Feedback Practices and the Classroom Culture

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In a case study of the feedback practices of a senior mathematics teacher there was found to be a close relationship between the classroom culture and the type of feedback that was used in the classroom. Underlying a classroom culture are the values agreed upon by the teacher and students. These values were reflected in the use of feedback. In this classroom the focus on marks, the correct solution and examination strategies demonstrated the value placed on achieving the correct solution during assessment. The emergence of the classroom culture as the major influence on the feedback practices will have a significant influence on the direction of further research. It was found that due to the culture valuing the marks achieved in assessment, the feedback practices focussed specifically on these marks, the correct solution and examination strategies.

According to the *Assessment Standards for School Mathematics* (National Council of Teachers of Mathematics, 1995) one important purpose of assessment is to provide students with feedback about their learning. "The feedback is used in an ongoing effort to promote each student's growth in mathematical power" (p. 25). *A National Statement on Mathematics for Australian Schools* (Australian Education Council (AEC), 1991) agreed there were benefits from feedback for student learning. "Appropriate feedback to students on their work is essential if learning is to be effective" (p. 10). The *Senior Syllabus in Mathematics B* (Board of Senior Secondary School Studies (BSSSS), 1992) stated that the purpose of formative assessment was to provide "teachers, students and parents with information on the performance of students...with a view to assisting students to improve their understanding and achievement" (p. 37).

These key documents recommend the use of feedback to improve student learning. Examining the literature resulted in much theoretical description of feedback practices, though little research has been undertaken to investigate mathematics teachers' actual use of feedback in the classroom. The absence of definitive research about mathematics teachers' feedback practices was the primary motivation for this study.

Feedback, for the purpose of this study, refers to the information gained from formal and informal assessment, provided to students, by teachers, about what the student has learnt, needs to learn, mistaken ideas and directions for improvement. To understand a teacher's feedback it was necessary to investigate the influences on these practices. Hence the research questions investigated in this study were:

1. What are the feedback procedures practised by a senior mathematics teacher?
2. What are the factors influencing the feedback procedures practised by this teacher?

Limited literature about the use of feedback in other school subjects suggested that feedback was used poorly, if at all. In a study of teachers' feedback practices in English composition instruction, MacDonald (1991) concluded that the use of feedback to improve understanding was not realised in practice. He stated that teachers' feedback "often lacks thought or depth; students often misunderstand their teachers' feedback..... and many students do not attend to teachers' feedback to begin with!" (p. 1). MacDonald (1991) justified these statements with his finding that teachers' comments were superficial or confusing

In a quantitative study of the effectiveness of feedback used in physical education classes where volleyball was being taught, Silverman, Tyson, and Krampitz (1992) demonstrated the limited use of feedback in the physical education classroom. This study of seven physical education teachers over seven, thirty-minute lessons for each of ten classes, involved a total of 200 students. The number of instances that feedback was directed at "individuals ranged from 0 to 237 with all but 23 students receiving feedback less than 50 times and 4 students receiving no feedback. Only 6 students received feedback 100 or more times" (p. 339). They concluded that most students received relatively little skill-related feedback, "about 4 times each class" (p. 341).

It is noted that in classrooms there is a definitive focus on grades (Elbow, 1996; Loughlin, 1998). The practice of grading is criticised because of the lack of information that may be portrayed. Elbow (1996) believed that "grades don't have clear meaning [and] they don't give students feedback about what they did well or badly" (p. 1). He suggested the minimal use of grading in addition to providing information about "what they are actually weak, satisfactory, or excellent at" (p. 9). In this approach students are provided with more information and meaning, and grades are made less mysterious. The literature states that feedback may be used to enhance student learning and there is much literature recommending theoretical feedback practices (Kulhavy & Stock, 1989; Seignon & Tobias, 1996; Ovando, 1997). The few studies investigating teachers' actual use of feedback come from subjects other then mathematics and suggest that feedback is generally not used effectively. This study set out to investigate the feedback practices of one senior mathematics teacher and the factors influencing these practices.

Method

This study consisted of interpretive, qualitative research in the form of a descriptive case study of the Head of Department presently teaching year eleven Mathematics B at a government secondary school located in Brisbane. Field-based research was conducted in semester 1 in the year 2000. Due to the limited literature relating to teachers' actual feedback practices in mathematics, research techniques were designed for an initial, exploratory investigation of one teacher's feedback practices. It was necessary to be able to change the focus of data collection to investigate issues as they arose. In this way data collection methods were semi-structured. As understanding deepened and new paths of inquiry emerged, the research methods evolved.

