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ABSTRACT

Researchers in goal orientation studies have successfully demonstrated the distinct effects of two separate single learning goals, mastery and performance goal. To advance the understanding of learning goals, a new research direction should be geared towards exploring the notion of multiple goals. Recent work in the field has also called for the study of multiple goals. However, it is not clear how multiple goals should be conceptualized. Should multiple goals be understood as students having three to four separate learning goals? Alternatively, should these goals be conceptualized as related or connected in some manner? This paper advances the latter position and theorizes goals as connected in a systematic network. Qualitative data gathered from in- depth interviews were employed to corroborate this network perspective of multiple goals. In general, high achieving students tended to have a more complicated goal network than low achieving students, which provided them with a strong motivation to master the knowledge and to perform well. (Contains 30 references.) (Author)

Adolescent Students' Multiple Goals in Learning Mathematics

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Abstract

Researchers in goal orientation studies have successfully demonstrated the distinct effects of two separate single learning goals, mastery and performance goal. To advance the understanding of learning goals, a new research direction should be geared towards exploring the notion of multiple goals. Recent work in the field has also called for the study of multiple goals. However, it is not clear how multiple goals should be conceptualized. Should multiple goals be understood as students having three to four separate learning goals? Alternatively, should these goals be conceptualized as related or connected in some manner? This paper advances the latter position and theorizes goals as connected in a systematic network. Qualitative data gathered from in-depth interviews were employed to corroborate this network perspective of multiple goals. In general, high achieving students tended to have a more complicated goal network than low achieving students, which provided them with a strong motivation to master the knowledge and to perform well.

Introduction

Adolescence is a stage of development characterized by incessant challenges, confusions and adaptations. One of the most challenging tasks for adolescent students during this stage is to make sense of their learning in school and to map out its relationships with other salient aspects of their life. The study of students' achievement goals has contributed substantively to our current knowledge of how students develop a sense of purpose in learning. This paper builds on the past research efforts and proposes a theoretical model that conceptualizes students' multiple goals as a connected network called "goal web". The goal web model provides a theoretical framing that goes beyond the dichotomized conceptualization of achievement goals and will enable researchers and teachers to understand students' purposes for learning from a holistic perspective. Goal

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webs of a group of adolescent students derived through a series of in-depth interviews testified to the validity of the proposed model.

Achievement Goal Theory: Past Findings

The research of the achievement goal theory has engrossed in the study of two single goals. Different labels, with similar connotation, have been used to describe these two achievement goals, for example, mastery and performance goals (Ames & Archer, 1988), learning and performance goals (Elliott & Dweck, 1988), Task-oriented and ego-oriented goals (Nicholls, 1984), task-involved and ego-involved goals (Jagacinski, 1993; Nolen, 1988), intrinsic and extrinsic orientations (Pintrich, 1989). For the sake of consistency, the term mastery and performance goals will be used throughout this paper.

Students holding mastery goals consider learning as an end in it itself. Their overarching intention is on mastering knowledge and skills. Collaboration with others is usually valued. Their sense of accomplishment is derived from the inherent qualities of learning tasks and the learning process leading towards mastery. Mastery-oriented students usually attribute effort over ability for their success, prefer challenging tasks, persist longer when facing difficulties or failures and show less anxiety over learning and examinations. Academic performance of this kind of students is expected to be relatively high.

In a stark contrast, students holding performance goals consider learning as a means to an end. They focus on maintaining positive evaluation of their abilities or avoiding negative judgments. Competition is always welcomed for it is considered as an opportunity to demonstrate their abilities. The sense of accomplishment is therefore derived usually from outperforming others or achieving high academic performance. This kind of students usually attributes success to ability, chooses easy work, demonstrates a relatively low level of persistence but a high level of anxiety. Consequently, their school performance will be constrained and is usually not comparable to that of mastery-oriented students.

This general characterization of mastery-oriented and performance-oriented students is substantiated by the past findings in the research of achievement goals. Mastery and performance goals were associated with various facets of cognitive engagement, including the use of cognitive strategies (eg. Meece, Blumenfeld & Hoyle, 1988; Nolen, 1988; Pintrich, 1989; Pintrich & DeGroot, 1990; Pintrich & Garcia, 1991), the use of self-regulatory strategies (eg. Pintrich, 1989; Meece, 1991; Pintrich & DeGroot, 1991; Pintrich & Garcia, 1991), the manipulation of learning resources (eg. Pintrich, 1989; Pintrich & DeGroot, 1991; Pintrich & Garcia, 1991), different levels of information processing (eg. Ames & Archer, 1988; Meece & et al., 1988; Nolen, 1988; Golan & Graham, 1990), various types of cognitive engagement (eg. Meece & et al., 1988) and different levels of performance (eg. Meece & Hole, 1993; Wentzel, 1989, 1991, 1992, 1993). Mastery-oriented students are usually associated with a more adaptive pattern of

learning, which is characterized by frequent use of elaboration and organization strategies, effective adoption of self-regulatory strategies, effort attribution for failures, higher level of persistence, deeper learning levels, and subsequently a better performance. Performance-oriented students, in contrast, reveal a maladaptive pattern of learning, which can be differentiated by a low level of learning engagement, frequent use of shallow processing strategies, less frequent use of self-regulatory strategies, ability attribution for failure and a low level of persistence after failures. Consequently, they have relatively lower level of performance (Golan & Graham, 1990; Nolen, 1988; Pintrich 1989; Pintrich & DeGroot, 1990; Pintrich & Garcia, 1991). Still worse, when performance goals are associated with a low perceived ability, students concerned will be more likely to produce a learning pattern normally found among learning helpless students (Elliott & Dweck, 1988).

