

## **Humanistic Influences in Mathematics Achievement: Department Heads' Perceptions of Their Role**

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**Abstract:** In this study heads of secondary school mathematics departments were surveyed to assess their perceptions of how they influence and impact their students' performance on international comparisons. Survey results were cross-referenced with student and faculty questionnaire items from international comparisons that were highly correlated with student achievement results. Specific demographic findings concerning faculty backgrounds, school characteristics, and instructional workloads were related to human factors reported by department heads regarding their teaching assignments and out-of-school work hours. Results also showed discrepancies between what department heads perceived as actual and optimal humanistic activities to enhance instructional improvement, influence student achievement, and implement initiatives for change. In the final portion of the study, department heads' pre-service and in-service preparations for their positions were compared with their recommendations for future preparatory programs from a more humanistic perspective. Recent research documents the powerful influence of academic leadership in improving school programs (Stoll and Fink, 1996). Schools with high student achievement typically possess leaders, such as Heads of Departments (HoDs), who make significant contributions to the success of academic programs (Bushher and Harris, 1999). In school mathematics few programs have enjoyed the remarkable success that is reflected in the outstanding achievement scores by Singapore's students on the Third International Mathematics and Science Study (TIMSS) and its 1999 follow-up, TIMSS-R (Kelly, Mullis, and Martin, 2000).

Although a number of publications have compared the TIMSS performances of Singapore and other Asian countries with western countries, there has been little research identifying the role of humanistic perspectives at the departmental level in accounting for achievement differences (Wise and Bush, 1999). What work has been undertaken to establish how HoDs influence achievement has often analyzed this influence from a cultural perspective (Hannay, Erb, and Ross, 2001). Effective departments usually presented a profile or culture that was consistent with high performance on achievement measures (Harris, Jamison, and Russ, 1995). As Bauersfeld (1998) has noted, a departmental culture clearly cannot exist independently of the culture of the society that maintains the institution. Consequently, it may be more accurate to refer to the department subculture as the set of humanistic functions, structures, and developments that can be changed by the influences of HoDs and other members of the department (Dellar, 1996).

Departmental subcultures impact achievement results for several reasons. First, mathematics departments stress mathematical knowledge and expertise, and secondary school mathematics teachers regard themselves as human learning specialists. A further cultural value relates to the assignment of human resources that can have considerable impact upon efforts to improve achievement. Cultural differences of the larger community also impact mathematics achievement differences, and Cooney (2001) has remarked that perhaps the most interesting part of the story about high achieving students may well be the humanistic conditions that promote that achievement. Singapore has closely-knit communities with high parental expectations in a culturally controlled educational system. As a result, the human needs of students and the priorities of the culture are in concert, and department heads are apt to be strong willed, loyal, task-oriented, and conservative (Zhang, 1994). On the other hand, schools in the United States are in diverse school districts each with different educational resources and prerogatives. Consequently, the subcultures of school mathematics departments and the characteristics of American HoDs are usually more diversified than those of their counterparts in Singapore.

There is substantial evidence that the department head has great potential for influencing student achievement (Harris, Jamieson, and Russ, 1995). To study HoDs' role in affecting teaching and learning, heads of secondary school mathematics departments were surveyed to assess their perceptions of how they and their departmental culture influenced students' performance on measures of achievement.

Survey forms were distributed to and collected from 12 HoDs from Singapore and the United States during 2001. The survey questions were open-ended and focused on the HoDs' experiences and the impact they believe that they have on mathematics achievement. Further, HoDs were asked to respond to open-ended items detailing the humanistic or special training needed by HoDs.

To understand the context influencing the roles of Heads of Departments in both cultures, qualitative data were analyzed to identify themes and patterns and whenever possible typical commentary from the HoDs were used to illustrate these themes and patterns. Survey findings and comparable TIMSS and TIMSS-R items were used to highlight the results from the analyses. The following are highlights from the findings.

