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AUTHOR	Tobin, Kenneth
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ABSTRACT

Interactive classroom activities can be dominated by a small group of students called target students. This publication explores what has been learned about target students and the reasons why mathematics and science teachers permit a relatively small number of target students to dominate interactions involving the teacher and other resources. Three assertions derived from several studies conducted in Australia and the United States are presented and discussed. These assertions are: (1) target students are present in most classes, (2) target students tend to be high achievers, and (3) target students tend to be risk-takers. (PR)

The Key Centre for School Science and Mathematics

What Research Says to the Science and Mathematics Teacher Number 7

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TARGET STUDENTS

Kenneth Tobin
Florida State University

TEACHING IS a very isolated profession. It is uncommon for science and mathematics teachers to observe one another teach. Also, because teachers are so busy, they might observe only a fraction of classroom events and therefore might not have a reliable picture of life in their own classrooms.

In the staffroom, it is unusual for teachers to discuss substantive issues associated with teaching and learning. In fact, the culture of schools often is not to 'talk shop' during break times. As a consequence, teachers have sketchy details of what happens in their own classrooms and those of their colleagues.

Until recently, most research has not focused on ascertaining what happens in science and mathematics classrooms. However, this question became the focus of a five-year program of research that is still ongoing (e.g., Tobin & Fraser, 1987; Tobin & Gallagher, 1987; Tobin, Kahle, & Fraser, 1990). This research focused on the manner in which students interacted with the teacher and with each another.

The first answer to our question regarding what happens in science and mathematics classes is that a high percentage of the time is allocated to two types of whole-class activities, namely, lectures and interactive activities. We also found that interactive activities were dominated by a small group of students called *target students* (i.e., students who dominate the interactions with the teacher, usually in whole-class activities). This publication explores what we have learned about target students and the reasons why mathematics and science teachers permit a relatively small number of target students to dominate interactions involving the teacher and other resources. Three assertions derived from several studies conducted in Australia and the United States are presented and discussed below.

Interactive activities were dominated by a small group of students called target students.

METHOD

SEVERAL METHODS were used to identify the target students in a class. First, and most obvious, was careful observation of students' participation in particular

activities. Which students answer most questions? Which students ask most questions? Who raise their hands most often to answer questions? Who does the teacher call on most frequently to answer questions? Who responds to questions without being called on by the teacher? Answers to questions such as these soon revealed a pattern in most classes. The same student names seemed to emerge.

A second method of identifying target students was to ask the teacher and students questions such as those listed above. It made no difference whether the questions were asked orally or in writing. A striking similarity was observed in the list of student names provided by the teacher and students and the list of students observed by the researcher to be most involved in interactions. Initially target students were identified in whole-class discussions. However, as our studies progressed, we also observed target students in small-group discussions (i.e., students who dominate discussions) and laboratory activities (i.e., students who dominate the use of apparatus).

ASSERTION 1: TARGET STUDENTS ARE PRESENT IN MOST CLASSES.

MOST CLASSES involved in our studies contained target students. For example, in four of the five science classes taught by Mr Hoskin (Tobin, Espinet, Byrd & Adams, 1988), three to five target students dominated whole-class interactions. There was a smaller number of target students in the general science class. Target students asked most of the questions and overtly responded to teaching cues more often than others in the class. Responses largely involved calling out, and hands were seldom raised. In a chemistry class taught by Mr Hoskin, 36 questions were asked in a 15-minute segment of one lesson. Nineteen questions were asked by one girl and four boys asked 19 questions. The remaining students in the class were involved in a covert manner only. Because the class consisted of 12 males and 8 females, more female target students might have been anticipated.

Although most target students were male, there were obvious exceptions. For example, Kathryn, one of the most able students in her class, dominated whole-class interactions along with four males. Furthermore, Tobin (1988) observed science classes in an all-girls school. Classes were characterized by several students who were much more dominant in classroom interactions than others (i.e., female target students).