Other goals

It is apparent that this dichotomous conception of learning goals is inadequate to capture all the essence of students' achievement-related perceived purposes for learning. Researchers have begun to explore the effects of other learning goals in collaboration with mastery and performance goals. Some researchers started (e.g. Meece & et al., 1988; Meece & Holt, 1993; Nolen, 1988) to investigate the effects of work-avoidance goals, which are characterized by an intention of getting work done with minimal effort. Students may adopt this type of goals as a way to express their deep-seated negative attitudes toward schoolwork, to avoid failure and to cope with unmanageable constraints and demands of difficult learning situations. Work avoidance goals are negatively related to students' active cognitive engagement, the use and valuing of deep processing strategies but are positively related to effort-minimizing strategies, such as eliciting help from others, copying others' work, guessing answers (Meece & et al., 1988; Meece & Holt, 1993).

In addition, there are studies that looked into the effects of various social goals, such as social responsibility goals, social approval goals and social welfare goals (e.g. Dowson & McInerney, 1997). Social goals were often collapsed with ability goals forming one united construct in the earlier studies of achievement goals (Meece & et al., 1988; Nolen, 1988). Nevertheless, social goals, such as pleasing other and getting approval, should be distinguished from the intention to show one's ability or outperform other. Social goals deserve to be studied on their own right. Wentzel (1989, 1991, 1992, 1993), though accommodating a somewhat different definition of goals, studied the social responsibility and social interaction goals. Social responsibility goals, like being dependable, were correlated positively with high grade. In contrast, students trying to have fun with friends (social interaction goals) scored relatively lower grades. It is therefore clear that the relationships between academic performance and social goals depend very much on the types of social goals and their nature. However, thus far, our understanding of social goals remains barren and piecemeal. More research efforts need to be expended on studying these goals (e.g. Ng, 1997; Urdan & Maehr 1995).

Combined goals

This trend of exploring other achievement goals discussed above coincides with the call for evaluting the effects of combined goals, that is, assessing the effects of two or more separate achievement goals simultaneously. Initial research efforts in this regard explored whether a combination of goals would multiply, or in reverse, lessen the positive effects of mastery goals.

To start with, it has been shown that performance and mastery goals were not correlated with each other, suggesting that students are capable of holding these goals simultaneously (Nicholls, 1984; Nicholls & et al., 1985). Pintrich & Garcia (1991) theorized that students stressing both mastery and performance goals would show adaptive patterns of learning or would have a positive multiplicative effect on cognitive engagement (Pintrich & Garcia, 1991; Wentzel, 1993). To the contrary of this hypothesis, they found that students high in both intrinsic and extrinsic orientations simultaneously were more anxious, which in turn hampered the positive effects of the intrinsic orientations. Likewise, Meece & Holt (1993) analyzed 275 fifth and sixth graders on the basis of their mastery, ego and work avoidance goals revealed similar results. Students exhibited a strong grab on both mastery and ego goals showed the most negative achievement profile. The endorsement of both mastery and performance goals simultaneously did not result in any positive adaptive function among the participants in these studies. The most notable positive effects in learning were found when students scored high in mastery goals but low in performance goals in both studies.

However, there are studies that show the reverse, supporting that there are positive effects originated from combined goals. Bouffard and his colleagues (1995) conducted a correlational study using an undergraduate sample. The study revealed that students high in both mastery and performance goals were correlated with the highest scores in cognitive strategy use, self-regulation and course grade. These students also showed a high level of effort expenditure and persistence. Similar positive results were reported by Seifart (1995). Using cluster analysis procedures, Seifart (1995) found that students who were oriented toward both mastery and performance goals simultaneously showed a preference for challenging task, positive affect, high perceived ability, higher self-worth and adaptive attribution pattern by explaining their success in terms of controllable factors.

The contradictory findings of these two sets of studies concerning the combined effects of both mastery and performance goals may probably be related to the confusion about the nature of performance goals. Some, therefore, went back to the drawing board and suggested that performance goals should be fine-tuned into different categories. For example, Elliot and Harackiewicz (1996) distinguished performance-approach goals and performance avoiding goals; similarly, Greene and Miller (1996) studied three different types of performance goals, namely relative ability goals, work-avoidance goals and extrinsic goals. Another reason for the confusion arisen regarding the combined effects of mastery and performance goals is probably related to the lack of a theoretical framework guiding the treatment of multiple goals. Our understanding of achievement

goals can be advanced more substantially and fruitfully if more efforts are devoted to the development of a conceptual framework guiding the study of multiple goals.

Goal Web: A Theoretical Framework For Studying Multiple Goals

Increasingly, researchers come to realize that rarely will students learn merely with a single goal. The study of multiple goals is ecologically more valid than investigating achievement goals separately. However, to date, research efforts embracing this line of thinking remains barely adequate. As discussed above, the findings in this regard are also far from conclusive. The difficulties of studying multiple goals can be traced to two sources: methodological practices and conceptual immaturity.