A major strength of the case study method is the opportunity to use multiple data collection techniques and to use the multiple sources of data to strengthen the inquiry. Data sources included file data, classroom artifacts, teacher interview, informal discussions with the teacher and students and classroom observations. The interview was audio-recorded and the observation lessons were audio and video recorded.

File data were collected to obtain a quantitative and qualitative description of the classroom context and the history of the teacher. This included information about training and professional development, teaching experiences and personal information. The term-one assessment consisted of an examination and researched assignment. A copy of each was collected as classroom artifacts. The criteria and marking sheets were included on the front page of each. At an initial meeting the research and methods were discussed with the teacher and the school's Mathematics B work program was collected.

Prior to commencing the interview and observations, the research methods and aims were informally discussed with the teacher. On completion of the data collection and analysis the research findings were reviewed with the teacher in a follow up discussion.

The interview was of an unstructured format using open-ended questions to introduce topics for discussion by the teacher. The interview consisted of three main topics. Firstly the teacher was asked to discuss his teaching of both the first term's units and in general. This led on to the techniques used to formally and informally assess the term-one units and the restrictions he felt controlled his use of assessment techniques. The final part of the interview looked specifically at the study's research focus of feedback and required the teacher to answer and discuss the two research questions as he interpreted them.

Five lessons of 70 minutes were observed to examine the teacher's general teaching practices and more specifically the use of feedback from formal and informal assessment. Three of the lessons involved the observation of the teaching of new work and the use of informal assessment and feedback. The purpose of another lesson was the return of the term-one examination to the students, where the teacher's use of feedback from formal assessment was the focus. The final lesson was chosen to observe students doing an in-class diagnostic test and to examine the teacher's informal feedback during, and as a result of the test.

Analysis in this study occurred concurrently with the data collection so as to direct further data collection. Initially the researchers read and listened to the raw data repeatedly. Using the overall picture drawn from the reflections on the raw data, summary notes, comments, observations and queries were written. Strauss and Corbin (1990) discussed breaking down these reflective notes as labelling "each discreet incident, idea, or event" (p. 63) into concepts. This process of conceptualisation used concept names, which were made up by the researchers to represent the incident, or concept it was related to. The concepts were grouped into categories and then named to reflect the main phenomenon underlying them.

Further reflections resulted in the emergence of general themes and relationships. This larger, consolidated picture within the interpretive descriptive frame was used to answer and discuss the research questions as they related to the case study.

Results and Discussion

The Context

The state high school in Brisbane where Noel (pseudonym chosen by the teacher) teaches, has an enrolment of around 1000 students with approximately equal numbers of males and females. The Mathematics B subject at the school is designed and taught in accordance with the *Senior Syllabus in Mathematics B* (BSSSS, 1992). The syllabus was written for Queensland state and private schools with consideration of the AEC's *A National Statement on Mathematics for Australian Schools* (1991). As Noel stated it "is very much a smorgasbord of topics…as soon as you've covered it, you have to move on to the next topic." He felt there was limited time to develop an in-depth understanding or constructive developments in student knowledge on a topic before having to move on to another. The syllabus' recommendation of an eclectic approach results in students seeing topics as separate and unrelated and in Noel's estimation, students therefore forget everything or "empty their brains" after each unit. The textbook used at this, and the majority of other schools in Queensland, is *QMaths 11B* written by Brodie and Swift (1993). During observations it became clear that lessons were structured around the textbook with examples, class practice and homework using the textbook alone.

The criteria that are used to mark formal assessment are those of the *Senior Syllabus for Mathematics B* (BSSSS, 1992) and the school's mathematics work program. The three criteria specified in the syllabus are "communication", "mathematical techniques" and "mathematical applications." For semester 1 in 2000, the year 11's formal assessment program consisted of a 25% examination, a 15% assignment and a 60% final examination. This is the general pattern used at this school for each semester with a small written test, then an alternative assessment such as an assignment, researched in-class assignment, investigation or project, and finally a larger end-of-semester written test. Informal assessment techniques that were used by the teacher during the observed period of time included questioning, observations, homework and diagnostic tests.