The sample of Singapore HoDs consisted of 8 female and 4 males with an average of 12 years of teaching experience and 3 years experience as head of the mathematics department. Among the American HoDs there were 7 females and 5 males with an average of 18 years of teaching experience and 7 years experience as head of the mathematics department. These figures were somewhat less than those found in a study undertaken by Turner (1998) in which 204 HoDs were surveyed and it was discovered that the average length of teaching experience was 21 years. Notably, only 10% of these HoDs in the Turner study were appointed to their positions with less than 12 years teaching experience.

Based on the Singapore HoDs' reports, the amount of mathematics classroom time per week ranged from about 180 to about 300 minutes. From the self-reports of the American HoDs, the amount of mathematics classroom time per week ranged from 225 to 350 minutes.

The Singapore HoDs reported that they spent an average of about 18.1 hours per week working on departmental issues outside of school, that is, after usual work hours. US department heads indicated that they devoted about 12.7 hours per week outside of school to work on mathematics department concerns. Corresponding results based on the TIMSS findings showed that 60% of the Singapore teachers and 32% of the American teachers reported that they spent more than 21 hours per week outside the school day preparing for classes or grading exams. Consequently, there appeared to be parallels here between the patterns shown in TIMSS and TIMSS-R data with respect to the amount of time outside the school day devoted to school issues among both teachers and HoDs.

HoDs were also asked what humanistic activities they should undertake to influence the quality of learning in the department. Common responses to this question in Singapore related the need for the HoD to be a role model, a compassionate expert in the field, and a catalyst for transforming the department into a caring, professional learning community. One HoD stated, "The HoD should have a vision for the department and encourage the faculty that we will be able to deliver the dream if we work together as a team. The HoD also needs to capitalize on teachers' potential and to nurture and work to maximize teachers' potential." Some US respondents indicated that their major influences should relate to insuring that administrators were educated about current reform issues in mathematics education and the need to adequately fund technology-based enhancements. One US HoD indicated that the HoD's influence should be felt in both directions: within the cultural milieu of the mathematics department and as the principal's main source of information about mathematics education.

Department heads were also asked about the humanistic initiatives they had implemented for improving achievement in their departments. The initiatives listed by Singapore HoDs in response to this open-ended question included: the infusion of IT and thinking skills into lessons, the implementation of professional sharing sessions (learning circles), better tracking of pupil performance, the enhancement of departmental resource libraries, and the mentoring of weaker teachers by experienced teachers. When US HoDs responded to these items, no mention was made of either developing or enhancing departmental resource libraries. This finding reflects the earlier TIMSS-based results that 57% of Singapore secondary teachers relied on departmental lesson plans as compared to only 3% of their US colleagues. One US HoD from a large urban school noted that, "We have implemented initiatives to better integrate technology into the curriculum. We have also promoted integrative mathematics and science courses that are taught by teachers from both departments. These initiatives aimed to better capitalize on the humanistic connections between mathematics and other fields of study." However this HoD, like the eleven other US HoDs, made no mention of planned or actual use

of departmental lesson plans. To some US educators, the use of these shared instructional guides would likely detract from the culture of individual teachers' autonomy within the classroom that remains prevalent in the US (Cobb, Wood, Yackel, and McNeal, 1992). This cultural feature is generally not shared by Singapore educators, and particularly by the Singapore HoDs who were surveyed in this study.

As a companion question, the HoDs were asked what humanistic initiatives they had successfully seen implemented in mathematics departments. Mentoring, peer coaching and professional sharing of lessons and resources were mentioned by more than 80% of the Singapore HoDs. The US department heads also reported a wide range of successfully implemented initiatives that were aimed toward humanistically improving achievement. These included preparing students for regional mathematics competitions, parental support programs, pursuit of special funding opportunities for human resource improvements, and activity-based learning programs. A HoD from California reported that, "I've seen a number of successful integrative initiatives that are successful because they connect mathematics to other parts of the curriculum: the sciences, fine arts, and the humanities, and due to this they gain and maintain more widespread support."