Wentzel (1992, 1994) suggested that the current methodological practices among achievement goal researchers rendered the study of multiple goals operationally difficult. The use of between-group design in both survey and experimental studies, assigning goals to students in trait-like manner, and over-reliance on assessing learning goals using pre-determined questionnaire scales have made the study of combined effects of multiple goals inconceivable. These methodological practices may have originated from the over-indulgence on contrasting the effects of mastery vis-à-vis performance goals.

In addition to the methodological problems, the difficulties of studying multiple goals can be attributed to the lack of a conceptual framework. Past studies, claimed using a multiple goal perspective did not have a theoretical framework to guide the conceptualization of the effects of multiple goals. By and large, achievement goal researchers are still bounded inadvertently by a conception that achievement goals are disparate mental constructs, of minimal relationships among each other. As such, the study of multiple goals, in the previous studies, simply meant measuring several goals simultaneously in the same survey questionnaire or experimental setting. Multiple goals were then constructed artificially using arbitrary statistical procedures (e.g. median split) during the analysis stage. The treatment of multiple goals in this manner can at best reveal the effects of goals combined together. However, their contributions to furthering the understanding of the relationships between achievement goals and their relative significance among each other are relatively limited.

This discussion draws us to consider seriously the need for the development of a theoretical framework of multiple goals that can be utilized to unfold the relationships and relative importance of different goals within a single psychological construct. This paper proposes that a goal web concept will serve this end. A goal web is a cognitive schema or a hierarchical mental structure consisting of a network of causally-linked learning goals held by individual learners. Within this cognitive structure, learning goals are linked with each other in specific causal patterns, depending largely on students' past learning experiences, the salient features of a learning context, and the assumptions as well as characteristics of the socio-cultural setting in which learning occurs. Each learning goal will occupy a strategic position within the web and its effects on learning

will hinged less on the nature of the goal itself but more on the causal links with other goals.

Different categories of goals can be identified in a goal web. One way to detect the possible categorization of goals is to check the goals' relationships with learning. Within a goal web, there are achievement goals that will have more direct, immediate and apparent effects on learning, while other exerts a rather indirect, delayed and less apparent impact. As such, some goals will occupy a more crucial position while other goals are less significant in the goal web. This theorization about the relative importance of learning goals within a goal web strikes accord with the distinction between core goals and subgoals (Schutz , 1991). According to Schutz (1999), core goals are more akin to learning; they are more relevant and proximally associated with learning tasks concerned. Subgoals occupy a subordinate role and offer supports to the actualization of relevant core goals. Mastery and performance goals within a goal web will usually be found as core goals or goals that are more directly linked with learning tasks. Social goals and functional goals, such as aspiring for university education, will occupy a more fallback position, offering supports to the core goals.

While the goal web model adheres to the different functions of core and subgoals, the categorization of a goal and hence its relative importance in the goal web is by no means fixed. The effects, status and meaning of achievement goals within a goal web will be a function of a/ the nature of the goals themselves, b/ their relative importance, and c/ their causal links with other goals. Performance goals, for instance, may become more adaptive if it is causally linked with mastery goals that focus on mastery and understanding. This will happen when performance is utilized in a formative manner for checking progress and understanding. In contrast, when connected with goals that are likely to aggravate learning anxiety and pressure, for example, meeting social expectation, performance goals may therefore release more of their negative impact on learning.

Similarly, the meaning of mastery goals may also change as a result of the causal link with a specific goal. For example when a mastery goal, such as "I like learning mathematics", is causally supported by a performance goal, such as "because I can do well in it", the positive effects of a mastery goal may be dampened as students will attend not just to mastering the knowledge but also the anxiety arisen from a concern with performance. Students holding this type of goal link when given rather challenging or difficult tasks will be more likely to retreat than to persist, opposing the usual expectation regarding the effects of mastery goals in the literature.

This paper offers initial empirical support for this goal web model. Learning goals and their relationships with each other were not determined by a pre-set questionnaire items but derived from students' own personal accounts of their learning experiences in mathematics through in-depth interviews. The interview data testified to the major premises of the goal web model, which are

- students have multiple goals for learning
- students' learning goals are related and connected in a causal fashion;
- not every goal is of the identical level of importance in relation to learning;
- effects of learning goals will be determined not just by the goals themselves but more often by their relationships with other goals within the cognitive goal web
- the configuration and the internal structure of a goal web are influenced by students' past learning experiences, the salience of a learning context and the characteristics of the socio-cultural setting

Overall, the significance of this study lies in advancing the multiple goal perspective through the proposed goal web model. In addition, the qualitative nature of this study offered insightful understanding on students' achievement goals, their relative importance and inter-relationships, which are not readily attainable through survey or experimental design using predetermined scales of achievement goals.

Method

Selecting interviewees

Thirteen year 10 students were selected for interviewing. These students were participants in a survey study completed earlier. They were selected on the basis of their achievement levels and their scores on the self-schema construct in the survey. In terms of achievement level, these students could be separated broadly into two groups: high achieving (N=8) and low achieving students (N=4). They came from three different classes in two different high schools in the Metropolitan West Region of Brisbane.

