Matching Learning Styles with Asynchronous Learning in Biomedical Engineering

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Introduction

Biomedical engineering requires students to learn engineering methods, anatomical and physiological information, and modeling methods so that the engineering tools can be applied. The quantity of information requiring memorization is extensive and it is difficult for students to retain unless it is provided in a just-in-time manner. From a teaching standpoint, it is difficult to determine the amount of class time needed because the backgrounds of the students are very diverse and many of the students need material that is very visual compared to standard textbooks. The latest alternatives are the use of asynchronous modules that can be used at the students selected time and at the pace that is best for them. Although the material can be developed, the faculty has the problem that the students view the material from a different context and the effort done by the students is unknown. This paper is based on the initial results of a human movement module, which proves information on both student learning styles, pre and post – examinations, and the time each student spent using the module as well as the use of video clip of the various motion.

Background

Biomedical engineering requires the learning of multiple technical languages, however the requirements of engineering are that the majority of time must be spent developing problem-solving skills. Several learning modules have been developed for the students that deal with misconception of concepts such as mass, weight and gravity.

The learning modules have resulted in improved testing scores, but there has been little understanding of the way students are utilizing the material to see if improved versions can be produced with a minimal effort.

The development of material for the students is made more complex because each student has a different cultural background, a difference in learning styles, and different intellectual capabilities. Studies on the effects of personality type on engineering performance have been done[1] based on standard teaching methods. The leaning styles have been documented in several ways; however the availability of learning style scales[2] has made it a focus for our future work. The different learning styles document a difference between individuals on the order of material and the method of presentation for different groups of individuals. The contrast of group instruction and individualized instruction has been well discussed, and it has emphasized the problems with the needed time to understand based on background and ability.[3]

The use of new technology may provide the needed differences for the students, which can allow the faculty to focus on general rather than specific needs. The use of asynchronous leaning modules which incorporate a variety of learning objects can provide sufficient forms of information that permit the majority of students to succeed. The use of the learning modules also eliminates the time restrictions, which result from traditional lectures.

Although success has been demonstrated in various applications[4], the ability to determine the elements that are critical for success can reduce the time efforts and improve the reliability of each module. Authorware™ by Macromedia is a software package that provides pathways to track the use of a learning module. In addition to

testing, the sections of module use and the time spent on each section can be documented. This process is complex to develop; however the application is to develop planning for future modules using a simpler software approach.

Plan

Determination of Learning Styles

Based on prior Meyer-Briggs testing of freshman students, the students that planned to take biomedical engineering were more diverse than the students in other programs. As part of this research effort, the students in the Introduction to Biomedical Engineering were required to take an assessment of learning styles.

As expected, the styles were diverse, however it was clear that the majority were active and visual learners. This information matched the expectations for the Joint Motion Module (JMM).

Joint Motion Module

The JMM was constructed to allow students to choose the pathway for learning that would reflect whether they were global or sequential learners. In both cases, information was provided in a number of different ways. The material had still images and text to simulate a standard text format, but it also had a combination of movie files and verbal discussion links.

Authorware™ JMM

During the term, the JMM was converted from a standard HTML file to an Authorware™ file. The students took an exam before the beginning of the module and at the end of the module. The data was collected in a file that could

be reviewed. The file contained the learning style information, the module use, and the results of the pre- and post- exams.

Results

Student learning Styles

GPA Range	Active – Reflective 11 to -11	Sensory – Intuitive 11 to -11	Visual –Verbal 11 to -11	Sequent global 11 to -11
3.6	-3	11	5	3
3.0	5	-9	5	-1
3.0	-3	9	5	1
3.9	7	-5	1	-3
2.2	7	1	3	1
3.0	3	-1	7	5
3.7	3	-3	11	1
3.2	3	11	11	5
3.0	9	3	-9	3
4.0	-5	7	1	-3
3.9	8	11	-8	10
4.0	1	-3	1	-3
2.2	9	9	5	5
2.4	3	-3	11	-3
3.9	3	5	9	3
2.5	3	-7	5	-5
3.1	9	-9	7	-5

3.0	-3	3	-3	-5
3.3	7	9	1	1
3.2	5	5	11	1
3.5	5	1	9	-1
3.0	1	7	1	1
2.4	7	7	3	5
2.4	-3	5	11	3

TABLE 1 – Sophomore Leaning Styles

The results shown in Table 1 illustrate the diversity of the students in the class. Some students reported that they were much more able to stay focused on learning the material because of the many options available for learning. The visual learners commented that the short video clips were especially helpful.

In the past, students have averaged 80% on a written exam with questions related to this topic. The use of the asynchronous module resulted in 29 perfect scores out of 33 students. Three students missed one question. One student missed 4 of 6 questions and later admitted that the CD that was provided was not used.

Initial results of the Authorware™ contained some of the information; however the program was not setup to allow the students to leave the site between taking the initial exam and the final exam; so the majority of students were not able to take the final exam or to document the time spent the next time they used the CD. The following table is for the students who did complete the information. Although the learning styles are provided, the degree of emphasis was not available.

	A / R	S / I	V / V	S / G	Movie	Time	TTR	Pre	Post
1	active	Intuitive	visual	sequent	61	28	1.19	4	13
2	active	Sensory	visual	sequent	65	52	0.79	8	10
3	active	Sensory	verbal	sequent	31	19	0.89	9	10
4	active	Intuitive	visual	sequent	26	25	0.62	9	14
5	active	Sensory	visual	sequent	60	36	1.49	9	14
6	active	Intuitive	visual	global	45	74	1.32	6	19
7	active	Sensory	visual	sequent	36	21	1.04	4	7
8	active	Intuitive	visual	sequent	4	23	0.29	14	14
avg					41	34.75	0.75	7.9	12.6

Table 2 – Sophomore Results

The questions used for this module were application rather than statement matching. For example, "What is the motion of the elbow when you pick up your cup to drink?" was one of the initial questions. For this group of student in the Introduction to Biomedical Engineering, they spent an average of ~ 35 minutes with the module and responded to the visualization material ~ 41 times. This group reduced the time spent on the test by 25% and improved their scores by 60% from the initial test. The only global student spent the most time on the module, and she had a 200% improvement. The students who used the module for less than 25 minutes had an improvement in score of 15%, while those who spent over 25 minutes had a gain of 107%.

A second group of junior students in Biomechanics spent about the same time on the module. They also reduced the time spent on the final exam, and they improved their score by 17%; however their initial scores were 47% higher than the sophomores. Based on students with a poor initial score, the student who used the module for less than 25 minutes improved by 14%, while the students who spent a greater amount of time improved by 27%.

Conclusions

This initial study demonstrated that the students' performance is related to the effort expended on the learning module. This information is clouded by the fact that the time relates to the time online, not the time actively using the module. A possible modification would be to turn the timer off when a certain time passes without interaction with the information.

The correlation with learning style was not possible because of an error in a modification of the module that will be corrected. The module presented two pathways for the students to use the information. It was assumed that there would be a correlation between the learning style and the pathway. Eight of 33 students used the assumed global pathway. The students who used the second pathway to a significant extent demonstrated an improvement of 46%.

The material developed will serve as both an initial presentation and the review for several courses in the curricula. The initial effectiveness will be tested using a website pretest.

The Authorware^{TM} module is being modified to include more information. It is proposed that a group of examples be provided to improve the thought process of

classifying normal movements. The module could then record whether the students used these examples. It is hoped that the new module will include the training of the modeling of joints for statics and dynamics.

This project demonstrated the potential power of the learning about how students learn; however future work will review alternatives that may involve less development time.

References

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