"Why are we assessed in mathematics?": The views of students

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Students from elementary, intermediate and high schools were asked why they considered they were assessed in mathematics. The small sample (n=559) came from the US, the Netherlands, and New Zealand. Some responses were consistent across countries. Most students thought they were assessed in order that teachers might find out what they know/understand. Some cultural differences are suggested by the data. Illustrative comments are included.

The issue of assessment has long been important and on-going in mathematics education. Researchers have investigated the:

- historical trends in mathematics assessment;
- efficacy and efficiency of different forms of assessment;
- political issues surrounding the topic;
- assessment procedures that may be most fair to learners;
- contexts that might be used for assessment purposes;
- impact of various theories of learning on approaches to assessment;
- relationship between what is taught and what is assessed.

Examples of how assessment (and in particular certain forms of testing) may drive the curriculum are well documented (Leder and Forgasz, 1992). The often-quoted research of Schoenfeld (1988) is a powerful description and analysis of how students may have outstanding results as measured by examination papers, but have little conceptual understanding of the geometry (in this case) that was being learned. This study revealed a teacher, while on the one hand exhorting the students to 'think' during mathematics lessons, was on the other encouraging them to rote learn examples because these would appear in the examination paper. Ritchie and Carr (1992) comment on the same phenomenon in the context of 'mastery' testing in primary schools. In this case once students were grouped for instruction following a mathematics pre-test, teachers regularly consulted the approaching end-of-unit mastery test during the teaching of the unit.

The purposes of assessment , therefore, may turn out to be different from that which was originally intended. In this regard, we might say that assessment devices *per se* may be powerful influences on what mathematics is taught, and how the mathematical content is presented to the students.

> ...assessment should be recognised, not as a neutral element in the mathematics curriculum, but as a powerful mechanism for the social construction of mathematical competence...assessment influences student mathematical behaviour and determines mathematical performance, distorting the behaviours it was intended to monitor and to inform constructively (Clarke, 1992, p. 166)

The evidence suggests that the assessment regime that is in place in a school can influence how teachers view mathematics. Of course these views will vary from teacher

to teacher. As well, there may be different teachers who hold different conceptions of the same assessment device (Clarke, 1992; Cohen and Manion, 1994). It seems likely, then, that the students themselves will hold varying conceptions of the assessment procedures that they encounter in the mathematics classroom. Clarke (1992) presents a small window on this when he notes how students are very accurate and consistent when ranking their peers in mathematics achievement. He also describes the effect that assessment can have on students' self-concepts. All of this suggests that students are actively reflecting on the assessment processes in mathematics.

The variety of assessment devices that students encounter in mathematics has probably become more extensive in the last decade. The strong recommendation in many curriculum and related documents (eg. Ministry of Education, 1992; National Council for Teachers of Mathematics, 1995; Australian Education Council, 1990) is for the use of a range of assessment procedures (whether or not these recommendations have been reflected in actual practice remains another question). Ellerton and Clements (1997) comment on the inadequacies of externally-set, pencil-and-paper mathematics tests (ESPPMTs), and note the dislocation between rhetoric and reality. They advocate more authentic methods for assessing mathematics, and present data that shows how even the most carefully constructed ESPPMT can yield "mismatches" of up to 28% - that is, up to this proportion of students may give correct answers while not understanding the concepts being assessed, or give wrong answers even though they possess a full or partial understanding.

Van den Heuvel-Panhuizen and Gravemeijer (1993), on the other hand, argue that students can be assessed fairly with pencil and paper tests if the contexts are realistic to the students and "offer the opportunity to test the children's abilities while avoiding obstructions caused by formal notation" (van den Heuvel-Panhuizen and Gravemeijer, 1993, p. 56). Test items need not remain restricted to flat one-step tasks that can be performed directly, without any preceding analysis. They can also be used to investigate more complex problem-solving activities. (van den Heuvel-Panhuizen and Gravemeijer, 1993, pp. 57)

It was with a background of these types of concerns that the writer approached the current study. In much of the above the central theme has been that of providing students with fair, authentic, realistic and varied forms of assessment in mathematics. As mathematics educators debated and researched assessment issues, students (in most cases) were foremost in their minds..

Turning to students, then, the general question arose of what they might think about the processes of assessment that they are subjected to in mathematics classrooms? To be more precise:

- what do they see as the purpose/s of assessment (in its various forms) in mathematics?
- in their views, why were they being assessed?

These were the questions that provided the focus for the present study.

The Present Study

The Sample

Students in this study came from three different countries. The data was collected in the period 1995 to 1997. The US sample (n=168) was obtained from three high schools in the state of Nevada during the autumn (northern hemisphere) of 1995. All three high schools were in urban areas. The Dutch samples (n=174) were from a high school which served a village and environs about 30 kilometres from the nearest city, and from an elementary school in the city of Utrecht. This data was gathered in the spring (northern hemisphere) of 1996. The New Zealand data was obtained during April 1997. These students (n=217) came from urban schools in the town of Hamilton. Four schools were sampled to get the NZ data - one high school, two intermediate and one elementary

school. The schools from the three countries were quite different in character - no attempt was made to tap into schools (between countries) of similar characteristics, perhaps because this would, in any case, be an impossible task in a study of this type.