Teachers were consulted regarding the suitability of these students as interviewees. A letter explaining the interviewing procedure and requesting students' cooperation was sent to all chosen interviewees. In addition, parental permission was sought. Interviewees and their parents were asked to sign a consent form before the interviewing process began. However, they were assured the right to quit from the study at any time they deemed appropriate.

The interview-analytical procedures

Students were interviewed three times either during the lunch break or during the mathematics lesson. Each interview took about 45 to 60 minutes. The interviews were taped and transcribed subsequently. The data reported in this paper confined to the first and second interview.

1/ The first interview--domain analysis

During the first interview, interviewees were encouraged to volunteer information and their right to refrain from giving any sensitive personal information was assured. Students were asked to talk freely about their backgrounds and interest. Students were

then encouraged to reflect on their past experiences in learning mathematics as well as other related subjects.

Domain analysis (Spradley, 1979) was conducted to locate major themes in the first interview and points the needed further exploration in the subsequent interview were noted. Domain analysis is a search for the larger units of cultural knowledge called domains. Each domain is composed of a 'covered term' and a set of 'included terms' that belongs to the category of knowledge named by the covered term. Table 1 in appendix shows the result of domain analysis on students' learning goals for mathematics.

Semantic relationships are the means by which domains are identified. It is assumed that in everyday language, symbols are linked together by a relational concept. Take for instance, in the following statement, "Paul is a poor mathematics student". The relationship between "Paul" and "poor mathematics student" is that "Paul" is a kind of, or an example of "poor mathematics student". There may be many kinds or many examples of poor mathematics student. Peter is one of them. "Poor mathematics student" can then be treated as a covered term while "Peter" is one of its included terms; "a kind of" or "an example of" is the semantic relationship linking these language symbols.

In this interview study, four types of semantic relationships were identified after the first interview: strict inclusion (a kind of), causal-effect (a cause of), means-end (a way of or a solution of) and attributes (a characteristics of). The covered term and their appropriate or related included terms were recorded on different sets of cards after the first interview. Central to this paper is the data grouped under the included term "reasons for learning mathematics", which was generated using mainly the strict inclusion and causal-effect semantic relationships, although some learning goals were derived from the means-end relationships.

2/ The second interview--taxonomy analysis

During the second interview, students were asked to confirm if they had given the correct information in the first interview. Several sets of cards that recorded students' responses from the first interview were shown to the interviewees. These cards were grouped into major themes (cover terms) like learning reasons, learning strategies, motivating lessons etc. developed after the domain analysis. With reference to the reasons for learning mathematics, interviewees were shown the cards on which their learning goals were recorded one at a time and they were asked if the reasons or goals recorded were their own perceived purposes for learning mathematics. Interviewees were asked to clarify their responses whenever a misrepresentation of their views was spotted. At the end of this confirmation task, interviewees were asked if there were other important reasons for learning mathematics they would like to add to the cards. Additional goals would then be added into the card set.

The second task invited students to explain the relationships among their goals. Contrasting questions ('is X different from Y?') were asked so as to clarify the meanings of their responses, and more specifically, to identify the differences among similar

responses. For example, contrasting questions during this task session included: 'Is this goal different from that?' 'Why do you learn maths with this goal?'. In order to further understand students' responses, students were asked to sort the cards of learning goals into order and explained why they had sorted the cards in that manner. Additional contrasting questions were asked to clarify why students had sorted the cards in a specific order. This task would elicit interviewees' perceived relationships among their reported goals and their relative importance.

A taxonomy analysis was administered after the second interview (Spradley, 19794; Miles & Huberman, 1994). This analysis searched the internal structure of a domain. The result of the card sorting activity and follow-up justification were the major sources of information this analysis relied on. This analysis elaborated the relationships among all the types of learning goals (included terms) within the domain of learning goals for mathematics (a covered term). Included terms could be reorganized according to the description of interviewees. Goal webs in appendix II provides some examples of taxonomy analysis of students' learning goals.

3/ Cross-case analysis

The last analytical step involved a cross-case analysis (Spradley, 1979), which enabled the investigation of learning goals across different interviewees. This was done through reviewing the tapes, field notes and the various analyses done after each interview. The relationships of separated parts were drawn together. Themes and patterns were noted or developed. Particularities and similarities among interviewees were located and compared. This cross-case analysis resembled what McCracken called 'the discovery of analytical categories' (1988), which involves making observation, expanding observation, examining interconnections, developing themes and formulating theses. In general, this cross-case analysis is a movement from particular to general by which students' personal information (cultural categories) found during interviews is turned into generalized themes (analytical categories).

Results and Discussion

The results discussed below were derived from continuous analytical efforts involving domain analysis, taxonomy analysis and cross-case analysis. The findings generally offered initial supports for the premises of the goal web model. In addition, it was noted that there were fundamental differences between the goal webs of high and low achieving students.