Many teachers were unaware of the presence of target students or inequitable involvement of males and females. When informed, most teachers wanted to make some adjustments to their teaching. However, not all teachers wanted to change their practices. Perhaps the best example of a teacher who was steadfast in his beliefs about teaching was Mr Hoskin, who had won a teacher-of-the-year award in a State in the US (Tobin, Espinet, Byrd & Adams, 1988). The following excerpt from an interview suggests that Mr Hoskin had made up his mind about target students and the involvement of females in science:

Many teachers were unaware of the presence of target students.

> *Whenever any group interaction is held, only a few people dominate the answering of questions. This is nothing new. There is nothing wrong with this. I feel that your assumption that more female target students might be expected in advanced sciences is wrong. Very few females actively participate in any higher-level mathematics or science courses. This is fact, not assumption.*

Tobin, Espinet, Byrd and Adams (1988) observed target student behaviour in laboratory activities. Because of equipment limitations, it was not possible for all students to participate by doing. Consequently, the stage was set for one or two students to monopolize the use of the equipment. For the majority of the time, most students watched someone else doing the experiment. Students seemed happy with this arrangement because the desired outcome of the laboratory appeared to be the completion of the worksheets rather than learning to manipulate experimental apparatus or constructing knowledge of science.

For the majority of the time, most students watched someone else doing the experiment.

It is possible that target students in Year 12 classes could have been target students for most of their high school lives. Tobin (1988) reported that 21 target students were identified in Year 8 science classes during the first six weeks of a study. Twelve months later, these students were in Year 9, which was streamed according to science ability. Because the 21 target students tended to be the highest-achieving students, most of them were streamed into two Year 9 classes. Only 10 of the original 21 target students continued as target students in Year 9. Therefore, ability grouping in Year 9 had allowed another set of target students to emerge in the lower-ability classes. With two exceptions, the students identified as target students in these classes were not in the list of 21 students from the previous year.

In contrast, the target students from Years 9, 10 and 11 tended to be target students in the subsequent year level as well. There were some variations which might be attributed to promotion of a target student to a higher-level class, personality clashes with a specific teacher, loss of interest in science or personal difficulties for specific students. However, approximately 90% of the target students identified in Years 10 - 12 were identified as target students again 12 months earlier.

Students who were target students in Year 8 and were not target students in Year 9 found science more difficult in Year 9 and more competitive. Most of these students regarded the target students in their class as bright, but disliked them for the public manner in which they flaunted their knowledge. Most target students reported that students made fun of them in and out of class. Alienation from other students could have been the root cause for these students to group together for activities such as discussion and laboratory investigations.

Tobin and Malone (1989) provide evidence that target students compete with one another during whole-class interactions. This was most evident in the types of answers provided by the more-able students. Responses to questions tended to go beyond what was required by the teacher, and terms were used that others in the class would not necessarily understand. There is a possibility that teachers encourage this kind of verbal response from target students and the observations suggest that instruction was pitched at the ability level of these students.

Target students tend to compete with one another for a variety of reasons. When they ask and answer questions, they could be trying to impress the teacher with their knowledge, impress other target students in the class, or find out whether their knowledge is complete. Undoubtedly, some of these motives apply to some target students and other motives would certainly apply as well. The members of the target

student clique compete with one another, often are disliked by others in the class and serve multiple roles within the class.

From the teacher's frame of reference, target students assist in getting the work done and provide feedback that the instruction is successful. Within the target student clique, the involvement of target students helps learning because they ask the right questions and, generally speaking, provide responses to questions that clarify and elaborate understandings. From the perspective of others in the class, target student involvement might not be a help at all. The questions that they ask and the responses that they provide could be too complex for most students in the class.

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In a study of mathematics teaching, one teacher did not have target students in his classes (Tobin & Malone, 1989). The teacher, Andrew, endeavoured to speak with as many students as possible during each lesson, he called on a relatively large number of students during whole-class activities and, during seatwork activities, he responded to student requests for assistance. Andrew used questions to probe student understanding of mathematics and he took the time to assist students to understand what they were doing. Because of a rule that students could not call out, the whole-class interactive activities were orderly, and the majority of students in the class raised their hands to participate. There was some incentive for students to think about teacher questions, as Andrew sometimes called on students with their hands raised and on other occasions called on students without their hands raised.