Students in the study followed the curriculum documents (mathematics) commonly used in that particular country. The US students were taught by three competent, highly qualified and motivated teachers who averaged eight years classroom experience. The Dutch high school sample was from a school where the 'realistic mathematics' approach was used (see de Lange 1992: van den Heuvel-Panhuizen, 1996) by a teacher who also was employed at the mathematics education research centre in the Netherlands. This experienced teacher was also an author of a Dutch textbook series in mathematics. The elementary school sample (Dutch) came from an inner city area which used a conventional mathematics programme. The New Zealand sample contained students from seven teachers - all experienced, averaging 24 years in the classroom.

The US sample (n=168) comprised 89 females, 79 males; the Dutch group (n=82) 43 females, 39 males; the NZ sample (n=217) 104 females, 113 males. All students in the study were from non-streamed classes.

Procedure

The study was approved by the School of Education's ethics committee, and the writer approached teachers in schools asking if they would be willing to have their students take part. The purpose of the study was explained to the students, and it was emphasised that participation was voluntary.

Each student was given a sheet of paper. On the top was written "As part of what you do in mathematics classes, sometimes you will be assessed. The assessment can take different forms. Why do you think that you are assessed in mathematics? In other words, in your view what is the point of this assessment?" This was read to the class. Students were asked if they had any questions, and once these were discussed they wrote their responses on the paper. The Dutch instructions were "Soms kryg je by wiskunde een toets. Waarom denk je dat je toetsen krygt by wiskunde? Schryf heronder op waarom". Dutch colleagues administered the task for the writer (and translated the subsequent responses).

The students were not given a time limit for the exercise. Most finished within 10 minutes. They were encouraged to work independently.

Results

As might be expected, the students constructed a wide range of responses to the open-ended question. Initially responses were difficult to categorise, but as more and more response sheets were considered, themes began to emerge. The writer consulted with two colleagues during this phase of the study.

The response categories in tables I to 6 are generic phrases that were generated to represent the views of the respondents without using the exact words of the student response.

Table 1:*Why are we Assessed? Elementary School Students NZ (n=51)*

		N	%
1.	To find out what we know/understand	47	92
	"I think we have maths tests because techers will have to know what you know and don't know" (female)		
	"So that she can find out if we are learning" (female)		
2.	So that we can be helped	31	61
	"...if I get the answer rong she will teach me more about		

	the problem I got wrong" (female) "So we can learn to do our mastacks right" (male)		
3.	To find out my level/group "...so they can put you on the correct level of maths" (female) "I think we get tested because it helps both the teacher and us children understand what level we are at, so we children aren't struggling at a hard level or an easy level" (female) "They give us tests in case we need to go into a special maths group or to help us" (male)	17	33
4.	So we can get jobs later "When we're older we can get jobs easier and be able to add things up" (female)	4	8
5.	To make us try "Cause the teacher want to know if you are working hard.. " (male)	2	4

Table 2: *Why are we assessed? Elementary School Students Netherlands (n=92)*

		N	%
1.	To find out what we know/understand "Because they need to know if you can do your maths" (female)	62	67
2.	For the report to parents	18	20
3.	In order to go up a grade (e.g. to high school)	16	17
4.	To see how clever we are	16	17
5.	Feedback to the teacher/student "To see what you can do the best - which one you do best - adding, take-away, multiplication, division" (male)	10	11

Table 3:*Why are we Assessed? Intermediate School Students NZ (N=91)*

		N	%
1.	To find out what we know/understand "So she knows what I'm good at" (male)	59	65
2.	To find out my level/group "I think you are assessed so they can show what level or stage you are up to" (male) "So that you are not put into a group that is a lot more advanced than you" (male)	46	51

3.	So we can be helped "We are also tested in maths so that the teachers can pick up on our slack parts in maths" (female) "I think you are assessed to find out whether you know something or not and if you don't then your teacher can help you" (male)	37*	41
4.	To provide feedback to the teacher "Mainly so they know what to teach you and know that they're not teaching you something you already know" (female)	14	15
5.	To get a (good) job "If you get a good mark and it is an important test eg.School C it can effect your career as an adult" (male)	12	13
6.	To show how you have improved "So we can see how much we improve over so long" (male)	11	12

* $\chi^2 = 10.8$ $p<.01$ (females more often than males)

