Determining College Performance of Allied Health Students

MARTI FLORES, EdD, R.T.(R), RDMS, RDCS
MARIE SIMONSSON, EdD

Background The need to find methods to reduce attrition rates in allied health programs has caught the attention of legislators and administrators of higher education institutions.

Methods A quantitative method design was used to investigate academic achievement in college as a function of high school achievement, high school performance, aptitude, and proactive measures taken by students. College transcripts and a survey were used to collect data. Eighty-six participants volunteered for the study. The data were analyzed with multiple linear regressions.

Results Academic achievement was found to be a function of the independent variables examined. Together, the variables accounted for 37% of the total variance in academic achievement among the respondents, as measured by college grade point average. The findings suggest that dual enrollment programs play an integral part in academic achievement and may help facilitate the transition of high school students into the radiologic sciences. The findings may assist educators working with students in public schools and in higher education, especially students seeking to enter the radiologic sciences as a profession.

Conclusion Dual enrollment programs may be an avenue to help reduce attrition rates in allied health programs, especially in radiologic technology programs.
for Education Statistics projected a rise in postsecondary enrollments between 2006 and 2017. If this projection is accurate, how might this increase affect enrollment in educational programs in the radiologic sciences? Because this question cannot be answered with any certainty, some educators are considering the potential benefits of giving high school students early access to colleges and universities. However, there may be factors that more directly relate to retention of students in postsecondary programs. The purpose of this study, therefore, was to investigate how a number of indicators — high school achievement, high school performance, aptitude, and proactive measures taken by the student — contribute to the academic achievement of college-attending students pursuing an allied health degree.

**Literature Review**

To aid the transition from high school to college and improve college readiness, many states have established an educational process called dual enrollment that gives high school students the opportunity to earn college credits while still attending high school. Dual enrollment programs are sometimes referred to as concurrent enrollment, joint enrollment, and dual-credit programs. The dual enrollment courses can be taught through distance education or at the high school campus or the postsecondary institution. The rationale for dual enrollment is that exposing students to college early may be beneficial because anticipation of college enrollment often declines as students progress through high school. The location where dual enrollment courses are conducted also may affect the educational aspirations of high school students.

In a study of 11,700 U.S. public high schools that offered dual enrollment courses, Waits et al found that 25% offered dual-credit courses through distance education technologies, 61% offered dual-credit courses taught on a high school campus, and 65% offered dual-credit courses taught on the campus of a postsecondary institution. When offering dual enrollment opportunities to high school students, colleges and universities may exercise several options. In Texas, public institutions of higher education and school districts are collaborating to offer dual enrollment options for students that include advanced placement credit, dual enrollment, and international baccalaureate programs. In a study of dual enrollment students in the Gulf Coast Community Colleges of Texas, Preston found that all public colleges are part of the “Closing the Gap” initiative to improve access to higher education and graduation rates. Although these programs appear to benefit students, no studies have investigated if these accelerated programs are effective and facilitate successful transition into college.

Studies comparing the outcomes of dual enrollment programs also are scarce. However, a limited number of studies have compared college retention among students participating and not participating in dual enrollment programs and examined the number of college credit hours earned. In compiling its annual progress report, the Washington State Board for Community and Technical Colleges found that the number of credits earned between these 2 groups of students were comparable. In contrast, a University of Minnesota study found that students in dual enrollment programs earned 15.1 more credits than their peers who were not enrolled.

The effects of student participation in dual enrollment programs on college graduation remains largely unknown. Nevertheless, the results of several studies suggest a positive correlation. Bailey found a positive association with participation in a dual enrollment program and success in graduating high school, enrolling in college, achieving a high college grade point average (GPA), and earning more college credits. In their study of career pathways, Leke et al found that students who earned college credits in high school increased their chances of earning a college degree. Similarly, Emers and Mullen found that students who earned dual credits were more likely to return to college for a second semester or a second year than those who had not. More recently, Swanson found that students who had earned dual credits were 11% more likely to persist through the second year of college. Even after removing students who had participated in dual enrollment, researchers found that earning college credit increases the probability of graduation for all students.

Despite these positive findings, Harnish and Lynch identified issues with credit transfers from dual enrollment programs. In its report, the Kentucky Council of Postsecondary Education documented an increase in the participation of high school students in dual enrollment programs, but did not find a comparable increase in college matriculation rates.