Noel stated that many students were only enrolled in the Mathematics B subject as it is a prerequisite for many university degrees, even when mathematics isn't actually required knowledge for the degree. This resulted in students who don't actually want to be studying Mathematics B and aim only to pass. Noel stated that many of the students were very busy with sports, part-time jobs and other subjects and therefore didn't have time for things that don't count in terms of their marks. Noel stated that many of the students do not have the ability to handle and comprehend most of what they are doing. When asked about the students' abilities at complex reasoning, Noel stated that "a minority of students are able to deal with that."

The Teacher

Noel is an experienced teacher who has taught mathematics and science in private and public schools in Australia and overseas. He has completed a Certificate of Teaching and numerous university courses at both undergraduate and postgraduate levels including Masters degrees in both mathematics and education. At high school he studied four senior mathematics subjects and worked on mathematics problems in his spare time.

In the lessons observed, Noel's teaching of mathematics aligned with an instrumentalist view of mathematics with aspects of a problem solving view, as described by Ernest (1989). The problem solving view of mathematics was most strongly held by Noel as an individual, outside the context in which he taught, as was evident by his mathematical studies and his attempts to encourage students to participate in a mathematics club and problem solving competitions. Noel was very aware of the discrepancies between his personal problem-solving view of mathematics and his observed instrumentalist approach.

The instrumentalist view sees mathematics as a body of facts, rules and skills that, once taught, must be practiced until they can be skillfully reproduced for assessment (Ernest, 1989). As Noel described, his teaching was mainly expository in nature. He described his teaching as involving "showing, worked example, and then I suppose a lot of student practice." He also described mathematics education in general as rote learning when he stated that students "learn how to do something, practice doing it, and then sort of reproduce it." His observed lessons were structured to include the teaching of new material, a worked example and then student practice of the new skill with the goal of enabling students to reproduce the skill in assessment. There was a definite focus on teaching students the mathematical techniques needed to pass the examination. Noel explained he teaches "the essentials in order for students can [sic] perform well enough in an exam on the traditional type questions." Noel's view of mathematics teaching is as the instructor whose desired student learning outcome is skill mastery and correct performance

(Ernest, 1989). The instructor relies heavily on the textbook as was demonstrated by Noel's complete reliance on the textbook during the lessons observed.

The inconsistencies between Noel's beliefs about the nature of mathematics, teaching and learning and his actual instructional practices were explored throughout the interview and informal discussions. In a study of one Brisbane year 8 mathematics teacher (Shield, 1999), the context in which the teacher worked was found to restrict the reflection of the teacher's beliefs in his practices. Noel was very aware of the differences between what he believed about teaching mathematics and the instructional practices he used. Thompson (1992) discussed the reason for the inconsistencies between beliefs and practices as stemming from contextual influences including students, parents, other teachers, administrators, the curriculum, assessment, and the educational system. The main contextual factors, which Noel felt influenced his teaching, included the syllabus, student abilities and attitudes and their motivations for studying Mathematics B.

The Classroom Culture

In describing the classroom studied, it became evident that there was a culture where marks were most valued. Teaching was for the purpose of developing the skills needed for the examination and once the assessment was completed and the marks received, the assessment process was completed. The major contributors to this culture were the teacher's beliefs and practices, the syllabus' requirements, the assessment process and the students' abilities and attitudes.

The classroom culture revolved around the process of developing skill mastery and then reproducing it for assessment. Once a topic was assessed the emphasis moved to mastering a new skill. Noel stated that the students did not develop an understanding of the topics but rather rote learnt the techniques needed to pass. Within this environment of skill mastery there was no extension beyond an emphasis on right and wrong. As was observed, the students were simply interested in whether they got the questions right or wrong and hence their mark achieved.

Noel stated that the "current process of having many, many topics and then this type of assessment I feel is retrograde to teaching mathematics." As a result Noel felt he had limited time to teach each topic to a depth that would enable understanding.

> You can not teach any topic to the depth of treatment that it should be covered. There are too many topics and with the 70-minute periods, as I said, theoretically you see students three times a week but in practice you don't. So apart from the fact that there are too many topics there is little continuity in the time.