Table 4: *Why are we Assessed? High School Students NZ (n=75)*

		N	%
1.	To find out what we know/understand "The point of assessment is to see how well people learn mathematics according to age and sex" (male)	68	91
2.	So we can be helped "The point of assessment is to acknowledge what you can/can't do, and establish what you can therefore improve upon" (female) "It is so they know who needs help in what areas. Because there are so many people in the class it is impossible for the teacher to know we are coping with the work. Our teacher doesn't take our books in, and only glances at our work, so apart from the tests, and when people answer questions out loud, they have no idea who understands and who doesn't" (female)	48	64
3.	To find out my group/level "So that the teachers know how good you are and can put you with people with the same ability as you and so you don't get bummed out if everyone gets 10/10 and you get 2 out of 10" (female)	28	37
4.	to compare you "Also so you can be compared to others in the class" (female) "...to find out how we might compare with different people in our age group" (female)	13	17
5.	For jobs in the future "It also helps us with jobs in the future.	6	8

I sometimes don't like maths test but what can we do?
We have to go with the flow" (male)

Table 5: *Why are we Assessed? High School Students Netherlands (n=82)*

		N	%
1.	To find out if we know/understand	59	72
2.	For reporting to parents	44	54
3.	So we can be helped	25	30
4.	To see if we can apply our learning	11	13
5.	To identify talented and untalented students	5	6
6.	To make students learn	4	5
7.	"It's the law - it has to be"	4	5

Table 6: *Why are we Assessed? High School Students US (n=168)*

		N	%
1.	To find out how much we know/understand "It's kind of a way to say, O.K., I've taught this to you, now what do you know. Prove it to me that you know it" (male)	62	37
2.	For the purposes of grading "I think we are assessed for a few reasons. One is for a grade to get through school" (female) "Showing somebody a grade or what there grade is in math is showing them what they know or how much they know. It's a tool (talking about grading) that every teacher in America uses. A teacher will grade a student to show them what they know but in reality that grade doesn't tell how smart a person is, it just shows how much they try. Grades, your grades are based on how much work you do" (anon)	31	18
3.	To help us learn (motivation) "The grades are also motivation. Like if you have a certain grade to play (illegible) you will work harder, so that you can. That's why and how assesment is used in math" (male) "We take tests because the information sticks in your head better" (anon)	25	15
4.	So we can be helped "To find out what the students need help on the most" (male)	19	11
5.	To see if the teacher is teaching properly	9	5

6.	To reward us when we work hard	5	3
7.	It's a requirement (of the School Board)	3	2

Apart from in table 3 no significant differences existed (in terms of frequency) between the responses of males and females within each of the categories.

Discussion

The statements of the students show some consistency across the three countries. This is particularly evident when the most common response is considered. In this study students (at whatever stage of schooling) in each country gave the same most common reason for assessment in mathematics. The response - words to the effect that assessment was put in place so that teachers might find out what the students know and understand - is possibly reassuring for many teachers. This view, coupled with little mention of assessment being for the purposes of comparing and ranking students, perhaps indicates that the students in this study were able to discern an 'educational' reason for assessment in mathematics.

The second most common reason for assessment reinforces this view. In all samples 'So that we can be helped' suggests a 'healthy' orientation that many of the students hold towards assessment. As teachers of mathematics, we would all like our students to feel that we are there to help them when they need support.

An interesting comparison can be made with the responses of the US high school students' (Table 6) and those of other groups and the two other countries. The US predilection with grading is hinted at with this group. It would appear that many of these students are in classrooms where newer approaches to assessment may not be present (National Council of Teachers of Mathematics, 1995). As well, the relatively small number of students (19 out of 168) in this high school group who saw a purpose of assessment as getting help from the teacher is worth commenting upon. This may suggest that the more educational aspects of assessment, including assessment for better learning, are not present to any large extent in the three schools that these students attended.

Another interesting view is that expressed by the Dutch high schoolers. Over half the students thought one reason for assessment was to report to parents. No other group approached this proportion (apart from the younger Dutch children). Without the support of qualitative data it is difficult to interpret this result, but a cultural artefact is suggested

Many educators consider that assessment orientations should shift increasingly towards self-assessment. In constructing their responses the students in this study did not indicate that they were thinking about this view of assessment . The only exception to this was the elementary school sample in the Netherlands where ten out of the 92 students thought that there was an element of 'feedback' to themselves.

Self-assessment involves the learner in assessing the task and in assessing her or his actions in it. In other words learners are making a judgement about their own sense making. In order for it to operate successfully teachers must develop a climate of respect, understanding, honesty and tolerance in their classrooms. Anderson (1993), in giving examples of self-assessment in practice, describes how it can be used as a powerful tool that has the potential to empower learners in the assessment process. Given the dearth of responses to do with self-assessment it would appear that the teachers in the present study will face challenges in guiding their students along the path of self-assessment. The question can be asked if teachers of mathematics, generally, are incorporating self-assessment into their programmes.

Perhaps the main point of this study is that it provides us with further information on *students'* views of what we (as teachers) do. The results may confirm what we thought we knew. The results may provide us with some surprises. In either case they

should help inform our practice, and remind us that learners have their own legitimate views of learning and assessment.

When asked why he was assessed in maths one ten-year-old wrote: "Because if you are big, you can go to work like a policeman and a teacher. Then you can have a family and have some money to buy anything for your children, and if you work very hard you can be the government." Assessment may also be confusing.

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