How Learning Styles Affect Student Attitudes Toward Technology

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Abstract

The problem of the study was to determine whether the learning styles of students act as predictors of their attitudes toward technology use in the curriculum. The learning styles were measured using the Kolb Learning Style Inventory and attitudes toward technology measured by a survey instrument developed specifically for this study. Results of a multiple regression analysis used to distinguish whether attitude toward technology could be predicted by gender, class standing, major concentration, and learning style, showed no significant results. Principal components analysis supported a two-factor solution for the 12 items contained in the survey. These two factors were Internet and CD-ROM technologies. The results indicating that the frequent use of computers for "one to one" communication (email) and web surfing supported the literature regarding the steady increase in the use of electronic mail and the Internet by students in higher education.

Keywords: technology, learning styles, Kolb Learning Style Inventory, attitudes toward technology

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Introduction

There is no question that the main goal of any educator is to provide all students with a learning environment that encourages the comprehension and retention of the content being presented. The modern day classroom contains access to a variety of technologies that include, but are not limited to, CD-ROM, videotapes, multimedia presentation software, World Wide Web (WWW) discussion forums, and the Internet. With this increase in instructional technologies, there has been a growing concern in the educational community regarding the effectiveness of these tools to meet the needs of the students when integrated into the curriculum (Castellan, 1993; Van Dusen & Worthen, 1995). This concern is the culmination of such issues as (a) the knowledge and skill level of students and instructors regarding the technologies, (b) students' attitudes toward these technologies, and (c) how these technologies influence individual learning styles.

Other issues that are often discussed in relation to instructional technology integration are whether or not these technologies are using sound pedagogical and/or learning theory principles (Ahola-Sidaway & McKinnon, 1999; Grasha & Yangarber-Hicks, 2000). As observed by Grasha and Yangarber-Hicks (2000), faculty may choose certain instructional media solely based on the attractiveness of structural features. These motives tend to focus on the unique features that the instructional tool can offer while "issues such as how technology fits into a conceptual framework of principles for how people learn or into a broader philosophy of teaching and learning are seldom raised" (Grasha & Yangarber-Hicks, 2000, p. 3).

Although previous studies have addressed the issues of technology integration into a curriculum (Shneiderman, Borkowski, Alavi, & Norman, 1998; Spotts & Bowman, 1995) and the attitudes of students toward the various technologies being utilized (Morris, 1994; Moss, 2000), there is limited research that link these attitudes to individual learning styles (Kraus & Reed, in press).

Learning styles are "a cluster of psychological traits that determine how a person perceives, interacts with, and responds emotionally to learning environments" (Heinich, Molenda, Russell, & Smaldino, 1999, p. 406). If the ultimate goal of education is to provide an environment where the emphasis is on the acquisition of knowledge, then should we not focus our attention on the learning process that students go through and their attitudes toward the educational process as a whole? Applying this to an educational setting, instructors could explore the process with students to discover their views about the various teaching techniques being utilized in the curriculum and how these may affect their learning.

The purpose of this study was to determine if learning styles can predict student attitudes toward technology use in a recreation curriculum. This study will examine the relationship between individual learning styles and attitudes of students regarding the impact technology has on their learning process.

Methods

The sample for this study was drawn from a recreation curriculum at a large Midwestern university. All 66 undergraduate courses offered in the curriculum served as the sample. This total included all sections of all courses offered in the undergraduate program during the fall semester of the 2001-2002 academic school year. There were a total of 671 students enrolled in these courses. Of the total number of students enrolled in the courses, 422 different students completed the Kolb Learning Style Inventory and the Attitude Toward the Use of Technology Survey for a 63% response rate. The response rate was not higher because students who were enrolled in several courses in the department during the semester were asked to only complete the two survey instruments one time. Duplicate surveys were not used since subjects were asked how they felt technology in the department as a whole had influenced their learning, not technology in that particular course. Due to the varying knowledge, skill, and interest levels of the instructors in the department, the population included courses that incorporated not only a range of instructional technologies, but also a range of frequency levels with regard to the uses of these technologies. Essentially, all courses offered during the semester were utilized regardless of whether the instructor used technology or not.

Instrumentation

Two instruments for standardizing the collection of data from the students were utilized. The learning styles were measured using the Kolb Learning Style Inventory (Kolb, 1984) and student attitudes toward the use of technology were measured by a survey instrument developed specifically for the study.

