Promoting Student Achievement  
With Integrated Affective Objectives  

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In contrast to the perception that the low graduation rates in the SMET (Science, Mathematics, Engineering, and Technology) disciplines are a result of a “normal weed-out process,” studies show that large percentages of students are capable but choose not to persist, while others despite their dissatisfaction persist to graduation. Primary reasons for dissatisfaction and departure include non-sustained student interest in the discipline and a lack of the sense of belonging. Moreover, affective measures have been shown to be better indicators of early student departure. For students who do persist to graduation, dissatisfaction negatively affects employee qualities identified by ABET and the National Association of Colleges and Employers (NACE 2001). Most of these factors, such as honesty/integrity, teamwork skills, interpersonal skills, motivation/initiative, strong work ethic, flexibility/adaptability, and self-confidence, fall into the affective domain. Because the development of affective qualities has been correlated with student achievement, the aim of affective efforts need not be on retaining students, but rather on student achievement and retention will naturally follow.

The fact that student interest, belonging, motivation, and most of the NACE qualities are affective in nature suggests that an organized approach to foster appropriate affective growth could favorably impact student success in SMET disciplines. Standard levels of affective growth have been defined in Krathwohl’s affective taxonomy: receiving, responding, valuing, organizing, and characterization. This paper recommends the integration of discipline-based affective objectives into curricula to enliven, incorporate, and sustain the energy of students in order to attain higher cognitive and affective achievement.

Our experience has centered on the freshmen problem-solving and programming sequence in the School of Computer and Information Science at our medium-size, state university. We anticipate that this approach is widely applicable throughout our curriculum and is adaptable to other SMET disciplines. We began with the freshman year, because national and local data indicate that the majority of students leave SMET disciplines and college as well by the end of their freshman year. Integrated with cognitive objectives, affective objectives served to provide higher quality cognitive experiences for students and served to retain students who might otherwise have left the discipline for reasons other than academic difficulty. Building on prior work, our enhanced approach began with the definition and integration of specific affective objectives which supported the internalization of cognitive objectives and professional practices. Affective-cognitive growth was pursued through methodologies which included active and cooperative learning, student self-reflection, classroom discussion, and student incorporation into
academic communities. This paper provides a detailed description of our implementation process. Our experience has indicated that affective objectives can be used to foster academic excellence. Factors supporting this excellence include perceived competence (or self-efficacy), student effort, and student interest/enjoyment. Results also suggest that this approach had a beneficial effect upon achievement in women and minority groups. The assessment effort included the analysis of data drawn from validated instruments that measured various factors correlated with course grades and comparative course-completion rates.

Prior Work

A Bloom-based cognitive curriculum was defined for the introductory programming sequence in 1994. This framework was based upon the six levels of Bloom’s cognitive taxonomy: knowledge, comprehension, application, analysis, synthesis, and evaluation. This cognitive approach led to modest increases in course-completion rates that were not statistically significant. Use of these levels in explicit learning objectives allows for a standard identification of the extent to which learning objectives should be achieved. The results of attitudinal surveys indicated that students perceived the approach to be beneficial. Realized benefits included (1) the generation of materials which proved to be transferable to other instructors and (2) added instructor and departmental confidence that course objectives were being successfully attained. Continued poor course-completion rates led to the identification of other problems: many students possessed poor learning and study habits, high student frustration, and a great deal of students with a myriad of personal difficulties impinging on their abilities to achieve. To address these shortcomings, two affective initiatives were piloted in Fall 2001 and continued in Spring 2002: (1) the discussion approach and (2) the self-reflection approach.

Discussion Approach

The discussion approach involved numerous class discussions about the students’ cognitive-affective potential. During these discussions students were encouraged to confidently order their learning experiences around the works of Bloom, Maslow, Polya, Whitehead, Armstrong, and others. The ability of students to plan their cognitive growth and develop self-efficacy is a critical issue for many students in the introductory programming sequence (as shown by data in our prior work and the current work). In an end-of-the-semester student survey, students reported very high satisfaction with this approach as an aid to learning and demonstrated higher grades than sections not using this approach.