Research data on the effects of dual enrollment on success in allied health educational programs are scarce, even though programs such as the Health Career Academy in Iowa are in place to encourage high school
students to pursue postsecondary education in health-related fields. Although Lekes et al's study included dual-credit courses in paramedical training, their findings were inconclusive because of limited data. In a study of high school students enrolled in career and technical education programs, Karp et al found that participation in a dual enrollment program had a positive and significant effect on persistence. Although the findings may not be definitive, the program provided students a pivotal opportunity to accelerate their education.

Although numerous studies have investigated dual enrollment programs and college success, none directly linked students in these programs and the allied health professions. For this reason, other variables that may contribute to secondary and postsecondary academic achievement, especially in the allied health professions, were investigated in this study.

**Methods**

**Literature Search**

The Google Scholar (Google, Mountain View, California) search engine was used to perform an Internet-based search, and EBSCOHost (EBSCO Publishing, Ipswich, Massachusetts) was used to access Academic Search Complete, Alt HealthWatch, CINAHLPlus, ERIC (ERIC Program, Washington, District of Columbia), MEDLINE (U.S. National Library of Medicine, Bethesda, Maryland), PsycINFO (American Psychological Association, Washington, District of Columbia), and EBSCO's Science and Technology Collection (see Box 1).

**Hypothesis**

The research question focused on academic achievement as a function of high school achievement, high school performance, aptitude, and student-initiated proactive measures. The null hypothesis tested the converse of this question.

**Research Design**

A quantitative research method was used to gather data for analysis. The institutional review boards of the University of Texas–Texas Southmost College in Brownsville and the University of Texas–Pan American in Edinburg approved the study before data collection.

**Study Site and Sample Selection**

The University of Texas–Texas Southmost College was selected as the study site because it is the only university in the lower Rio Grande Valley that participates in dual enrollment partnerships with area high schools. The university also has a unique college partnership that offers associate degrees in 5 allied health professions: radiologic technology, diagnostic medical sonography, respiratory therapy, medical laboratory technology, and emergency medical science.

In the dual enrollment program, the university offers health science technology courses to high school students to help them transition from high school into an allied health program. Students can enroll in the courses if they:

- Achieve math and reading scores of 2200 on the ninth grade Texas Assessment of Knowledge and Skills (TAKS) or achieve passing scores on the reading and writing portions of COMPASS, a computerized college placement test.
- Achieve passing scores on all portions of the COMPASS test for all academic courses.
- Are deemed eligible by the high school principal and university vice president of academic affairs to take a course.

The dual-credit courses are equivalent to the health profession-related skills courses at the university level taken by students who did not complete all health science technology courses in high school or by students who may not have participated in a dual enrollment program. High school graduates who have earned all the course credits available through any of the available offerings or a combination thereof may be accepted into 1 of 5 allied health programs.

The study sample was identified from the files of students enrolled at the University of Texas–Texas Southmost College from 2005 through 2009.

<table>
<thead>
<tr>
<th>Box 1</th>
<th>Characteristics of Search</th>
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<tbody>
<tr>
<td></td>
<td>Search terms included dual enrollment programs, allied health students, dual enrollment and allied health programs, academic achievement and dual enrollment, high school dual credit, academic achievement, persistence, and retention.</td>
</tr>
<tr>
<td></td>
<td>Limits placed included dual credit for high school students only (not middle school) because allied health dual credit is granted from the 10th grade and beyond.</td>
</tr>
<tr>
<td></td>
<td>Limits were placed on allied health dual credit, not the general education core dual credit.</td>
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<td></td>
<td>Limits were placed on allied health professions to exclude medical school and nursing school.</td>
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</table>
The 224 who met the study eligibility criteria attended 1 of 8 high schools that had a dual enrollment program with the university. All of the students were contacted with a hardcopy letter, an electronic letter, or both to invite them to participate in the study. Of these 224 students, 86 agreed to participate. These 86 students were seeking degrees in at least 1 of the 5 allied health programs offered at the university but did not disclose a commitment to a specific program. However, 1.2% planned to earn a technical school certificate, 37.2% planned to earn an associate degree, 43% planned to earn a bachelor's degree, and 18.6% planned to earn a doctoral degree. A majority (67%) of the students considered their performance as a student to be fair. The average amount of time participants spent preparing for classes was 15.49 hours, and the average number of hours they spent at work was 13.74.

