Applying Complex Adaptive Change Theory to Increase Nontraditional Engineering Technology Student Enrollment

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The increasing need to accommodate nontraditional engineering technology students at one state university is approached by presenting complex adaptive change theory to reduce this gap through multimodal delivery methods. A plan is in effect to reduce this gap by offering a systems-thinking flexibility of delivery modalities. A survey of 984 engineering technology students indicated 60.7% traditional and 38.2% nontraditional students. Adaptive organizational changes in this complex system support the gap reduction dependent upon whether these changes are 1) understood by prospective students, 2) related to the desired enrollment levels, 3) satisfies the student's needs, and 4) capable of significant improvement.

INTRODUCTION

The main goal of the complex system of higher education is to recruit qualified prospective students, educate those students, prepare those students for a career via education/training, and graduate accomplished students ready to join the professional workforce. Traditional college life is present for traditional full-time students who have recently graduated from high school, but there is a need to adapt this system by outwardly attracting the nontraditional student. Nontraditional individuals are over 24 years of age and possess some life altering event(s) typically preventing them from attending a traditional campus college (Jinkens, 2009). Further defining these types of individuals, they may have lost their jobs, started families, lack proper tuition funding, or have aged or retired needing to fulfill a lifelong dream of earning a college degree.

This paper copes with addressing this gap by describing a plan to gain information to reduce the gap. This paper includes the resources needed, how stakeholders are involved, how best to communicate the changes, and how to implement the plan. Most importantly, measure the results of the change in order to execute additional changes, and slowly fine tuning the system to remove any chaos or unnecessary complexity that may occur. The goal is to close the gap between the current and the desired state and continue to execute a feedback plan for a continual process improvement. The following sections describe this accomplishment in more detail.

THE GAP AND COMPLEX ADAPTIVE CHANGE

The gap is the need to increase nontraditional engineering student enrollment at one state university. We are targeting a unique group of potential students called nontraditional students. These students are typically over 24, married, have a family, and/or have a full-time job. These types of students cannot participate well in a traditional campus classroom setting such as attending day classes due to their personal obligations and job restrictions. The approach in reducing this gap is to explore alternative delivery methods and their properties. Offering pure online courses to all types of students, especially nontraditional students are nothing new. In addition, studies have shown that a purely online course is not suited for every student (Kyungbin, Daehoon, Eun-Jun, & Armstrong, 2010). Taking an online distance-learning course can isolate the student with feelings of loneliness leading to a decline in learned social cues and interaction skills previously obtained with their fellow students and their teachers in traditional school systems (Kyungbin et al., 2010). Realizing that this type of experience is undesirable, one university not only offers traditional, online, and hybrid courses but also another method called the converged course. A converged course contains the properties of online and hybrid courses, however, the class time is synchronous (real-time) with one instructor teaching two student audiences at the exact same time.

By addressing the gap in a systemic way, this complex system must change to fill this gap and at the same time must be agile enough to continue the status-quo traditional operation. The mere act of introducing a perturbation into this complex educational delivery system such as online or hybrid classes creates new innovative constructs and many possible solutions with the perceived best solution being implemented. Hawe, Bond, & Butler (2009) described the introduction of a new program in terms of complex adaptive system thinking as a focus on multilevel measures, structures, and capacity to assess the possibility of a whole system transformation and noting that the outcomes may involve long-term evaluation. Incorporating change in organizations as a whole is daunting and is often moving, or dynamic complexity where cause and effect are gradual such as the dynamically complex machine - the gyroscope. Gyroscopes react slowly to abrupt movements such as pushing it with your finger, righting itself surely but slowly. We experience this when an organizational change occurs in weeks, months, or even years after a discovered cause (Senge, 2006). To know if an implemented plan is working there must be feedback measures in place. Moreover, after analyzing the feedback, be prepared to make adaptive changes within the system (Senge, 2006; Meadows, 2008).

RESOURCES AND STAKEHOLDERS

At an early stage in time, this experiment may appear chaotic because of uncertainty, technical issues, and lack of outreached understanding. To aid in reducing the chaos is to make use of proper communication and feedback loops (Senge, 2006; Meadows, 2008). The resources needed to develop this information feedback loop will be someone designing and administering a survey instrument. The information gathered from the students will help determine if the plan is working. If changes to the planned gap reduction need to be made, the stakeholders of this system will need to get involved. The first line of change agents would be the faculty member and the department chairs. External stakeholders such as the Deans, Vice Presidents, the Registrar, or the Faculty Senate may get involved if the change is significant.

IDENTIFYING AND COMMUNICATING THE CHANGE

To support the planned gap reduction, the changes would need to be related to the desired goals to determine if these changes have an impact on the nontraditional student enrollment rate. A survey instrument will help determine if students understand the differences in the course offerings, and if this understanding relates to enrollment increases. Data collection, for the purpose of this study, was obtained independently from an already existing Student Course Evaluation (SCE) survey given now at the end of the semester. The independent survey was much faster to develop and administer to the students than a proposed adaptation of the existing SCE survey. This type of information is valuable regarding the course and the instructor but later the SCE could be adapted to include questions pertaining to the delivery method.