Self-Reflection Approach

Another affective initiative of our prior work, the BAM chart, was designed to enable students to enhance their attainment of the course’ Bloom-based cognitive objectives through the students’ use of an Affective framework and Maslow’s hierarchy of needs. This self-regulated learning tool was developed to foster affective and cognitive growth through student reflection and planning. Specifically the BAM chart (see Figure 1) assisted students in organizing their activities toward the successful completion of programming assignments, exams, and sometimes the course as a whole. Using Maslow’s hierarchy of needs in the left column of the chart, the student classifies specific needs and goals relative to a particular course effort. Then the student
identifies (1) the supports needed to fulfill these needs and goals, (2) necessary actions for success, and (3) values that should pervade the process. The two right columns were used for evaluation. This effort was initiated not only to improve the completion of specific endeavors but also to encourage the development of habits that would lead to successful college and career experiences.

<table>
<thead>
<tr>
<th>Krathwohl’s affective</th>
<th>Receiving Support needed</th>
<th>Responding Actions needed</th>
<th>Valuing</th>
<th>Results: positive and negative</th>
<th>Lessons learned Organization Habits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maslow’s needs</td>
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<tr>
<td>Self-actualization needs</td>
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<td>Esteem needs</td>
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<td>Belongingness needs</td>
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<tr>
<td>Security needs</td>
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<td></td>
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<tr>
<td>Basic needs</td>
<td></td>
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</tbody>
</table>

Figure 1: Original BAM chart (used in an enlarged format on legal size paper)

Support for this approach includes research which indicates that students, who set specific course-related goals for themselves, will attain higher levels of motivation and achievement.\textsuperscript{3, 15, 18, 26} In our experience, students often found the simple identification of necessary supports and an order of actions to be performed as highly enlightening. Many students expressed surprise that they could control the outcome of academic achievement. Others expressed how this tool could positively affect their future careers.

**Benefits and Limitations of Prior Work**

Results of these affective initiatives included (1) a 15% increase in students successfully completing the introductory programming course in the sections which implemented the plan and (2) strong student appreciation for both the discussion approach and the self-reflection approach as learning resources.\textsuperscript{11} Added benefits included a better understanding of the students entering our program, higher student motivation, less student frustration, and the potential for more successful students to meet the demand from industry for high quality graduates. A major limitation of these piloted affective initiatives was the lack of documentation for instructor transfer and a lack of clarity resulting from a lack of specific affective objectives.

**Affective Objectives in the SMET Disciplines**

Our current work centers on the integrated use of defined affective objectives to further promote achievement. Generally these affective objectives are tightly related to the cognitive objectives. In this section, we will discuss some concerns about the use of affective objectives, the
interdependence of the cognitive and affective domains, content sources for affective objectives, the development of affective objectives, and the instructional methodology.

Concerns about Affective Objectives

In SMET disciplines, a common concern relates to the distinction between students “feeling good” about themselves versus being actually competent. This is a legitimate concern. Affective course objectives should be grounded in the course content and should be used to increase overall student achievement. It is also evident that not every student belongs in a particular discipline and care should be taken not to mislead students concerning their actual abilities in relation to a chosen major. Nonetheless affective growth can be a valuable asset to talented students and can provide the motivation students need to remain committed to their chosen discipline.

Other concerns about the use of affective objectives identified by Bloom are: the fear of indoctrination, the belief that affective objectives are better treated at home or church, the privacy of personal values and beliefs, the length of time needed for student attainment of affective objectives, and the difficulty associated with the assessment of affective objectives.7 While the fear of indoctrination and respect for personal beliefs are certainly legitimate, we see an appropriate use of affective objectives in encouraging students to internalize discipline-accepted values and professional practices. While the length of time for affective growth is certainly longer, such growth can pay dividends in the long run. Affective growth in fact may facilitate future cognitive achievement. Though not easily assessed with exams like cognitive objectives, affective achievement can often be evaluated through the classroom observation of identified behaviors. Such observations may also serve to attune the instructor to student achievement throughout the course and help the instructor to move beyond a narrow evaluation of course success through the sole use of cognitive-based tests. Such instructor observation provides the instructor with a window into how the students are valuing the course’ content in terms of how the students are choosing to act. This information can assist the instructor in adjusting the course delivery and content in order to better address student needs. While affective-based behavior should be evaluated, these behaviors need not and generally should not be graded.7