The Kolb Learning Style Inventory (LSI) was used to ascertain differences among individual learning styles and corresponding learning environments. The respondents were directed to rank order four sentence endings that corresponded to the four learning modes: (a) Concrete Experience (CE) – feeling; (b) Reflective Observation (RO) – watching; (c) Abstract Conceptualization (AC) – thinking; and (d) Active Experimentation (AE) – doing. The four cognitive learning styles developed from the 12 questions are Accommodator (leader, risk-taker, achiever), Assimilator (planner, theorist, analyst), Diverger (creator, artist, sensitive to values), and Converger (problem-solver, deducer, decision-maker). Along with the four main categories, two combination scores were also assessed to indicate which end of two dichotomous scales the individual emphasized. The relationships were between abstractness and concreteness (AC-CE), and action and reflection (AE-RO). The relationship between the four dimensions and the four learning styles can be seen in Figure 1. The four ends of the model are identified as the subject's preferred way of dealing with information.

Kolb's Learning Styles

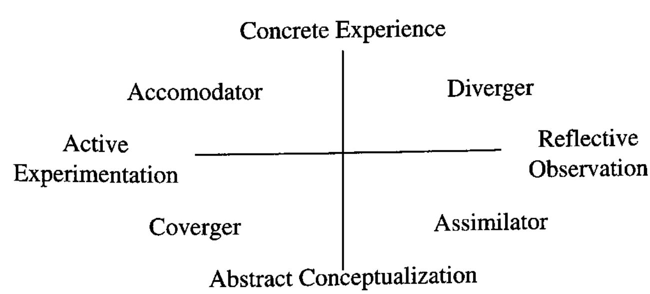

Figure 1. Kolb's Learning Style Types As They Relate to the Four Learning Style Categorizations (Kolb, 1984).

The Kolb LSI demonstrates a high degree of reliability with coefficient alpha reliabilities ranging from .81 to .87 for the four learning style scales (Willcoxson & Prosser, 1996). Evidence of the validity of the four factors forming two bipolar dimensions has also been found for this instrument (Loo, 1999; Willcoxson & Prosser, 1996).

A survey instrument was used to measure the attitudes of students toward technology. The survey contained a total of 28 questions separated into three sections: (a) personal information, (b) personal use of computers, and (c) attitudes toward the use of technology. This instrument was developed through a combination of a review by a panel of experts and an extensive review of instructional technology literature.

The first section gathered demographic data such as age, gender, and skill level regarding computers. Computer skill level was assessed through the use of a scale that included "1" as "novice" and "5" as "expert". Data collected from these items were used to provide a detailed description of the sample. A total of five closed questions were included in this section.

The second section requested specific information about the respondents' personal use of computers and related technologies. A scale was provided to guide the responses for these 11 questions. This scale provided five options regarding how frequently the respondent uses the specified technology: (a) never – at no time do I use the computer for this purpose, (b) rarely – less than 5 hours a week, (c) sometimes – more than 5 hours a week but less than 1 hour a day, (d) often – more than 1 hour a day but less than 4 hours a day, and (e) frequently – more than 4 hours a day. Examples of specific software applications were provided for some of the questions to help clarify the terminology.

The final section assessed the respondents' attitudes about specified technologies and whether they facilitated or distracted their achievement of the objectives of the recreation courses. A scale was provided to guide the responses; the range of the scale extended from –5 to +5 with 0 being undecided. The negative end of the scale was labeled with the following sentence: This technology generally distracts me from achieving the objectives of the course. The positive end of the scale was labeled as: This technology generally facilitates my achievement of the objectives of the course. A total of 14 questions addressed technologies such as on-line quizzes, course websites, and interactive CD-ROMs.

The students who were enrolled in the courses that were included in the sample received a packet of information including a Study Information Sheet, the Kolb Learning Style Inventory, and the Attitudes Toward the Use of Technology Survey. Each of the three items in the packet contained a number, listed on the top right corner, in order to ensure that the responses of each student were kept together and so the responses on the LSI could be statistically compared to the responses on the Attitudes Toward the Use of Technology Survey. The packets were distributed either at the beginning or end of each class in the sample. An individual working with the researcher reviewed the Study Information Sheet with the class as a whole to ensure that all students were aware of the information contained therein.