Different types of goals

The learning goals of the interviewees were recorded after the domain analysis (see Appendix I). Various types of performance and mastery goals were the most commonly reported reasons for engaging in learning mathematics among the interviewees. Performance goals included "getting a better result", "showing that one is smart or able",

"competing with other students or relatives", and "trying to avoid showing inability". Among these performance goals, "getting a better result" was the most common goal reported, regardless the achievement levels of the interviewees. As for the mastery goals, "enjoying learning mathematics", "considering that mathematics is fun and interesting", "considering that mathematics is challenging", " a desire to master mathematics" and "a desire to learn more" were frequently discussed among the high achieving students. Low achievers seldom discussed these mastery goals.

Two types of functional goals were often reported. High achieving students commonly placed great emphasis on "meeting the requirements of university entrance" while low achieving students talked more about how studying mathematics was related to "preparing themselves for year 11 and 12 courses". As such, high achieving students seemed to be able to relate their learning to a more distant aspiration. Low achieving students in contrast had a more proximal focus. The second type of functional goals was related to the general utility of learning mathematics. High achieving more often than low achieving students recognized that mathematics was useful or relevant for their everyday life. One of the high achieving students even mentioned that learning mathematics could help him understand life and he thought solving mathematics problems was synonymous to overcoming hurdles in life.

The last category of achievement goals generated from the interview data was social goals, which included "meeting family expectation", "pleasing teacher", "having fun with friends". These social goals were mentioned exclusively by interviewees with different Chinese cultural backgrounds, reflecting the influences of social values characterizing collective cultures.

Goal profiles of high and low achieving students

High achieving students reported a more diverse set of learning goals while low achieving students' goal diversity was relatively low (see Appendix I), implying that high achieving students relative to low achieving ones are more resourceful in terms of goals for learning. This result can be taken as an indication that high achieving have a relatively clear sense of purposes for learning mathematics and therefore they are more motivated than low achieving students.

Low achieving students seldom cited mastery goals as the reasons for learning this subject. This is can be explained by the long history of failure experiences in learning mathematics, which might have created a relative low sense of efficacy. In addition, it is important to note that the low achieving interviewees tended to mention teacher-related variables, such as "my teacher is helpful", as the reasons for engaging in learning mathematics. This strong reliance on the teachers' personality, interaction and teaching quality for driving learning and engagement indicates that low achieving students lack strong internalized purposes for learning mathematics. Their learning motivation, goals and behaviors were still externally regulated. Expectedly, they placed much stress on an introjected goal, "I have to do it", as the perceived purpose for learning mathematics.

Damien, one of the low achieving interviewees, ranked this introjected goal as the prime reason for his learning of mathematics.

Relative importance

Of course, not every goal was of identical level of significance to the interviewees. Mastery goals and performance goals were usually ranked high among other goals. Social goals and functional goals were usually assigned with a lower rank. This relative importance of mastery and performance goals reveals the salience of these goals for learning. In Schultz's term, these two types of achievement goals can be taken as core goals for learning mathematics as they are more directly related to how and why interviewees engaged in learning mathematics. Social and functional goals with their relatively lower ranks can be treated as subordinate goals, offering supports for the actualization of core goals.

Nevertheless, this generalization about the categories of learning goals should not be taken as a hard and fast rule. This categorization may vary with other variables including students' cultural backgrounds, past learning experiences and the characteristics of a learning context. For example, Dian, an overseas student from China, reported that the most important reason for learning mathematics was to meet the expectation of her family, which could be attributed to the collective culture of the Chinese. Sally, for instance, considered "demonstrating her intelligence" as the prime goal for learning the subject since she was expected to do poorly by her classmates during her junior secondary years. Therefore, she aimed high and initiated all sorts of "gambling games" with her classmates in order that she might beat them in tests and examinations. The characteristics of a learning context are also an important consideration for understanding the relative importance of a learning goal. Mick, Ben and Amy, who used to satisfy with a bear pass, consistently reported that they were determined to get better results in mathematics despite their past failures. This was made possible through learning mathematics with an intervention program designed to accommodate the special learning needs of low achieving students (see Ng, in press for details). The intervention program revolutionized their understanding of themselves as mathematics learners and their interactions with the learning materials. Within this new context, they set new goals and began to understand their potentials to do well in this subject.

The meaning of a goal in a goal web

All but one interviewee's learning goals were connected in a systematic manner. Learning goals were linked together in a complex causal network. The taxonomy analysis revealed that interviewee's learning goals formed complex goal webs (see appendix II). As predicted in the goal web model, the causal links between learning goals would have effects on how a single goal should be interpreted. Among the interviewees, the referent effects of causally linked goal on another goal were apparent in the interpretations of the performance goals.

A performance goal—to get better result in mathematics—was the most common goal reported. Nevertheless, the meaning of this performance goal did not confine to achievement and competition. Its meaning hinged more on the goals linked causally with it, and that how goals were linked was a function of students' individual characteristics, including past experiences in learning mathematics, achievement level, future aspiration and their cultural backgrounds. Among the high achievers, "getting a better result" was a way to

- demonstrate ability when it was linked with the desire to show one's intelligence;
- achieve a desired distant aspiration when it was utilized for meeting the university entrance requirements;
- fulfill social obligation when it was a way to meet high family expectation;
- survive competition when there was intense competition within school and among family members or relatives;
- check progress and understanding when there was an equally strong desire to master the knowledge and;
- demonstrate mastery when a high performance level was considered as a natural trajectory of events after the knowledge has been mastered.