Interdependence of the Cognitive and Affective Domains

There is much overlap, interdependence, and parallelism between the cognitive and affective domains.13 Cognitive level 1.0 Knowledge is related to affective level 1.0 Receiving since being attentive (receiving) is prerequisite to knowing (knowledge). This willingness to learn is also needed at the higher cognitive levels. At affective level 2.0 Responding, the student as prompted puts specific cognitive skills into action. At affective level 3.0 Valuing, the student moves beyond compliance and freely chooses to put that knowledge to work based upon a comprehension and ability to apply that knowledge. At the highest affective levels, 4.0 Organization and 5.0 Characterization, the student must have acquired the ability to analyze, synthesize, and evaluate a body of knowledge. Throughout this process affective behaviors are inseparably linked to the cognitive domain. Moreover growth in each domain may lead to further growth in the other domain.13
Instructional Methodology

Based on the results of our prior work, which indicated that the affective initiatives resulted in higher final student grades and course-completion rates,\textsuperscript{11} we implemented an enhanced plan in Fall 2002 to integrate specific affective and cognitive objectives into sections of our introductory problem-solving and programming sequence. Our goals were to clarify, document, and assess the methodology in order to make dissemination possible. Documentation included (1) the definition of integrated cognitive and affective objectives, and (2) the development of active and cooperative learning experiences, student self-reflection exercises, as well as classroom discussions. Assessment will be discussed in a subsequent section of this paper.

Content Sources for Affective Objectives

Since a major limitation of our prior work was lack of defined affective objectives, our first step was to develop these objectives. We found behaviors to be targeted in affective objectives from many sources. For example, a cognitive objective can serve as a prompt for an affective objective:

\textbf{Cognitive objective:}  
Students will be able to explicitly describe the steps involved in problem solving and how each of those corresponds to a phase of the software life cycle (Bloom Level 2).

\textbf{Affective objective:}  
Students will demonstrate a preference for reflective problem solving by choosing to create an analysis and design prior to implementing a program in the lab (Affective Level 3).

In a similar manner, specific classroom and lab activities may provide a springboard to the development of affective objectives. Priorities for affective objectives may also include those qualities and practices valued in industry such as those identified by NACE: honesty/integrity, teamwork skills, interpersonal skills, motivation/initiative, strong work ethic, and others. The results of our informal attitudinal surveys from our prior work\textsuperscript{11} also provided us with specific affective issues which needed attention: belonging, security, interest, and management of external personal issues. Open-ended questionnaires provided another source of feedback on student needs and satisfaction. Questions like the following were used in informal mid-semester course evaluations to uncover student problems and interests:

- What is your favorite thing about how this class is conducted?
- What is your least favorite thing about how this class is conducted?
- What concerns do you have about this class?
- What would you like to know how to do with your laptop?

In summary the sources of material for affective data are many: cognitive objectives, professional practices and qualities, the results of student surveys and other student instruments, and departure data from the literature and from the local institution.
Development of Affective Objectives

Like cognitive objectives, affective objectives need a defined behavior, a level of achievement, and a context in which the behavior can be assessed. Examples of affective objectives will be provided for each of the levels of the affective taxonomy. On the first level of receiving, the aim is to prompt the student to become aware of a particular subject, pay attention, and be particularly attuned to important information. A growth in interest can be seen in the subcategories of the receiving level: 1.1 Awareness, 1.2 Willingness to Receive, and 1.3 Controlled or Selective Attention. The following are example affective objectives for each subcategory.

1.0 Receiving

1.1 Awareness
Students become aware that testing is a part of the software development life cycle during the initial programming labs.

1.2 Willingness to Receive
Students are ready to participate as members of small groups to perform specific tasks during group activities.