**College Transcripts**
Data gathered from the college transcripts included high school GPA, high school ranking, high school curriculum course type, TAKS scores, Scholastic Aptitude Test (SAT) scores, the number of dual-credit hours completed, persistence (attendance into the second college academic year), and college GPA.

**Dual Enrollment Survey**
Our survey instrument was modeled after the Survey of College Preparation and the 1980-1986 High School and Beyond sophomore cohort study. The instrument contained 3 parts:
- Part 1 elicited demographic information on the participants and the education level of their parents.
- Part 2 contained 6 questions that elicited information on students' motivation to participate in a dual enrollment program and their educational plans, as well as 4 questions that asked for information on the social interactions of the students.
- Part 3 asked students for suggestions to improve the dual enrollment program.

The initial intent of the survey was to investigate certain key factors (see Box 2). However, after the data reduction procedure, the proportion of the total variance in college academic achievement was accounted for or explained by 11 independent variables.

**Statistical Tests**
We began the quantitative analysis by organizing the data into box-and-whiskers plots and stem-and-leaf...
The discriminatory index was used to perform a psychometric item analysis of the 4-question socialization subscale in part 2 of the survey instrument before confirming the Cronbach alpha reliability coefficient.\(^{41}\)

Before analyzing the study model with regression analytic methods, an intercorrelation matrix was derived. The Pearson product-moment correlation coefficient (\(r\)) was used in this study.\(^{15}\)

A factor analysis was conducted to explore the correlation between the dependent variable (college academic achievement) and 22 independent variables. Varimax rotations with an Eigen value of 1 were used to reduce the redundancy of the 22 independent variables. After the data reduction procedure, the proportion of the total variance in college academic achievement was accounted for or explained by 11 independent variables:

- High school achievement (1), as measured by TAKS scores (2).
- High school performance (3), as measured by high school GPA (4), high school rank (5), and the number of dual enrollment credits earned (6).
- Aptitude (7), as measured by SAT scores (8).
- Proactive actions (9), as measured by SAT scores (8).
- Persistence in the first year of college (10) and socialization outside the classroom with professors (11). Although not included as an original research question, the dual-credit courses' direct contribution to health professional education was obtained within the high school performance construct.

Multiple linear regression analysis was used to examine the relationship between the dependent variable and the independent variables using SPSS 17 (IBM, Chicago, Illinois).\(^{44,46}\) Assumptions made during this analysis included linearity, homoscedasticity (homogeneity of variance), and normal distribution of the dependent and independent variables. In the background elimination analysis, all the independent variables were entered manually, tested 1 by 1 for statistical significance, and deleted when not significant. The amount of unique variance per independent variable was calculated with standardized regression coefficients/beta coefficients. The F-distribution test statistic was used at the 0.05 level of significance to test the overall fit of the data.\(^{44}\)

**Results**

The study sample was drawn from a population of university students in a dual enrollment program at the study site who attended between 2005 and 2009. The number of students who responded to this survey was 86 (23 men and 63 women), representing a survey response rate of 38.4%.

**Psychometric Analysis**

The exploratory approach did not detect any outliers, and the stem-and-leaf plots confirmed normality. The psychometric properties of the independent variables were addressed. Item analysis — the item distribution and discrimination index for the socialization scale — resulted in the removal of 1 socialization item. The 4 social interaction items included students participating in university activities outside the classroom, visiting with classmates outside the classroom, visiting with the professor outside the classroom, and visiting with an academic counselor. The 4 socialization items resulted in a Cronbach alpha reliability coefficient estimate of 0.512.

To investigate this further, the 4 items were aggregated into 1 composite score for the socialization construct. Item discrimination was used to determine how the 4 socialization items correlated to the total subscale created. Discriminatory indices obtained, based on Pearson correlation coefficient (\(r\)), which ranged from 0.30 to -0.30, dictated either a modification or deletion of the item. This item will introduce randomness and only increase the measurement error. Because the discrimination index for outside activities with the counselor had a discriminatory index of 0.30, it was deleted. This resulted in an increase in the Cronbach alpha reliability coefficient estimate from 0.51 to 0.59 for the new aggregated total score distribution of the socialization construct.