Andrew demonstrated that whole-class interactive activities could be used as a means of introducing and revising mathematics content and ascertaining the extent to which students understood the lesson content. Andrew asked questions because he wanted to know the answers and he adjusted instruction on the basis of the answers which he received. He selected a wide range of students to respond to questions because of a concern with the learning of all students in his class.

ASSERTION 2: TARGET STUDENTS TEND TO BE HIGH ACHIEVERS.

THERE APPEAR to be two types of target students. The first type consists of students selected by the teacher to respond to questions. These students are selected because, in the opinion of teachers, they can contribute a response to facilitate learning and content coverage. In the interviews, one teacher described these students as high achievers. Confirmation of this trend was obtained in analyses involving the science achievement and formal reasoning ability of target students. Tobin and Gallagher (1987) reported that target students attained higher science achievement scores and had higher levels of formal reasoning ability than did other students in the same class.

There was a tendency for target students to respond to high-level cognitive questions posed by the teacher. When suitable answers were received from these students, the teachers tended to paraphrase and elaborate on them. In this way, knowledge was developed from the responses of students and participants received feedback about the adequacy of their responses. However, non-target students did not receive the same amount of feedback and their concepts were not evaluated, clarified or elaborated by the teacher to an appreciable extent. Consequently, the

learning environment for target students was more conducive to learning with understanding than the learning environment which applied to non-target students.

ASSERTION 3: TARGET STUDENTS TEND TO BE RISK TAKERS.

A SECOND TYPE of target student initiated whole-class interactions by raising the hand or by calling out to respond to teacher questions, asking questions and evaluating the responses of others. Of course, the two types of target student are not mutually exclusive. A significant proportion of target students who volunteered to participate in science and mathematics activities also were called to respond as a result of teacher initiatives.

Most teachers directed a high proportion of questions to the whole class rather than to individuals. This style of questioning favoured risk takers who called out or raised their hands to volunteer an answer. Questions tended to be asked at a rapid pace and students were encouraged to raise their hands in response to teacher questions. Teachers stated that students who raised their hands were likely to be selected more often than those who did not. Although teachers endeavoured to maintain a high risk level by occasionally calling on students with their hands down, the observations indicated that the students who were most involved were those called on after raising their hands, those who called out a response to a question, and those who signalled an intention to contribute by non-verbal means.

Student interviews (Tobin & Malone, 1989) suggest that, whereas target students did not appear to be afraid to answer questions, many non-target students did not like to be wrong because of what the teacher and other students in the class might think. It was apparent that some target students had a strong orientation to accept responsibility for their own learning. As a consequence, they asked a question of the teacher if they needed to know something that had not been explained to them. These students also responded to questions if they thought that they knew the answer. In contrast, other students stated that they would only respond to questions when they were certain that they knew the answer.

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Some target students used the public forum of the classroom to gain recognition rather than to learn (Tobin, 1988). For example, Spencer was a show-off and liked to ask 'off the wall' questions in order to frustrate the teacher and to inject humour into the class. At least that is how the teacher and most others in the class viewed Spencer's behaviour. This was not the way that Spencer viewed his own behaviour. Spencer said that he liked to achieve and be recognized by the teacher and other students. He liked everyone to know when he had the right answer, he would always attempt to answer questions and did not worry whether he was right or wrong. Sometimes, he raised his hand and, on other occasions, he called out. He stated that he asked a lot of questions because he wanted to find out why things happened in the way in which they did. He valued discussion as a learning mode and did not enjoy listening to teacher explanations.

The observations reveal that there are one or two "Spencers" in most classes. These students disrupt the class with their comments and noises which are intended to be heard by others in the

class. In some cases, the remarks are related to instruction. However, the tone of the response attracts attention to the respondent. The involvement of these students make classroom management very difficult for teachers. In many cases, the students involved in classroom "banter" appear to lack motivation to learn and appear alienated from the system.