1.3 Controlled or Selective Attention
Students pay particular attention when Polya’s problem-solving strategy is being utilized in a class discussion directed toward the development of a program.

Level 2 affective objectives presume receiving (all higher levels include achievement at all lower levels), and define some action that the students perform. Each of the sub-categories defining Level 2 affective achievement involves learner participation: 2.1 Compliance, 2.2 Willingness to Respond, and 2.3 Satisfaction in Response.

2.0 Responding

2.1 Compliance
Students document the software development process as stipulated in the problem description for programming assignments.

2.2 Willingness to Respond
Students use coding standards as taught in the lectures with minimal prompting in the lab.

2.3 Satisfaction in Response
Students demonstrate an appreciation for the value of high-level programming languages by solving a problem with a high-level language and comparing that solution with a solution written in assembly code.

At the third level, valuing, the student goes beyond compliance, appreciation, and willing participation. Valuing includes perceived relevance, an understanding of a practice,
worthwhileness, and commitment. Subcategories are 3.1 Acceptance of a Value, 3.2 Preference for a Value, and 3.3 Commitment.

3.0 Valuing

3.1 Acceptance of a Value
Students consistently show strong work ethic and initiative while working in groups.

3.2 Preference for a Value
Students recommend the use of Polya’s problem-solving strategy to fellow classmates who are having difficulty solving a problem.

3.3 Commitment
Students choose without prompting to enhance the quality of a program with appropriate search and sorting tools.

The fourth level of the affective domain, organization, refers to how deeply a value becomes part of the way a student forms judgments, makes decisions, and lives. Here the student not only values but also has integrated that value into a belief system. This system changes with the incorporation of new interrelated values. Subcategories are 4.1 Conceptualization of a Value and 4.2 Organization of a Value System. As students progress in the discipline, moving beyond the introductory courses, fourth level objectives become more appropriate.

4.0 Organization

4.1 Conceptualization of a Value
Students choose to create their own software development model to better fit the challenges posed by the nature of their senior project.

4.2 Organization of a Value System
Students discuss specific personal initiatives which demonstrate their commitment to lifelong learning.

At the fifth and final level, characterization, the person has so deeply internalized a concept or practice that it has become part of the person’s character. This is closely related to Maslow’s self-actualization level which is the highest level of achievement in his hierarchy of needs. There is a natural, comfortable, effortless quality associated with how the person performs activities at this level. This level of internalization is not usually accomplished until the student has become a professional and acquired years of experience. The subcategories are 5.1 Generalized Set and 5.2 Characterization.

5.0 Characterization

5.1 Generalized Set
Quality control managers always ensure the use of several appropriate testing strategies to effectively test a particular system.
5.2 Characterization

Software project managers continually energize their development teams remaining focused on team motivation, the organization and melding of individual and team efforts, and the fostering of innovation and quality.

Use of Affective Objectives

Like cognitive objectives, affective objectives need a context in which they are evaluated. Because classroom observation is one of the most common means of evaluating affective objectives, the students in the class must be active, otherwise there is no activity that can be evaluated. Group activities can often simplify the evaluation process because it lowers the number of student processes to evaluate. Group or team experiences can be used for problem-solving, discussion, and even student reflection exercises. Fortunately, active and cooperative learning have many benefits and do not impose undue burdens. For example, active and cooperative learning has been shown to increase motivation, self-efficacy, depth of understanding, skills, comfort, and stimulate problem-solving. Use of these approaches has been shown to improve overall retention, retention of non-traditional students, and reduce gender and racial bias.

Our Experience of Active and Cooperative Learning

Our lecture and labs are integrated. Lab work and other classroom activities are conducted in a cooperative atmosphere and students are often encouraged to work in small groups. The instructor and lab assistants observe, encourage, and assist each group. When a group comes up with something good or interesting they generally share it with the rest of the class. The discussion approach, discussed in the prior work section, has also continued to be used as an active approach where students explore cognitive and affective strategies to support their overall ability to achieve. In informal questionnaires, many students reported that this active and cooperative learning experience was their most valued aspect of the course.