The instructor was not present at the time of its distribution, completion, and collection in order to ensure that participation was strictly voluntary. The instructor was never informed of which students completed the surveys to not only protect their privacy, but to also keep any negative or positive consequences from occurring due to the completion of the survey. The completion of both instruments took approximately 20 minutes.

Pilot Study

A pilot study was conducted using the Kolb LSI and the Attitudes Toward the Use of Technology Survey. Both were used in order to test the validity of the attitude survey, and also to test the distribution process. The students were identified for participation through a random selection of classes offered through the curriculum during the first summer session of the 2001 academic school year. A total of 108 undergraduates completed the surveys. The individuals who participated in the pilot study were not included in the actual distribution and completion of the formal surveys during the data collection phase of this study. The researcher attended all randomly selected classes and distributed the surveys either at the beginning or end of the selected class. The completion of the surveys took approximately 20 minutes. The instructor was not present during the completion of the survey instruments and was never informed of which students chose to participate.

Since the Attitudes Survey was developed specifically for this study, an analysis of the reliability of the scales used in the personal use of computers and attitude toward technology sections was conducted. The Cronbach alpha for "Section 2: Personal Use of Computers" was .82 and "Section 3: Attitudes Toward the Use of Technology" represented a value of .84.

Results

In order to gather demographic characteristics of the sample, the first section of the Attitudes Survey contained five questions addressing the respondents' gender, age, class standing, major, and computer skill level. Of the survey respondents (N = 422), 56.9% (n = 240) were female. A total of 50.3% (n = 212) of the respondents were either 20 or 21 years of age. Although undergraduate courses were used for this investigation, 2.6% of respondents were graduate students and were not included in the data analysis. The majority of the students were juniors and seniors (30.1% and 32.9%, respectively). Freshman and sophomores made up 11.6% and 22.8% respectively.

Table 1, a cross tabulation of the gender and computer skill level data (one representing a novice and five representing an expert), showed that 58.5% of the females viewed their skill level as "3" with the next highest category being level "2" with 21.7%. Of the male respondents, 50.8% viewed their computer skill level as "3" with the next highest category being level "4" with 34.2%. The majority (55.2%) of the students (both males and females) believed their skill level was "3".

TABLE 1

Cross Tabulation of Gender and Computer Skill Level

	Computer skill level					
Gender	1	2	3	4	5	Total
Female	3	52	140	43	1	239
Male	3	19	92	62	5	181
Total	6	71	232	105	6	420

A cross tabulation of the data gathered regarding the respondents' age and computer skill level revealed that with every age category except "over 22", at least 50% of the respondents in the representative categories viewed their computer skill level as "3". The cross tabulation of class standing and computer skill level confirms this point with 30 freshmen (61.2%), 53 sophomores (55.7%), 68 juniors (53.9%), and 77 seniors (55.3%) all reporting a computer skill level of "3".

Descriptive Analysis of the Kolb Learning Style Inventory

The Kolb LSI assessed respondent learning styles. The results revealed that 31.9% of the students were classified as "Accommodating" with 27.2% falling into the "Diverging" category. The remaining students were "Assimilating" (26.0%) and "Converging" (14.9%). A cross tabulation of learning style with gender identified a fairly equal distribution of learning styles for both males and females. This supports the idea that the students in the courses were not (regardless of gender) categorized as only one or two learning styles.

Suitability of the PCA for the Actual Data Collection

An examination of the correlation matrix revealed the presence of numerous coefficients of .30 or above. The initial run of the PCA revealed the presence of four factors with eigenvalues exceeding 1 (totaling 66.86%): factor 1, 4.37; factor 2, 1.56; factor 3, 1.07; factor 4, 1.04. These factors explained 36.38%, 12.96%, 8.88%, and 8.64% of the variance, respectively.

As with the pilot study, several forms of analyses were conducted in order to identify how many factors should be extracted for further analysis. First, an analysis of the scree test of eigenvalues plotted against factors was conducted. Using Catell's scree test, it was decided that retaining two factors for further investigation would be recommended. Only the first two factors, which accounted for a total of 49.34% of the variance, were included in the Varimax rotation analysis. The rotated solution (Table 2) revealed both factors showing a number of strong loadings. The distribution of the variance explained was also adjusted after rotation. The two-factor solution explained a total of 49.34% of the variance with Factor 1 contributing 29.86% of the variance and Factor 2 contributing 19.48%.