The first five cases show that a performance goal can be taken as a means to an end, which may be in form of fulfilling a social obligation, actualizing an aspect of the self, or maintaining a status or checking mastery. Seldom a performance goal is conceptualized as an end in itself. In other words, rarely will students try to aim high in performance for performance's sake. More interesting is the last case listed above in which a performance goal is considered as a natural trajectory of events. In essence, students with this goal configuration, in which performance goal was causally explained by a strong mastery focus, consider that a better result is assumed and expected. Their focus therefore is not on high performance but on how well they have mastered the knowledge. They will be surprised when they end up with a poor grade after expending a lot of mastering efforts in learning a subject.

Qualitative difference between high and low achieving students' goal webs

The discussion above alerts us that when studying students' learning goals, their relationships among each other and their relative importance within a goal web should be taken into account. Essentially, these two principles can be demonstrated vividly through a close look of the goal webs of both high and low achieving students. The goal webs of high achieving and low achieving students were qualitatively different from each other in terms of level of complexity, strength of the links and their goal diversity. High achieving students relative to low achieving students had more complex goal webs, more learning goals within the web and these goals were more connected. In order to illustrate these qualitative differences, the complete goal webs of both high and low achieving students need to be considered in conjunction with the interviewees' past experiences, their cultural backgrounds and the salient features of the learning context. The following section describes the goal webs of four selected high and low achieving students.

High achieving interviewees

1. Dian

Dian, an overseas student from a northern province in China, reported that her key learning goal was to meet the expectation of her family. The prime status of this social goal was attributed to that she faced intense competition from her cousins who had migrated to Australia few years before her arrival. Being the only child in an extended Chinese family, Dian has been socialized into a culture that considered high academic achievement brought honor to the family. She was used to the comparison her parents and grandparents made between her and her cousins since young. She had always been 'the winner'; she was ranked among the top students in her former school in China and gained straight A grades in mathematics since her arrival in Australia. She considered that it was a social obligation to continue to perform well in order to live up to the expectation of her parents, although she admitted that she did felt the pressure. The dominance of this social goal was undoubtedly intensified by an economic consideration relating to the expensive school fees incurred on her as an overseas student.

Dian's aspiration for high performance is therefore causally supported by the strong social obligation to meet family expectation. In addition to that, her performance goal was driven, to a large extent, by a desire to compete with others, a future aspiration of studying economics in university and a focus at mastering mathematics knowledge. As such, her performance goal should not be considered as overtly competitive and achievement oriented in nature.

The second most important learning goal for Dian was mastery in nature. She liked mathematics and she enjoyed learning it since primary school. These mastery-oriented goals were supported by the recognition that mathematics was fun and interesting. This emphasis on mastery orientations has led to a desire for learning new mathematical knowledge. However, surprisingly, she assigned a relative low rank to this goal, implying that to learn new things was not at all important for her. This comparative low rank of "learning new things" among other mastery-oriented goals seemed counter-intuitive, judging from the current understanding of mastery goals in the literature. Nevertheless, this weak link can be attributed to her learning experiences in Australia. She explained that she was in doubt of her ability in learning mathematics and especially new knowledge. This was because she considered that she did not learn anything new in mathematics in the past two years since her arrival. The mathematics she learnt here had been covered long time ago in her former school in China. Therefore, she was doubtful about her ability to learn challenging mathematics. She managed to maintain her interest in the subject; however, her learning experiences in Australia has dampened her desire and confidence in learning new mathematical knowledge. This case can be considered as an example of mastery avoidance goal (c.f. Elliot, 1999).

Finally, Dian reported that "I have to do it" as one of the perceived purposes for learning mathematics. However, this goal was not connected with any other goals and yet occupied a relatively high ranking in the goal web. This can be explained in terms of the strong sense of social obligation derived from a collective culture. Having been socialized into a culture that upholds the importance of obligation, responsibility and filial piety, Dian might have considered that a social responsibility for her to do subject assigned by significant others.

2/ Christy

Christy's goal web was much simpler than Dian's. However, it was still characterized by strong causal links among different goals. Christy came from Pauper New Guinea five years ago. Her father was a New Zealander with high educational qualification who met her mother while working in Papua New Guinea. Social goal was not present in Christy's goal web. The most important goal was mastery-oriented. She loved learning mathematics since she was in primary school and always tried every means to master mathematical knowledge. She would feel very uncomfortable when she did not understand something in mathematics.

She considered that a good result would come natural after she had mastered the knowledge. Therefore, her goal for high performance should be understood in conjunction with her strong mastery focus. In addition, her performance goal was considered as a means to attain her aspiration for university education as well as an indication of her ability. Christy recently encountered difficulties in handling problem solving questions. She was confused, as she did not understand why some other could find solutions while she was still struggling to get through the basics. Therefore, her fifth goal "other can do it, I can do it too" should not be understood as a kind of social comparison goal such as outperforming other and showing that one's smart. The connotation of her mastery struggles in learning to solve this specific type of mathematical task needs to be taken into consideration in understanding her fifth goal.