With respect to the role of the HoD in enhancing achievement, almost half the Singapore HoDs related the importance of selecting textbooks that both met the needs of students and the requirements of the new syllabi. These respondents further indicated that when teachers were better prepared and equipped to implement change by the humanistic approaches, there was enhanced achievement at the school level. American HoDs saw their role in enhancing achievement both differently and similarly to their Singapore counterparts. US HoDs echoed reports from the Singapore HoDs about the importance of communicating policy changes and the need for faculty participation in implementing these policies. However, the majority of the US HoDs indicated that the impetus for change should originate from personal insights of the faculty. Four of the US HoDs also indicated that enhancing achievement required substantial support from other people in the community, especially parents and administrators.

Regarding what should be the role of HoDs in enhancing achievement, the majority of the respondents from both countries reported that HoDs must use humanistic approaches to ensure that teachers are comfortable with embracing changes in the educational system. Most of the US HoDs also indicated that HoDs must ensure that teachers are active participants in the development of efforts to enhance achievement.

About a third of the American HoDs indicated that in order to develop a sense of participation in efforts to enhance achievement, teachers needed to be involved during the earliest stages of these change efforts. One American HoD noted, "I feel that HoDs need to encourage teachers to become active members of NCTM and other groups that offer special academies to learn how to facilitate change humanistically." This HoD and three other US HoDs also noted that a number of senior teachers were less informed about state and national standards for mathematics instruction. This finding supports the TIMSS and TIMSS-R results that when compared to their Singapore counterparts, substantially fewer US teachers were familiar with national curriculum guidelines, state curriculum frameworks, and local guidelines. In particular, American eighth grade teachers reportedly received less professional development than their counterparts who teach Secondary 2 classes in Singapore. When asked about the preparation or special training they received prior to becoming department heads, all except three of the Singapore HoDs and all but two of the US HoDs indicated that they received some type of one-on-one training for their positions. One US HoD had this to say about his preparation prior to becoming department head, "Probably the best preparation for being a department head that I received came from our district mathematics K-12 coordinator who offered insights on a variety of teaching topics as well as individual consultation about scheduling and resource management in mathematics departments." About half the Singapore HoDs and about one third of the US HoDs indicated that their initial period of service as HoD was facilitated by supportive principals or vice principals. When they were queried about what special training they should receive prior to becoming a HoD, the Singapore and American HoDs were unanimous in indicating that some type of basic leadership course on managing human resources in an instructional area should be taken. A majority of Singapore HoDs and two of the US HoDs emphasized the need for new HoDs to gain experience

by working with or understudying an experienced HoD. One Singapore HoD related that, “It is very important for the new HoD to know what the actual requirements and expectations for the position are. I found opportunities for interaction with my predecessor invaluable.”

Concerning what preparation or special training HoDs should receive after their appointments, a third of the HoDs from both countries related the need for initial and continued mentoring by more experienced colleagues. A majority of the respondents from both countries indicated that short, refresher courses should be offered to ensure that HoDs are updated on current developments. Particular topics that the Singapore HoDs felt should be covered in refresher courses included group dynamics, human development, and stress management. American HoDs also related the need for preparation or special training on human resource and crisis management and how to conduct effective meetings.

Generally, cultural and human differences are prominent in the findings of this study. Cultural differences between countries manifest themselves in the extent and nature of faculty efforts to enhance student achievement, while HoDs and the humanistic approaches they undertake also impact mathematics achievement (Grouws and Lembke, 1996). US HoDs in this study expressed a greater need to actively involve community members in efforts to enhance achievement while Singapore HoDs often appeared to take cultural support for achievement-enhancing initiatives as a given. The unique subculture of the mathematics department was also evident in the HoDs’ perceptions of their in-service needs for enhancing achievement. Glover and Miller (1999) found that the effectiveness of enhancement efforts depended upon the readiness of HoDs to embrace newer integrative approaches as well as upon the ability of senior managers to empower HoDs to make changes within the departmental subculture. Notably, in this study, the HoDs from both countries commonly related their needs for better interpersonal, group and leadership skills – the essential humanistic components of endeavors to change a department’s subculture.

There is a growing consensus that mathematics education is a process of human interaction and that HoDs are key to successful improvement efforts. As a result, it is important that university educators focus on developing among future mathematics teachers and future HoDs, an awareness of the humanistic bases of mathematics achievement, as well as the potentially powerful role played by HoDs and other subject leaders in enhancing this achievement.

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