TABLE 2

Principal Component Analysis: Rotated Component Matrix

	Component	
Attitude toward technology	1	2
Course website	.750	
On-line quizzes	.719	
Internet (used by professor)	.687	
Internet (IUCAT, Knowledge Base)	.680	
On-line course evaluations	.653	
Class discussion forum	.621	
Multimedia	.489	
Class listserv	.439	.313
Email (one to one)	.409	
DVD		.864
Music CD		.844
Interactive CD-ROM	.378	.729

Note. Rotation Method: Varimax with Kaiser Normalization.

Only two items (class listserv and interactive CD-ROM) were classified as complex variables, or those that load on more than one factor. Loadings of more than .71 are considered excellent, .63 very good, .55 good, .45 fair, and .32 poor (Comrey & Lee, 1992). According to this standard, there were two items (Course Website and On-line Quizzes) that were considered excellent loadings on Factor 1 and three [Internet (used by professor), Internet (IUCAT, Knowledge Base), and On-line Course Evaluations] that were considered very good. Items in this factor were mostly related to the Internet and multimedia. If only items that loaded stronger than .60 were included in the analysis for Factor 1, then all items would not only relate to the Internet, but they are all very strongly loaded. Since an analysis of the factors is partly due to the logical arrangement of the items, it was determined that only including items with a .60 loading or higher be used to describe Factor 1. Factor 1 contributed 29.86% of the variance in the original variables.

The second factor was also well defined by a total of 3 items. The largest factor loading was for DVD with .864 and the lowest loading was for Interactive CD-ROM with .729. All items loading on this factor dealt with the use of the CD-ROM capabilities of a computer. Factor 2 contributed 19.48% of the variance in the original variables. Comrey and Lee's (1992) suggestion for significance of loadings shows that all three items loading on Factor 2 are considered excellent measures of the identified component.

Personal Use of Computers

Section 2 of the Attitudes Survey included 11 questions relating to the students personal use of computers and related technologies. Students reported that "one to one" communication (email) was used at least once a day with a total of 81.6%, while only 1.7% claimed to have never used computers for email. The next most frequent use of computers for these students was web surfing. A total of 40.5% surf the web more than 4 hours a day with 75.3% surfing the web more than 1 hour a day. Only one percent of respondents claimed to have never used the computer for surfing the web.

With reference to word processing, 65.3% utilize this form of computer technology more than 1 hour a day. There were no respondents claiming to have never used word processing before; this was the only item in Section 2 where this was the case. Although the majority of respondents used word processing on a regular basis, the data revealed that they rarely (49.3%) or never (19.5%) use spreadsheet and database management software (combined as one item) during their personal use of computers. A very small percentage (3.3%) of students used this technology more than 4 hours a day.

There were a significant number of students who reported that they have never used computers for computer programming (64.7%) or creating web pages (59.0%). Also scoring high in the "never" category was the use of computers for "one to many" communication (chat rooms) with a percentage of 36.2. A total of 34.3% claimed to never or rarely view and manipulate images during their personal use of computers. Seventy-one percent of respondents stated that they only rarely or never use computers for desktop publishing. With reference to playing and downloading music on the computer, 45.2% of students said they do this often or frequently. Thirty-one percent of students stated they play games on computers in their personal time less than five hours a week while only 6.9% played games more than four hours a day.

Attitudes Toward the Use of Technology

Section three of the Attitudes Survey included 12 questions about respondents' attitudes regarding whether specified technologies had either facilitated or distracted from their achievement of the objectives of the courses they have taken. Course websites, one to one communication using email, Internet used by the professor in class, and multimedia scored the highest among the 12 technologies. The use of a course website to supplement the classroom was viewed more positively than all other technologies listed. A total of 81.1% of respondents indicated that the use of a course website had some positive effect upon their learning. Only 2.8% of respondents recorded any negative scores for this technology.

Email communication (one to one) was viewed as positive by 63.8% of the students and 57.5% related positively to the use of the Internet by a professor in the classroom. Also acquiring a high positive score was the use of multimedia in the classroom with 56.5% of students giving a positive score. There were only 4.3% of respondents giving multimedia a negative score.