Low achieving interviewees

3/ Amy

Amy, a low achieving student, came from a class in which an intervention program designed to help low achieving students learn mathematics with confidence was being implemented. Amy had a long history of failures in learning mathematics. She was put into a remedial class in primary school and had troubles understanding mathematics since then. Her favorite subjects were cooking and drama. She was of the view that mathematics was not useful and neither was it relevant to her future career aspiration. She ranked "having to do it" as the sole goal in learning mathematics prior to the current school year. However, after learning mathematics with the intervention program for a semester, she developed additional achievement goals and concurrently her sense of coercion in doing mathematics lessened substantively, which was reflected in the low rank of this coercive goal. Getting a better result as a learning goal coincided with the rise of her own self-efficacy belief. In addition, she now considered that mathematics was of some value and would not reject learning it immediately as she used to do in the

past. Her dramatic change in the goal web was attributed to the intervention program and her teacher's encouragement. Her teacher's at one stage asked her why she did not aim for a higher grade early in the semester. Amy considered this comment encouraging and therefore thought seriously about the possibility of getting of a better grade. During the last interview, she explained that she was in track for a B grade, which was different dramatically from being satisfied with a bear pass in the previous few years.

4/ Damien

Damien was Amy's classmate. However, the intervention program seemed to have no effect in redirecting Damien learning goals. He still considered that doing mathematics was a pure coercion. He mentioned two other learning goals. However, their significance was minimal, as he did not assign any rank to them. In fact, these two goals were recorded during the second interview when he was invited to consider if there were other purposes for learning mathematics.

Conclusion and Future Directions

Overall, this study provided initial empirical evidence on the validity of a goal web model. The interview data offered support to the notion of networked multiple goals. In addition, it was demonstrated that high and low achieving students had qualitatively different goal webs. More empirical evidence is required to corroborate the basic premises of the goal web model. Special attention should be given to verify the notion that the effect magnitude of learning goals varies as a function of their causal relationships with other goals.

Some insights can be derived from this goal web model to inform the future studies of achievement goals. First students' multiple goals conceptualized as goal webs poses a challenge to the current research practices in the study of achievement goals. It seems arbitrary to classify students into mastery-oriented and performance-oriented when the relationships between other goals have not been explicated. Second, investigating achievement goals from a more individualized perspective deserves more attention from researchers. It is important not just to test the effect of a single goal but also to understand the combined effects of the goals when they are considered as a goal network with intricate relationships among each other.

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Appendix I: Domain analysis

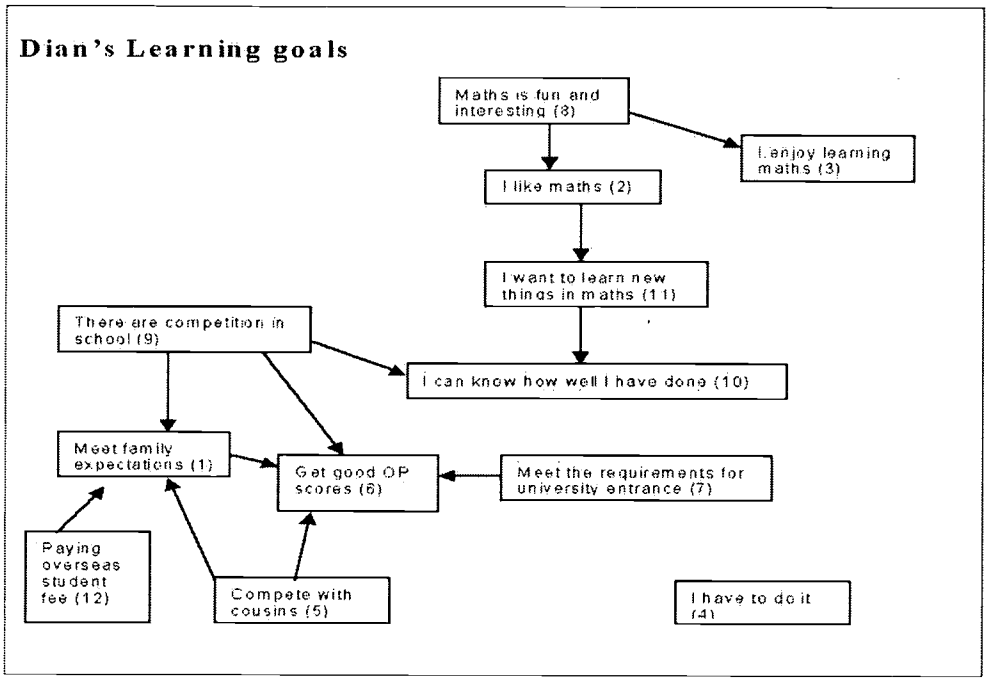
Selected Interviewees' achievement goals for learning mathematics