The intercorrelation matrix between the dependent variable (academic achievement) and the 22 independent variables indicated a statistically significant correlation between the dependent variable and 11 of the independent variables (see Table 1). The independent variables that were not statistically significant were SAT writing, SAT multiple choice, SAT essay, high school dual enrollment course type, parental education level, persistence in the second college year, outside-classroom activities, outside-classroom activities with classmates, outside-classroom activities at the university, and visits with academic advisors (\(P > .05\)). These variables were excluded from further analysis.

Factor analysis using varimax rotations with an Eigen value of 1 was used to reduce the redundancy of...
the 11 independent variables. The principal component analysis yielded 4 factors that accounted for 68.99% of the variance between all 11 variables (see Table 2). After the data-reduction procedure was complete, the 4 identified factors were renamed to represent 4 new independent variables:

- High school achievement, as measured by TAKS scores.
- High school performance, as measured by high school GPA.
- Aptitude, as measured by SAT critical reading and math scores.
- Proactive, as measured by student persistence in the first year of college and the student’s socialization outside the classroom with professors.

A correlation analysis of the dependent variable and 4 new independent variables yielded the intercorrelation matrix depicted in Table 3.

The full model regression analysis used to determine the variance between the dependent variable of academic achievement (Y) and the linear combination of the independent variables high school achievement (X1), high school performance (X2), aptitude (X3), and proactive (X4) yielded results for the regression coefficient (R = 0.61); degrees of freedom (4, 81), the F-distribution value (F = 11.92, P = .05), the effect size (R² = 0.37), and the adjusted effect size (R² = 0.34).

The derived F value for the full model (11.92) was statistically significant (P < .01). Based on these findings, the null hypothesis was rejected, and college academic achievement (Y) was considered to be a function of the 4 independent variables (X1, X2, X3, and X4). The effect size (R² = 0.37) indicated that 37% of the variance in academic achievement was accounted for by the combination of the 4 independent variables.

The significance of the standardized regression coefficients between academic achievement and the 4 independent variables was tested (see Table 4). Both high school achievement and high school performance were found to be significant at P = .03 and P = .01, respectively.
A second comparison of variance was made between the full model and the independent variables by removing 2 of the independent variables at the same time from the equation $\beta_Y | X_1 + X_2 + X_3 + X_4$ (see Table 6). All possible procedures were used to derive the best fit. Removal of high school achievement ($X_1$) and high school performance ($X_2$) contributed to 17% of the variance in the dependent variable ($Y$).

A third comparison of variance was made between the full model and the independent variables by removing 3 of the independent variables at the same time from the equation $\beta_Y | X_1 + X_2 + X_3 + X_4$ (see Table 7). All possible procedures again were used to derive the best fit. Removing high school achievement ($X_1$) contributed to 21% of the variance and removal of high school performance ($X_2$) contributed to 27% of the variance in the dependent variable. Removing both aptitude ($X_3$) and proactive ($X_4$) contributed to 12% of the variance in the dependent variable ($Y$).

All Possible Procedures

After performing multiple linear regressions, further analysis of the data was completed by using a backward elimination regression procedure on the full model to address the unique variance explained by each of the independent variables. All possible procedures also were completed to derive the best, or most parsimonious, fit of the data. These procedures were done manually.

Variance between the full model and the independent variables ($X_1$, $X_2$, $X_3$, and $X_4$) also was analyzed to address the unique variance each variable contributed to the dependent variable ($Y$), academic achievement, as measured by the student’s college GPA (see Table 5). Each independent variable was removed individually in succession from the equation $\beta_Y | X_1 + X_2 + X_3 + X_4$. When the $X_4$ variable (proactive) was removed from the equation ($\beta_Y | X_1 + X_2 + X_3$), the beta coefficient ($\beta$) was 0.59, and the effect size ($\beta^2$) was 0.34, indicating that the proactive variable contributed a unique variance of 3%. When the $X_3$ variable (aptitude) was removed from the equation ($\beta_Y | X_1 + X_2 + X_4$), $\beta$ was 0.60 and $\beta^2$ was 0.36, indicating that the aptitude variable (SAT critical reading and math scores) contributed a unique variance of 1%. When the $X_2$ variable (high school performance) was removed from the equation ($\beta_Y | X_1 + X_3 + X_4$), $\beta$ was 0.54 and $\beta^2$ was 0.29 indicating that the aptitude variable (high school GPA, high school rank, and number of dual enrollment credits earned) contributed a unique variance of 8%. Lastly, when the $X_1$ variable (high school achievement) was removed from the equation ($\beta_Y | X_2 + X_3 + X_4$), $\beta$ was 0.58 and $\beta^2$ was 0.33, indicating that the high school achievement (TAKS scores) variable contributed a unique variance of 4%.