We have also observed the importance of incorporating students into learning communities. The sense of belonging has been shown to be an important component for contributing to the success of college students. Studies indicate the lack of belonging is one of the most frequent reasons for student departure from universities and disciplines. Survey data of our students in the introductory problem-solving and programming sequence indicate the importance of belonging. Our university through the Supplemental Instruction (SI) program provides a setting that fosters belonging. SI sessions are voluntary, for all students in the course, and generally meet three times a week. SI is supplemental rather than remedial. SI sessions are led by trained students who have successfully completed the course.

Student Self-Reflection and the Revised BAM Chart

The BAM chart, also discussed in the prior work, has continued to be used. The BAM chart serves as a tool to encourage self-regulated affective growth in the context of a student seeking to accomplish a specific course endeavor (e.g. a programming assignment). Student surveys
(Spring 2002) indicated that some revisions to the BAM chart might be desirable. Those results indicated the following:

- 87% of the students perceived a match between the BAM chart and its theoretical underpinnings
- 87% of the students thought it was an appropriate tool for the course
- 60% of the students considered the BAM chart easy to use yet only 47% of the students felt confident using the BAM chart and 67% of the students felt that it required a lot of effort and time

As a result of the survey, the BAM chart was simplified somewhat: Maslow’s highest two levels were combined into a row titled personal aspirations and Maslow’s two lowest levels were combined into a single row titled personal needs. In addition belonging was more clearly identified with course or project expectations since real belonging implies that students will be able to fulfill the course requirements. Personal aspirations can also be viewed in terms of pursuing excellence beyond the explicit course requirements. Personal needs deal with basic personal resources (e.g. owning a textbook, prerequisite knowledge), skills needed to start projects (e.g. the student is secure in writing program methods), and with issues that are holding a student back from achieving (e.g. enough time to sleep and study). The problem-solving aspect of the tool was also emphasized by adding Polya’s problem-solving strategy\textsuperscript{23} to the top row of the chart. The revised BAM chart is displayed in Figure 2.

<table>
<thead>
<tr>
<th>Understand the Problem/Opportunities</th>
<th>Design a Plan</th>
<th>Implementation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Personal Aspirations (Esteem and Self-Actualization)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Group or Course Goals (Belongingness)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Personal Needs (Physiological and Security)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 2: Revised BAM chart (used in an enlarged format on legal size paper)

From a practical viewpoint, there are few more cost-effective ways of encouraging student achievement than student self-reflection (much of which may occur outside of the classroom).
We do not grade the BAM charts themselves but observe improved student performance (e.g. better student solutions to programming assignments) linked with use of the chart.

Assessment Methodology

The current assessment methodology builds on our prior work and findings. These prior efforts, which addressed issues external to the cognitive domain, showed significantly higher rates of course completion in the introductory programming sequence and high student appreciation for the discussion approach and the self-reflection approach. The current work augmented this approach with the explicit definition of affective objectives and a greater use of active and cooperative learning to achieve those objectives. As anticipated the significantly higher rates of course completion in the prior work continued into the current work. In the current assessment, however, we focused on exploring what specific affective factors might be contributing to these higher rates of course completion. We used the Intrinsic Motivation Inventory and the Institutional Integration instruments at the end of the Fall 2002 semester in the sections using explicit affective objectives. Because these surveys were given at the end of the semester, the results were limited to input from those students who completed the course. The affective factors measured in these validated instruments were correlated with two grade variables: (1) course grade, and (2) the difference between course grade and cumulative GPA. We analyzed this second statistic to explore what factors might be influencing students whose course performance exceeded course expectations based upon their overall academic performance. We also explored possible differences between ethnic and gender populations with regards to the grade variables and affective factors.

Synopsis of Results

We found that course grade had a significant correlation with two affective factors: (1) perceived competence and (2) effort. We also found that the difference between course grade and cumulative GPA had a significant correlation with three affective factors: (1) effort, (2) perceived competence, and (3) interest/enjoyment. With regards to the achievement of under-represented groups in SMET disciplines, the results in fact showed strong achievement by the African American group and female group. The results also indicated no significant differences with regards to course grade between gender groups or ethnic groups. Nonetheless, specific affective factors were found to significantly impact grade variables differently for specific groups. In the following sections, we will describe our instruments and present further details of these results.