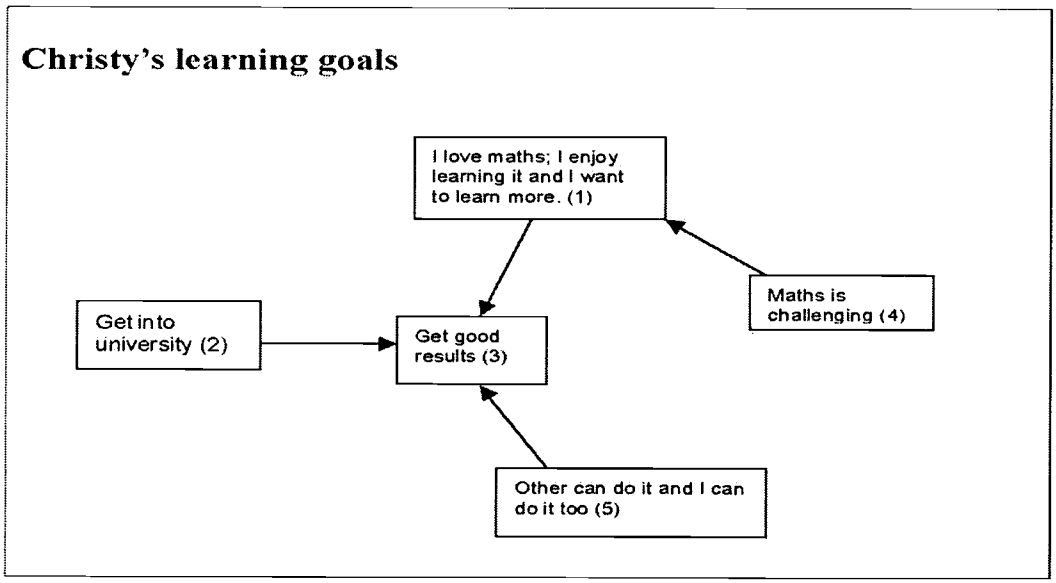
Interviewees	Reported Goals	Label
Dian (high achieving)	Maths is fun (8)	M
	I like maths (2)	M
	I enjoy learning maths (3)	M
	I want to learn new things in maths (11)	M
	I can how well I have done (10)	M/P
	There are competition in school (9)	P
	To meet my family expectations (1)	P
	I am paying expensive overseas student fee (12)	O
	To get good OP scores (6)	P
	To compete with my cousins (5)	S
	To meet the requirements for university entrance (7)	F
	I have to do it (4)	O
Christy (high achieving)	I love maths (1)	M
	I enjoy learning it and I want to learn more (1)	M
	Maths is challenging (4)	M
	To get good results (3)	P
	Other can do it and I can do it too (5)	P
	To get into university (2)	F
Amy (low achieving)	Some stuff is useful (5)	F
	Encouragement from teacher (4)	S
	I want to get A or B grade (2)	P
	I can get better grades (1)	P
	Module mathematics (3)	S
	I have to do it (6)	O
Damien (low achieving)	I have to do it (6)	O
	To get better results (not ranked)	P
	Maths is important for everyday life (not ranked)	F

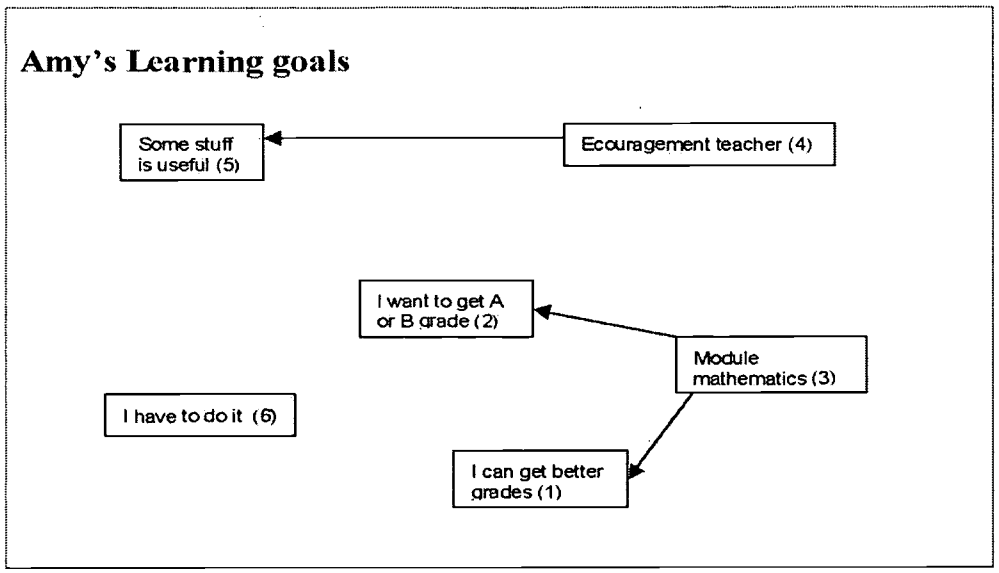
Note: M=mastery goal; P=performance goal; S=social goal; F=functional goal; O=goal not classified

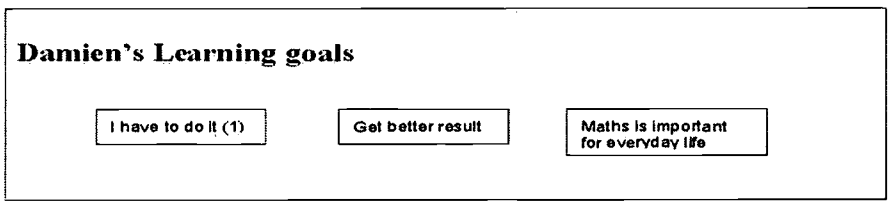
Appendix II: Taxonomy analysis

Goal webs for learning mathematics of selected interviewees









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