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Table 3
Intercorrelation Matrix for 4 Factors

<table>
<thead>
<tr>
<th></th>
<th>College Academic Achievement</th>
<th>High School Achievement</th>
<th>High School Performance</th>
<th>Aptitude</th>
<th>Proactive</th>
</tr>
</thead>
<tbody>
<tr>
<td>College Academic Achievement (Y)</td>
<td>1</td>
<td>0.459**</td>
<td>0.520**</td>
<td>0.351**</td>
<td>0.340**</td>
</tr>
<tr>
<td>High School Achievement (X_1)</td>
<td>1</td>
<td>1</td>
<td>0.454**</td>
<td>0.405**</td>
<td>0.222*</td>
</tr>
<tr>
<td>High School Performance (X_2)</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0.366**</td>
<td>0.295**</td>
</tr>
<tr>
<td>Aptitude (X_3)</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>0.196</td>
</tr>
<tr>
<td>Proactive (X_4)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
</tbody>
</table>

**P < .01
*P < .05

Table 4
Standardized Beta Coefficients Between Academic Achievement and Independent Variables

<table>
<thead>
<tr>
<th>Independent Variables</th>
<th>Standardized/ Beta Coefficients</th>
<th>t</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>High school achievement</td>
<td>0.23</td>
<td>0.22</td>
<td>.03</td>
</tr>
<tr>
<td>High school performance</td>
<td>0.33</td>
<td>3.15</td>
<td>.01</td>
</tr>
<tr>
<td>Aptitude</td>
<td>0.11</td>
<td>1.06</td>
<td>.29</td>
</tr>
<tr>
<td>Proactive</td>
<td>0.17</td>
<td>1.85</td>
<td>.07</td>
</tr>
</tbody>
</table>
RadioLogic Technology explains 17% of the dependent variable, academic achievement, as measured by college GPA.

- Aptitude, as measured by the critical reading and math component of the SAT examination, accounts for 12% of the variance in college academic achievement.

- Proactive measures taken by students account for 12% of the total variance in college academic achievement.

The results of this quantitative study support the results of Adelman’s “toolbox” studies and Tinto’s longitudinal model of student departure. Both Adelman and Tinto purport that a rigorous high school curriculum plays a significant role in college success. The findings from this study underscore the importance of college preparation while in high school. Specifically, participation in a dual enrollment program that allows students to earn college credit, together with high school GPA and ranking, accounts for 17% of the variance in college academic achievement. Consequently, administrative and academic oversight of dual enrollment programs and their curricula is warranted. Dual enrollment program participation may be a key to decreasing college attrition, especially in the allied health professions.

**Implications for Practice**

By increasing the body of knowledge about academic achievement, especially for students seeking an allied health degree, the results of this quantitative study contribute in four primary ways.

- The results help postsecondary institutions and school districts develop academic and financial support programs.

- The findings emphasize the importance of high school curriculum and preparation for college success.

- Administrators should consider implementing dual enrollment programs and monitoring their effectiveness.

- Financial support and academic advising should be provided to students enrolled in dual enrollment programs.
systems for dual enrollment programs, especially allied health programs. Allied health programs require a hefty budget to maintain expensive medical equipment and supplies; thus, sharing resources might be a viable option for both secondary and postsecondary institutions. In addition, colleges may develop mentorship programs to assist high school teachers with course development in an effort to “close the gap” and assist students who are transitioning from secondary to postsecondary schools.

Results also assist postsecondary institutions in developing retention strategies for students participating in dual enrollment programs, especially those interested in allied health fields. Perhaps colleges may work with school districts to provide tutoring for students who are challenged by courses in which medical terminology and patient-related concepts are introduced. Tutoring may help decrease attrition rates once these students enroll in college allied health professional programs.

In addition, our results attempt to meet the demand for health care professionals by recruiting and retaining more students in the allied health professions. College faculty may elect to visit high school classrooms and provide information on current medical practices to keep students engaged in their pursuit of a medical profession. Secondary and postsecondary institutions might consider incorporating a clinical component into their curricula to provide exposure to the hospital environment in all allied health-related courses.