The different topics studied each semester were not linked in the syllabus or the textbook. As a result, Noel discussed the fact that the students see each topic as separate and "empty their brain" after each unit. The process of teaching and assessing each term consisted of teaching the topic, students practicing the techniques, revision, assessment, one lesson for returning assessment, and then new work.

The strict adherence to the 11B QMaths textbook (Brodie & Swift, 1993) compounded the view of mathematics as separate, independent topics because of the textbook's structure. Nickson (1994) also concluded that the culture that was encouraged by the reliance on textbooks was dominated by an emphasis on right or wrong answers. This emphasis dismisses the importance of feedback, as students were only interested in whether their answers were right or wrong, as was observed in this case.

The interrelationship between the students and the classroom culture is complex. The existing culture influences students' motivation for and beliefs about mathematics learning

(Wood, 1994). Noel justified his displayed instrumentalist approach as being a response to the students' abilities and attitudes. The students' understanding of mathematics and their behaviour patterns were developed within the classroom culture and the teacher established and maintained this culture because of his perception of the students' abilities and attitudes. There appeared to be an implicit agreement with the values of this culture and without these values being expressed, a pattern of acceptance had been established.

The students' abilities and motivations were discussed by Noel as a major restriction on his teaching practices.

> In an ideal world, where you have a group of students who are mathematically gifted and are interested in mathematics, you could devote more time to the study of specific mathematics and you could do investigations and problem solving. You could do modeling of things but this is for the gifted mathematician, for whom mathematics is more of a hobby and an interest then for a student currently, who is thinking about getting an OP. Who wants to know, do I have to know this, is this going to be on the exam and if not you can give them an open ended question and they've got six subjects, many of them have part time jobs, they're perhaps playing sport and it gets down to doing what they have to do rather than actually taking time out and doing it out of any interest in the subject.

He believed that students don't want to reason or problem-solve and that the majority of students were poor at it. He explained that when he does introduce problem solving "very few of the students are able to handle that and you end up having to do most of it for them," as was observed. Noel also expressed concern that many students weren't studying Mathematics B out of interest in the subject but rather because it was a prerequisite for university courses.

> Maths at high school is wrongly used by many students and therefore we're obliged, as it were, to try to enable students, who shouldn't be doing mathematics, to learn enough techniques, tricks of the trade, to reach a pass or sound achievement in mathematics, with a view to not going on in mathematics but going on and doing something completely different.

The culture was not conducive to the provision of informative feedback or it's use by students, as feedback was not valued in this classroom. In its place was a definite culture of marks, tacitly agreed upon by both the teacher and the students. The value attributed to marks and grades reflected on the teaching and assessment process. The feedback that was used focussed on the marks or grades achieved, the correct solution to assessment and class-work and recommendations for developing assessment skills.

The Feedback

When asked about the students' use of feedback Noel stated that it depended on their ability and motivation but he did not feel that the students looked for feedback from assessment. "Many of them would probably just look at their marks and not be too worried about how they lost marks." A student's use of feedback depended on whether the student wanted the information or not. He elaborated on this, stating that:

> a bright student would perhaps want more information … you could say this is what you could have done … where as if the student doesn't want the information you're not going to be bothered giving it to them, you give it to them but it's going to be rejected.

The feedback from formal assessment was delivered in the form of written feedback on the assessment paper and the verbal feedback provided when the assessment piece was returned. Feedback from informal assessment resulted from homework, seat work, observations, questioning and diagnostic tests.

During the initial interview the teacher described the process of the lessons when formal assessment was returned, as being for the purpose of students checking the marking and trying to get more marks, with the teacher going through the correct solution and the marking scheme.

> Give examination back with the solution and they'd get their marking scheme and you'd show them and then they'd check their marks and find out how they should have done it. But since test papers are required for panels they can't write on these and you collect it. So this post-mortem really only enables them to ensure they have secured as many marks as possible.

Feedback from formal assessment was delivered in the form of written and verbal information. The written feedback consisted of ticks and crosses indicating where the students' solutions were correct and incorrect. The total mark for each question was provided in the techniques criterion in addition to the allocated mark for the communication and applications criteria. Oral feedback consisted of the correct solution and public recognition for those who received high results.

When handing out the examination, students who had achieved high marks where publicly commended with comments such as "I won't call out results but [name] got 32" and "[name], [name], [name] these are some of the people who were successful" and "[name] scored 35 out of 35." Further public recognition was given throughout the lesson when Noel asked "hands up who got full marks" after going through the marking scheme for a question.