Intrinsic Motivation Inventory. The Intrinsic Motivation Inventory (IMI) is a validated instrument that consists of several subscales which are designed to measure a participant’s subjective experience such as interest/enjoyment, perceived competence, effort, value/usefulness, and felt pressure and tension regarding a particular activity. The scale consisted of seven possible responses ranging from “not at all true” to “very true.” The items can be modified to fit specific activities or situations and each of the subscales can be used independently. Several studies have used the IMI for assessing intrinsic motivation, internalization, and self-regulation. We added scales for external factors to measure such issues as home life, health, and time management. Figure 3 shows a sample of the items from our IMI.
11. Working with other students contributed much to my success in this course.
   1 2 3 4 5 6 7
   not at all true  somewhat true  very true

12. I believe this course could be of some value to me.
   1 2 3 4 5 6 7
   not at all true  somewhat true  very true

13. I think this is an important course.
   1 2 3 4 5 6 7
   not at all true  somewhat true  very true

14. I think I am pretty good at this course.
   1 2 3 4 5 6 7
   not at all true  somewhat true  very true

Figure 3: Sample Items from the IMI Assessment Instrument

1. I am satisfied with the opportunities to meet and interact informally with faculty members.
   [ ] Strongly disagree  [ ] Disagree  [ ] Don’t know  [ ] Agree  [ ] Strongly agree

2. Since coming to this university I have developed close personal relationships with other students.
   [ ] Strongly disagree  [ ] Disagree  [ ] Don’t know  [ ] Agree  [ ] Strongly agree

3. Few of the students I know would be willing to listen to me and help me if I had a personal problem.
   [ ] Strongly disagree  [ ] Disagree  [ ] Don’t know  [ ] Agree  [ ] Strongly agree

4. My non-classroom interactions with faculty have had a positive influence on my personal growth, values, and attitudes.
   [ ] Strongly disagree  [ ] Disagree  [ ] Don’t know  [ ] Agree  [ ] Strongly agree

5. Most students at this university have values and attitudes different from my own.
   [ ] Strongly disagree  [ ] Disagree  [ ] Don’t know  [ ] Agree  [ ] Strongly agree

Figure 4: Sample Items from the Institutional Integration Scale

**Institutional Integration.** This instrument is based on Tinto’s predictive model\(^{30}\) of student persistence in college. Tinto’s model suggests that levels of social integration, academic integration, and goal commitment predict the likelihood of student persistence at an institution. The instrument was developed and validated by Pascarella and Terenzini.\(^{21}\) A Likert scale, ranging from “strongly disagree” to “strongly agree,” is used to measure the level of student integration into social and academic communities. For our assessment, we used the Scale I: Peer-Group Interactions, and Scale II: Interactions with Faculty, to measure the level of belongingness students had with peer and faculty. Figure 4 shows a sample of the items from our instrument.
Correlations Between Affective Factors and Grades

In order to test whether there was a significant increase in course-completion rates between the course sections that used the affective initiatives over those who did not, we conducted a one-sample chi-squared test. The expected pass rate for the classes using the affective initiatives was set to the pass rate of the corresponding non-participating classes from Fall 1998 to Spring 2002. Because the two courses in this two semester sequence have different pass rates, separate tests were conducted for the first semester course and the second semester course. The results of the test for the first semester course showed a significant increase, $\chi^2 (1, N = 210) = 49.23, p < .001$.

The proportion of passing students in the sections using affective initiatives ($P = .65$) was much greater than the pass rate in the non-participating sections ($P = .41$). Likewise the results of the test for the second semester course showed a significant increase, $\chi^2 (1, N = 126) = 19.92, p < .001$. The proportion of passing students in the sections using affective initiatives ($P = .73$) was greater than the pass rate in the non-participating sections ($P = .53$). One potential confounding variable was the different instructors who taught in the compared groups.