Finally, results should strengthen collaboration between postsecondary institutions and school districts that participate in dual enrollment programs.

Recognizing that the academic work of high school students provides a significant contribution to their college academic achievement is crucial to the success of both secondary and postsecondary institutions. For example, this study revealed that TAKS scores, high school GPA, high school rank, and the number of dual enrollment hours acquired in high school play a significant role in college academic achievement. Therefore, it benefits postsecondary institutions to assist school districts in maintaining college-level rigor in their dual-credit courses. This can be accomplished by sharing college course resources with the high school teachers teaching dual-credit courses. In addition, college professors may serve as mentors to high school teachers striving to achieve college-level rigor. These joint actions may better test the college ability of students and give them the type of academic preparation necessary for a successful college career. These actions may also help reduce attrition rates in allied health programs, especially in programs preparing students for a radiologic technology career.

Study Limitations
In conducting this study, there were several assumptions made. First, it was assumed that the information in the student files was accurate and factual. In the statistical analyses, the study assumed linearity and homoscedasticity of the data and a normal distribution of the dependent and independent variables. Additionally, the research designs used do not apply to cause-and-effect relationships.

The sample size used was small, and the subjects attended a single postsecondary institution. Caution, therefore, should be exercised in generalizing these findings to all high school graduates. Because this study examined the relationship between academic achievement and the independent variables among students pursuing allied health degrees, this relationship may not apply to students in other academic programs.

Gender was not explored as a factor contributing to the choice of an allied health program. In addition, because this study included students who had matriculated into an allied health program immediately after high school graduation, they may differ from students who matriculate later in life. The authors chose not to explore the reasons why the students selected the university, which may have been a factor in their college performance.

Because our dual enrollment survey relied on the recollections of the students, the time-lapse since they earned their dual credits in high school may have affected the reliability of those recollections.

Future Research
This study accounted for 37% of the variance in college academic achievement among allied health students in dual enrollment programs, but many of the factors affecting that achievement remain unknown. Future researchers may consider relating academic success of dual enrollment students to variables such as health profession-related skills, attendance in a clinical component of the program, and cultural or social background. Because dual enrollment credits were embedded in the high school performance construct, which also included high school GPA and rank, future researchers may want to investigate dual enrollment credits as a separate variable.
The academic success of dual enrollment students also could be related to the secondary teachers and the allied health professionals who teach them. Examining such variables as educational background, teaching credentials, years spent teaching, performance outcomes, and past work experience might give additional insight into student success. Because participation in dual enrollment programs and social networking with professors both contribute positively to college GPA, additional research is needed to confirm this finding. Investigating the types of social networking that help students succeed in college is also important.

Lastly, this study should be replicated among allied health students in other dual enrollment programs in other school districts to add to the findings. Refining and validating the survey instrument so that it better captures the phenomenon of dual enrollment, specifically targeting the experiences of students while in high school, also is recommended. To capture the long-term effects of dual enrollment programs on allied health students, a study targeting students who matriculated from dual enrollment programs and are now part of the workforce would be beneficial.

Conclusion

Dual enrollment programs can provide an effective pathway for students to transition into college. College academic achievement is a function of high school achievement and performance, aptitude, and proactive measures taken by students while in these programs. Directors of allied health programs should consider evaluations of academic work that model the variables identified in this study before admitting students to their programs. In addition to high school GPA, high school ranking, and entrance examination scores, the participation of students in dual enrollment programs and socialization activities also should be considered. These steps may help reduce attrition rates in allied health programs and help meet future national needs for health care professionals.

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Marti Flores, EdD, R.T.(R), RDMS, RDCS, is a tenured associate master technical instructor at the University of Texas–Texas Southmost College in Brownsville where she teaches in the radiologic technology and diagnostic medical sonography programs. She also serves as the director of the diagnostic medical sonography program. Dr Flores is the recipient of an Outstanding Teaching Award from Blinn College in Brenham, Texas, where she served as the clinical coordinator of the radiologic technology program (1990 to 2003), and of the National Institute for Staff and Organizational Development Teaching Excellence Award from the University of Texas–Texas Southmost College.

Marie Simonsson, EdD, is an associate professor at the University of Texas–Pan American in Edinburg, Texas. She is also the director of the educational leadership doctoral program.