Nine percent of students believed the use of a music CD contributed negatively to their learning of the course objectives. There were, however, 35.9% of the students who claimed that this technology was either "Not Applicable" or they were "Undecided" as to whether it had a positive or negative affect on them. Also scoring high on the "Not Applicable" and "Undecided" options was the use of interactive CD-ROMs with 38.8%. Even with this amount not having either seen the use of this technology or being unclear as to how it influenced their learning, 35.3% of the students rated it positively. Out of the 12 technologies, the two highest occurrences of "Not Applicable" and "Undecided" scores were recorded for the use of DVD (50.5%) and a class listserv (47.7%).

One-Way Analysis of Variance

A one-way ANOVA was used to compare the data gathered from both the Kolb LSI (4 groups) and the Attitudes Survey (Total Attitude Score) in order to determine if learning styles of students act as a predictor of their attitudes toward technology use in a recreation course. Although ANOVA is not a statistical analysis that deals with prediction, it can identify if further prediction analyses are needed.

This analysis was chosen for this study to identify if the group means for each of the four learning styles differed with relation to the Total Attitude Score (calculated from responses in Section 3). The ANOVA table (Table 3) shows that the Between Groups F value of .450 is not significant at the $p < .05$ level. It was concluded, therefore that there is no difference between the four learning styles with reference to the Total Attitude Score.

TABLE 3

Analysis of Variance for Learning Styles

Source	Sum of Squares	Mean Square	df	F	p
Between Groups	315.644	105.215	3	.450	.717
Within Groups	85748.685	233.648	367		
Total	86064.329		370		

Note. Significance at the $p < .05$ level.

Multiple Regression Analysis

A standard multiple regression analysis was conducted to distinguish whether attitude toward technology (total score) can be predicted by gender, class standing, major, and learning style. Table 4 illustrates the correlations between the independent variables (gender, class standing, major emphasis, and learning style) and the dependent variable (attitude total score). These results showed no relationship between student attitudes toward technology as it related to gender, class standing, major emphasis, or learning style, since the highest correlation was only - .183.

TABLE 4

Multiple Regression Analysis: Correlations

Variables	1	2	3	4	5
1. Attitude total score	-	-.065	-.064	-.017	-.029
2. Gender		-	.006	.021	.101
3. Class standing			-	-.183	-.001
4. Major emphasis				-	-.002
5. Learning style					-

The R^2 value for this dataset was .010. This indicated that only 1% of the students' attitude toward technology was explained by the independent variables of gender, class standing, major emphasis, and learning style. The statistical significance of the prediction equation was analyzed by looking at the ANOVA table. This dataset showed a significance of .878 at the $p = .477$ level.

Discussion

Results of this study clearly indicate students' attitudes toward the use of technology in the classroom have no significant relationship with their preferred learning style as identified by Kolb's LSI. The regression analysis, also confirmed this with no significant results. Because many high school instructors now understand and use instructional technologies in their classes, they are exposing and engaging students to an increasing number of these technologies. Thus, the use of these technologies is more "normal" than "out of the ordinary." This familiarity may be why learning style had no significant relationship to attitude toward technology.

This point further highlights that this study was based on technology being used to enhance the learning environment. If technology were viewed as part of the learning environment as a whole, the students very well may not be able to clearly delineate it as either hindering or enhancing their learning.

Frand (2000) addressed this issue when he discussed "the information-age mindset" regarding how students have changed over the past several decades. Advanced telecommunication, such as cell phones, PDAs and wireless laptops, are becoming standard operating equipment for the 21st Century student. In addition, because of the power of word-processing, today's student prefers typing to handwriting notes, papers, and projects in comparison to the student of just 10 years ago. Frand suggested that this power goes beyond the simple improvement of legibility and the ability of spell-checking and electronic filing of documents. Students can now easily manipulate the course information that facilitate critical problem-solving and decision making skills. This mindset, as Frand described, "is common among students growing up in the globally connected, service- and information-intense, digitally based culture" (p. 16). This study supports this view and also advocates the idea that instructional technology has similar influences on students regardless of their preferred way of learning.