To determine if there was a relationship between affective factors and the rise in course-completion rates, correlation coefficients were computed among the five scaled factors of the Intrinsic Motivation Inventory (i.e. interest/enjoyment for the course, perceived competence in the course, effort given to the course, value/usefulness of the course, and pressure/tension relating to the course), the two scaled factors used from the Institutional Integration instrument (i.e. peer-group interactions and faculty interactions), the impact of external factors, participation in course support activities, course grade, and the difference between the course grade and the cumulative GPA. We were particularly interested in significant correlations with course grade and significant correlations with the difference between the course grade and the cumulative GPA. These two grade-related factors are generally reflective of cognitive achievement. The correlations between course grade and perceived competence, $r(74) = .39, p < .001$, and between course grade and effort, $r(74) = .29, p = .012$, were significant. The correlations between the difference between the course grade and the cumulative GPA with effort, $r(74) = .31, p = .006$, with perceived competence, $r(74) = .30, p = .009$, and with interest/enjoyment, $r(74) = .25, p = .029$, were significant. These and other correlations with effort, perceived competence, and interest/enjoyment are shown in Table 1.

It is possible that the relatively low correlations shown by peer-group interaction and faculty interaction are a result of the fact that the Institutional Integration instrument is designed to measure institutional rather than departmental specific integration. In future work, we are adjusting this instrument to better reflect departmental integration as opposed to the broader notion of institutional integration. Similarly we are taking some of the questions in the Intrinsic Motivation Inventory and shifting the object of the question from the course in general to a major component of the course such as programming or problem solving. It is hoped this effort will provide more accurate correlations between the various factors.
Table 1
Correlations with Perceived Competence, Effort, Interest/Enjoyment and other Factors (n = 76)

<table>
<thead>
<tr>
<th></th>
<th>Perceived Competence</th>
<th>Effort</th>
<th>Interest/Enjoyment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Course Grade</td>
<td>.394**</td>
<td>.287*</td>
<td>.195</td>
</tr>
<tr>
<td>Course Grade – GPA</td>
<td>.297**</td>
<td>.314**</td>
<td>.250*</td>
</tr>
<tr>
<td>Perceived Competence</td>
<td>.433**</td>
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<td>.548**</td>
</tr>
<tr>
<td>Effort</td>
<td></td>
<td>.433**</td>
<td>.411**</td>
</tr>
<tr>
<td>Interest/Enjoyment</td>
<td>.548**</td>
<td>.411**</td>
<td></td>
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<tr>
<td>Pressure/Tension</td>
<td>-.598**</td>
<td>-.016</td>
<td>-.327**</td>
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<td>.539**</td>
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<td>.360**</td>
<td>.672**</td>
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<td>Peer-group interaction</td>
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<tr>
<td>Faculty interaction</td>
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<td>.174</td>
<td>.084</td>
</tr>
</tbody>
</table>

** Correlation is significant at the 0.01 level (two-tailed)
*   Correlation is significant at the 0.05 level (two-tailed)

Correlations Between Ethnicity/Gender And Grades

Due to the lower retention rates of minorities and women in SMET disciplines, one-way analyses of variance were conducted to evaluate the relationships between ethnicity and grade and between gender and grade. Course grade was the dependent variable in each ANOVA. The ANOVA testing ethnicity and course grade showed no significant relationship, $F(2, 72) = 1.87, p = .162$. Similarly the ANOVA testing gender and course grade showed no significant relationship, $F(1, 73) = 2.40, p = .126$. These results indicated that there was no significant performance edge demonstrated by any ethnic or gender group. The mean, median, and standard deviation of each of the groups is show in Table 2. The strong achievement shown by the African American and female groups is particularly encouraging.