A relatively small number of students seem to seek a public forum in an endeavour to gain recognition. On occasions, these students inject humour into the lessons and, on other occasions, they are a source of disruption. These 'risk takers' had a significant influence on many of the observed lessons. Students in the class seemed to approve of the disruption and this provided encouragement to repeat the performance.

CONCLUSIONS

ONGOING STUDIES of high school mathematics and science classes indicate that the existence of target students is widespread (e.g., Tobin, 1988). Not only are target students apparent in whole-class interactions, but they also can dominate small-group activities, interactions with the teacher during seatwork activities, and laboratory activities. However, because of the dynamic and complex nature of teaching, it is possible that the presence of target students might not be recognized by most teachers, and potential problems associated with disproportionate target student involvement might never be considered. Yet, the results of five years of research suggest that target students might exist in classes for a variety of reasons and fulfill different niches in the classroom ecosystem. Consequently, prescriptions to teachers about the need to minimize target student involvement might not be appropriate or well received. Ultimately, teachers need to decide what is and is not desirable in their own classrooms. If teachers do decide that target student involvement should be curtailed, it is likely they will need assistance to change in the manner intended. Recent studies have highlighted the value in having colleagues in the same school provide feedback about teaching, analyse what happens in lessons, and consider alternative teaching and learning strategies.

One solution to the problem of teachers being unable to identify target students is to involve teachers in conducting research in their own classrooms. That is, teachers could be involved in: formulating problems, questions and plans; data collecting, analysis and interpretation; and dissemination of the findings. The thought and reflection associated with conducting research is likely to catalyze changes in beliefs, knowledge and classroom practices.

One solution to the problem of teachers being unable to identify target students is to involve teachers in conducting research in their own classrooms.

Teacher-researchers can investigate the existence of target students, the characteristics of various types of target students, and alternative ways of engaging learners in science and mathematics classes so that target student involvement is no longer a potential learning problem. The cognition which accompanies discussions and arguments over interpretations of data are likely to drive understandings about teaching and learning to new levels. Asking questions and seeking answers can provide a context for teachers to reflect on teaching and learning practices, to

analyze and discuss alternative teaching strategies, and to identify desirable changes and procedures for implementing change.

There is little doubt that target students enjoy a more favourable learning environment than their non-target peers in the same classroom. The purposes of interacting in the classroom are numerous and relate to communication and learning. For example, the teacher asks questions to ascertain whether students understand what s/he is endeavouring to communicate or to focus student thinking on some aspect of the lesson. As students respond to a teacher's question, they have an opportunity to assign language to what they have learned. Thus, students describe and elaborate their knowledge, clarify, evaluate and often restructure what they know as they respond to a question. Alternatively, a person might ask a question to seek information or to solve a puzzle in his/her mind, or make an evaluative statement about something a teacher or student has said. Thus, students who engage in verbal interactions are involved in an overt manner that has the potential to improve their learning.

In contrast, those who do not engage in verbal interactions might be engaged in an active manner or, alternatively, they might not be thinking about a question or its answer. Over a period of time, students who do not engage in verbal interactions have a different type of learning environment than those who do. As a consequence, target student behaviour can promote inequitable learning experiences. Teachers should give consideration to adopting practices associated with equitable involvement patterns of students, irrespective of gender, race and socioeconomic status.

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Professor Kenneth Tobin is Coordinator of Science Education and Head of the Department of Curriculum and Instruction at Florida State University, Tallahassee, Florida 32306, USA. Previously he was Senior Lecturer in science education at Curtin University.

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Environments for Learning Science and Mathematics (By Barry Fraser & Kenneth Tobin) Cost: $10

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Key Centre for School Science and Mathematics
Curtin University of Technology
GPO Box U1987
Perth, Western Australia 6001
(Telephone: 09 351 7896 Fax: 09 351 2503)

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