If all students (male and female) are being exposed to a variety of technologies throughout their entire educational careers (before college), many students may simply view these as permanent or regular components of the learning environment and there may be no difference between the views of males and females for this reason, as was found in this study.

The non-significant results regarding the predictability of students' class standing on their attitude toward technology may have also resulted from respondents' socialization to technology throughout their educational careers. Since most of the subjects in the study were between the ages of 18 and 21, there did not appear to be any difference in attitude between the age groups. This may be due to the proximity in age and the exposure that these groups have had to technology.

It is unclear as to why a student's "major" emphasis (i.e. outdoor recreation, therapeutic recreation, and parks and recreation) would not generate significant results with regard to predicting attitude toward technology. One possibility, in addition to those discussed previously for gender and class standing, is that the major emphases, being offered within the same department, may be too closely related, or attract a similar type of student. This would lead them to have similar attitudes toward technology use in the classroom.

The findings of this study are consistent with the frequent use of computers for "one to one" communication (email) and web surfing reported in the literature (Goggin, Finkenberg, & Morrow, 1997; Maughan, 1998). In addition, it is quite evident that college students are very familiar with the infusion of word processing into the classroom and its use in the preparation of homework assignments and projects. However, the large number of students that reported never using their computers for computer programming or creating web sites seemed to contradict the general interest with the Internet. One reason could be that students do not have access to either the software needed to create web sites or the software needed to transfer a finished site to the Internet. The appropriate software needed for these activities is typically expensive, which means that they may be somewhat "out of the reach" of students who are usually operating within a limited budget. Other reasons may be that students just prefer to be a user that "surf's" the net instead of web programming, the time commitment often needed to create web sites, the lack of knowledge on how to develop a web site, the need and practicality for a web site, and the complexity of creating and maintaining a web site which includes such issues as site design, information gathering (for content), navigation, and browser capabilities and compatibilities.

Course web sites, "one to one" communication via email, and multimedia all scored high on the positive end of the scale used in this study. Goggin et al. (1997) described the many uses of course web sites such as on-line syllabi, assignments, grading, and lecture notes. It seems only reasonable that students would find this one of the technologies that helps to facilitate the learning of course objectives.

Villamil-Casanova and Molina (1997) described multimedia as the "use of a variety of media to communicate messages, ideas, and content, thus appealing to more than one sense to create a multisensory experience" (p. 30). With this technology, all learning styles should, theoretically, be engaged and positively influenced since the multimedia tool may include narration, pictures, animation, video and/or text. This combination of capabilities can be altered to effectively distribute a variety of content in a variety of ways. This diversity may be the essential reason that 56.5% of the students recorded a positive attitude at the upper end of the scale for the use of multimedia in the classroom.

Overall, the descriptive data regarding the personal use of computers and the students' attitudes toward the use of technology in the classroom appeared to support the current literature on the subject (Alonso, 1995; Shneiderman et al., 1998). The lack of differences found between learning styles and attitudes toward technology were surprising. However, as discussed, there appear to be ample reasons why this result may have occurred.

Conclusion

While numerous studies have concluded that learning styles play an integral role in the learning process, there are few empirical studies that have explored learning styles as a predictor of college student attitudes toward the use of technology. Although the current capabilities of instructional technologies are well documented, Ahola-Sidaway and McKinnon (1999) suggested that:

> beliefs about how multimedia learning materials should be designed and about what they can and should be able to do in an educational context continue to evolve as new knowledge in the form of research findings, learning theory, technological innovations and applications, actual product development, and user feedback combine in unforeseen ways to inform those beliefs. (p. 68)

With the increasing use of technologies available for classroom instruction, it is important to be aware of how these will affect the learning process of students. If instructors simply use these technologies because they are unique and exciting, the sound pedagogical principles that should provide the basis of all instruction are completely ignored (Ahola-Sidaway & McKinnon, 1999; Brouwer, 1996; Grasha & Yangarber-Hicks, 2000; Rintala, 1998). Additional studies of this nature will help to solidify the perceived, and often assumed, positive effects of all educational technologies as they are used for classroom instruction. Rintala (1998) and Brouwer (1996) each warned against accepting all new technologies into the educational framework without investigating whether they are appropriate and useful. All too often instructors blindly use new technologies because of perceived benefits for the students and the educational process, but additional empirical evidence is needed to identify whether students are receiving these expected benefits.

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