The written feedback on the assessment paper was common to both the examination and the assignment. Ticks and crosses were used to indicate what was correct and incorrect. These were placed throughout the solution and related to the marking scheme, not just for the answer. Students were therefore given an indication of where they had made a mistake, although there were no other markings to describe what exactly they had done wrong. The questions were given a numerical mark, generally being the number of ticks. The number of marks for each question were added up and recorded on the criteria sheet for criterion 2, techniques. The questions were examined according to the syllabus recommendations for the criterion 1, communication and criterion 3, applications.

As demonstrated by the feedback during the process of returning formal assessment and written feedback on the assessment papers, the marks and their reflection on their grades was the focus. Noel explained that the feedback from formal assessment:

> does not increase their knowledge. All they want to know is how many marks they got and what level of achievement they're at, but they're not really interested in learning where they went wrong or how they could have corrected and they're not going to use it for future knowledge because they feel that since it's various topics you've covered a topic you move on to another topic and you're not likely to meet this again anyway and if you do meet it again you have to re-teach it.

In general, feedback from formal assessment reinforced the emphasis on right or wrong and the marks or grades achieved. The total marks for each question was given by a numerical score and the level of achievement for the techniques criterion related to the total of the numerical scores. This information, consisting of ticks**,** crosses and a numerical grade, provided very little feedback for students. When the students received their marked assessment, it was this numerical total that they focused on.

During class work Noel would provide students with individual and class feedback. Individual feedback generally came as a result of a student asking the teacher a question such as "I don't know how to do it," or "how do I do question 3." In one case, after an individual discussion, he explained to the class: "some people need to get in the habit of writing things in mathematical language." In another example, a student had just asked

Noel about question 3a. He replied that it was about year 9 standard and to "use a calculator. It's like the circus. Get the formula, write down what p equals, what n equals and what r equals."

The teacher's observations were never formally recorded but served two main feedback purposes. Firstly, they would give Noel an indication of how much work students had actually done and would allow him to indicate to students whether they were working at a satisfactory speed or if they need to work faster. Secondly, they would allow for feedback to both Noel and the students on the quality of their work. As Noel said to the students, "I'll come around now to see how you're going, where you're up to." When observing students during their class-work, Noel brought the attention of the whole class to key ideas that became apparent. For example, "question 1 is a good practice question," "it's easy to make mistakes," "draw all graphs in pencil."

The teacher's and students' questioning provided very little opportunity for feedback as students rarely asked or responded to questions. The importance attributed to right or wrong answers may be a contributing factor to the lack of response to questions. Those who did answer questions correctly were sometimes acknowledged with a comment such as "yes", "correct" or "right". Students may have limited their questioning due to the attention drawn to the students when they asked questions.

Noel had discussed the diagnostic test as a major source of feedback, providing the teacher and students with an idea of their progress or "how they have been operating" during the semester, prior to the examination. In the diagnostic test observed, students were allowed to use any resources they wished except their peers. Noel stated this was to show their understanding, as many students would normally rely on their neighbours for the answers and wouldn't be aware of how little they actually understood. Students were to check their answers using the back of the textbook and later hand in their work to be checked by the teacher. This test was not returned as the students had generally achieved well.

Conclusions

The classroom culture was a significant influence on the use of feedback by the teacher and students. One of the influences on the culture of the classroom was the teacher. Teaching reflected an instrumentalist conception of mathematics where skill mastery, for the purpose of correct reproduction in assessment, was the goal of learning. There was little extension beyond an emphasis of right and wrong. As was observed, the students were mainlyly interested in wh the mark achieved.

The discrepancy between the teacher's personal view of mathematics and his displayed instrumentalist view appeared to stem from contextual influences such as the syllabus' content and assessment requirements and the teacher's perceptions of the students' abilities and attitudes. The culture, where feedback was focussed towards marks, was reinforced by the syllabus' smorgasbord of topics, in which Noel felt he only had time to teach the skills necessary for the students to pass. The perceived time restrictions resulted in their being little time available for reflection on assessment or feedback because of the need to progress to the next topic. The teacher believed that the students did not demonstrate the ability or interest to comprehend complex application questions, resulting in the need to teach the techniques needed to pass assessment rather then developing understanding.

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