Table 2
Descriptive Statistics for Ethnicity/Gender with Course Grade

<table>
<thead>
<tr>
<th>Group</th>
<th>Mean Grade</th>
<th>Median Grade</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>American White (= 41)</td>
<td>85.4</td>
<td>87</td>
<td>9.5</td>
</tr>
<tr>
<td>International (n = 23)</td>
<td>79.8</td>
<td>80</td>
<td>12.7</td>
</tr>
<tr>
<td>African American (n = 11)</td>
<td>83.4</td>
<td>88</td>
<td>13.3</td>
</tr>
<tr>
<td>Male (n = 59)</td>
<td>82.4</td>
<td>83</td>
<td>10.4</td>
</tr>
<tr>
<td>Female (n = 17)</td>
<td>87.1</td>
<td>91</td>
<td>13.4</td>
</tr>
</tbody>
</table>
Correlations Between Affective Factors and Grades Within Ethnic/Gender Groups

Significant correlations were also found between affective factors and grade variables. These results are shown in Table 3. Particularly noteworthy results include the correlations with interest/enjoyment for students who are not white Americans, the negative correlation with pressure/tension for international students, the correlation with peer-group interaction for White Americans, and the correlation with faculty interaction for African American students.

Table 3
Significant Correlations involving Ethnicity/Gender with Grade Factors

<table>
<thead>
<tr>
<th>Significant Factors by Group</th>
<th>Course Grade</th>
<th>Course Grade – GPA</th>
</tr>
</thead>
<tbody>
<tr>
<td>American White (n = 41)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Peer-group Interaction</td>
<td>.388*</td>
<td>.187</td>
</tr>
<tr>
<td>Perceived Competence</td>
<td>.327*</td>
<td>.238</td>
</tr>
<tr>
<td>Non-American-White (n = 35)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Perceived Competence</td>
<td>.455**</td>
<td>.367*</td>
</tr>
<tr>
<td>Effort</td>
<td>.383*</td>
<td>.412*</td>
</tr>
<tr>
<td>Interest/Enjoyment</td>
<td>.352*</td>
<td>.400*</td>
</tr>
<tr>
<td>International (n = 23)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Perceived Competence</td>
<td>.520*</td>
<td>.379 (p = .075)</td>
</tr>
<tr>
<td>Pressure/Tension</td>
<td>-.510*</td>
<td>-.411 (p = .052)</td>
</tr>
<tr>
<td>Interest/Enjoyment</td>
<td>.406 (p = .055)</td>
<td>.540**</td>
</tr>
<tr>
<td>African American (n = 11)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Effort</td>
<td>.695*</td>
<td>.831**</td>
</tr>
<tr>
<td>Faculty Interaction</td>
<td>.390</td>
<td>.653*</td>
</tr>
<tr>
<td>Male (n = 59)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Perceived Competence</td>
<td>.408**</td>
<td>.323*</td>
</tr>
<tr>
<td>Effort</td>
<td>.271*</td>
<td>.333**</td>
</tr>
<tr>
<td>Interest/Enjoyment</td>
<td>.166</td>
<td>.299*</td>
</tr>
<tr>
<td>Female (n = 17)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No significant correlations</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

** Correlation is significant at the 0.01 level (two-tailed)
* Correlation is significant at the 0.05 level (two-tailed)

Conclusion

Built on a stable cognitive framework, the use of affective objectives can facilitate student achievement. The process for forming affective objectives involves the identification of student needs and the definition of affective objectives. Affective objectives can be implemented and evaluated in classroom environments where active and cooperative learning are practiced. Affective and cognitive achievement can be further supported through student discussions in class and student self-reflection outside the classroom. Assessment results show significantly higher course-completion rates for the sections of our introductory programming sequence using
affective initiatives. In the current work, results indicated that course grades were significantly correlated with perceived competence, effort, and interest/enjoyment. Peer-group interaction, faculty interaction, and pressure/tension were found to be significantly correlated with grade factors for specific ethnic groups. Course achievement for minority and women groups were not significantly different from other groups. Our experience suggests that (1) affective factors do significantly influence student achievement and (2) the integrated use of affective objectives assists the cognitive development of students as measured through grades. Continued practice and expansion of these affective efforts are anticipated to favorably impact our overall retention rate and allow us to provide more quality graduates to industry.

References


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