mathematics: It's All a Game," Gough (2000) writes,

> Mathematics games are good, because children learn better if they enjoy what they are doing. Unlike worksheets, games present challenges at every turn, and feel worth doing. Apart from practice in arithmetic when scoring, tactical problem solving, spatial thinking and probability, there are social and attitudinal benefits. Attention spans extend. Students learn "game manners": co-operatively taking turns, abiding by rules, playing fairly, and being gracious when they win or lose. It's all learning, and it's all fun and games.

However, all games are not equal! Some so-called mathematics games are merely a different way of testing children on such things as tables and combinations. Instead of asking, "What is 6 times 4?", a teacher might throw two dice and see who is first to say the product or sum of the numbers that come up. The better students will still win, and the weaker ones will still lose, with fear of failure and ridicule being reinforced.

Other games go to the other extreme: the outcome is decided by chance alone. Although such games may provide educational or social benefits, they are ineffective mathematically.

The element of chance is, however, important: it adds excitement, introduces elementary probability and allows the less able player to be successful, at least occasionally. (Psychologists tell us that occasional rewards are, in fact, a more effective stimulus than rewarding every performance.) It is obvious, too, that no one enjoys playing games in which they seem to have no chance of success.

If a mathematics game is to serve its purpose, it needs to be

- enjoyable to the point that children are enthusiastic about playing it,
- constructed in such a way that the more skillful player (the better mathematics student) wins on the majority of occasions but not always, and
- useful in providing opportunities to teach and reinforce specific elements of mathematics.

This is how Numero has established itself—throughout Australia and, increasingly, around the world. Children and adults of all ages and all numeracy levels love playing Numero. School principals have made comments such as "Our children love rainy days because they can stay inside at lunchtime and play Numero!"

Although the game's element of chance means that weaker players sometimes win, the better mathematics students will do so more often. In Western Australia—where there is a weekly newspaper column, "Numero Challenge," in the *West Australian's ED Magazine* and an annual Interschool Numero Challenge—some schools have developed a reputation for outstanding performances and success.

Teachers continue to be amazed by how Numero enhances their work in the classroom, speeding up students' acquisition of basic numeracy skills and giving them the perfect tool for coping with and extending a wide range of abilities. Indeed, as one principal said, "Numero transforms the attitudes of students, not just towards mathematics, but towards school as a whole." One classroom teacher enthused, "My children do more arithmetic calculations in a 15-minute game of Numero than they do in a week of traditional [mathematics]."

It is no surprise then to read from W. Edwards, Numeracy Consultant for the Royal Boroughs of Windsor and Maidenhead in the United Kingdom, "Children really enjoy playing Numero without realising they are practising mental calculation strategies. To them it is just a great game, while teachers are finding that Numero can play a key role in achieving the mental calculation abilities required by the latest National Numeracy Project."

In Western Australia, A. Newhouse (a Mathematical Association of Western Australia committee member) says,

> I have used Numero with students for six years. When played regularly, it becomes a strategy for teachers to develop the number outcomes from the Curriculum Framework. Concepts such as fractions can be easily introduced without the anxiety which often accompanies this aspect of mathematics. Numero is a strategy game, and so it is ideal for developing lateral thinking skills, achieving confidence and self-motivation for their learning. Students really enjoy playing Numero.

Gough (2000) refers to "the latest math game rage from the US" that had been highlighted in recent TV programs. While acknowledging that children enjoy these games, he goes on to say that "the novelty wears off quickly, and waiting for your turn is very time consuming. The materials are very expensive and not easy for children or parents to find." He continues, "All the advantages of [these games] are contained in an Australian card game, Numero, that practises arithmetical thinking, using a special pack of number cards and an easy rummy-like playing method."

In light of her earlier comments about the need for fostering positive attitudes while improving children's numeracy, Judy Anderson (1995b), reviewing Numero for the journal of the Mathematical Association of New South Wales, writes,

> Numero is an innovative card game, designed to provide students with practice in basic number facts, as well as allowing them the opportunity to develop strategies and problem solving skills. Numero provides students with a motivating way to practise their basic number facts, using mental computation, rather than relying on a calculator. I believe that all junior secondary students, as well as primary students, will benefit from playing this game as it would certainly enhance their ability to calculate mentally, develop problem-solving strategies, and make quick decisions.

Let's return to my opening question: Is playing games a waste of time in a mathematics lesson? No—far from it! In fact, it seems to be the best way to break the relationship between improving numeracy and increasing negative attitudes toward mathematics. As C. Serravite, principal of Amaroo Primary School in Collie, Western Australia, says, "Numero is the highlight of every mathematics lesson. It challenges all students, as it allows them to progress at their own pace, as well as having mathematical fun. Numero has become an integral part of the curriculum."

Numero is useful at all levels of primary school and lower secondary school. It can be easily learned even by five-year-olds. Although the few simple rules (which are set out clearly in the instructional guide and video) never vary, the advanced levels can be extended to be more suitable for secondary and even tertiary students, as well as teachers. Numero also fits into the nonacademic stream for upper secondary students, where something is needed to help improve the numeracy levels of students who are bored of and antagonistic toward the methods that have failed them throughout their earlier years.

Numero allows all students in a class to play at levels commensurate with their ability. Within seconds of the packs being distributed, with a minimum of preparation, students are engaged in the game. The teacher is free to move around the class, helping when necessary and motivating students to extend themselves.

Numero can be used to teach and practise all basic arithmetic operations, fractions, decimals, percentages, powers and indices. Children often find themselves mastering such things as multiplying negative numbers long before they are expected to do so.

As one school principal said to his staff before a Numero professional development workshop, "Be warned! Numero is addictive!"

For more information about Numero, contact Ernest Klassen, a mathematics consultant and a teacher at Woodlawn School in Steinbach, Manitoba, at ernestk@mb.sympatico.ca. A student from Australia brought Numero to Ernest Klassen's classroom, and Klassen has demonstrated the game to teachers in Manitoba and Alberta.

References

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The two sides of a rectangle are a metres and b metres. If each side is increased by 10 percent of its original length, by what percentage does the area increase?