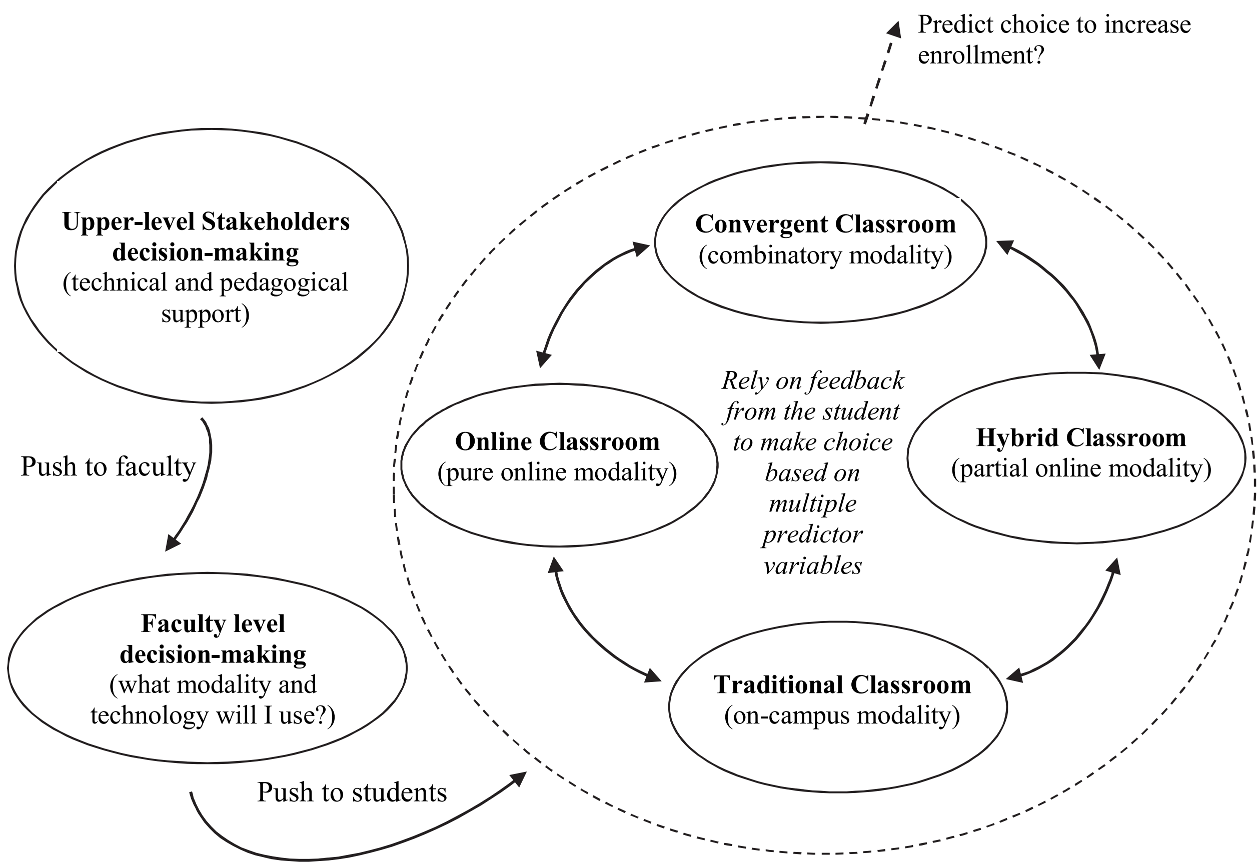
The data is assessed and analyzed sufficiently to ensure that any proposed change achieves the objective that ultimately helps the nontraditional students and not figuratively harms them. The following sections address the process of committing to change, reducing the chaos, and implementing positive improvement.

THE CONCEPT MAP

One of the best ways to illustrate a point, a paradigm, a system, or a mental model is to create a concept map. This allows both the author and the reader to share a common understanding and helps explain not only interactions but also captures the diminutive purpose that contribute to the whole of the system. Actually, two concept maps contribute to this explanation. The concept map shown in Figure 1 illustrates an explanation relating to high-level administrative support with a much lower level approach toward a specific area of interest. The initial node is the upper-level stakeholder decision-making position such as deans, academic directors, or vice presidents, representing the means available both technically and pedagogically for the department faculty for confident and assured modality decisions. Higher academic authorities make decisions based on budget, and the variety of packaged applications or social media that could be useful academic tools. At faculty-level decision-making and upon the known support of technology and pedagogy, the faculty has the academic freedom to design their classrooms to better utilize time, resource, and improve the student's learning experience.

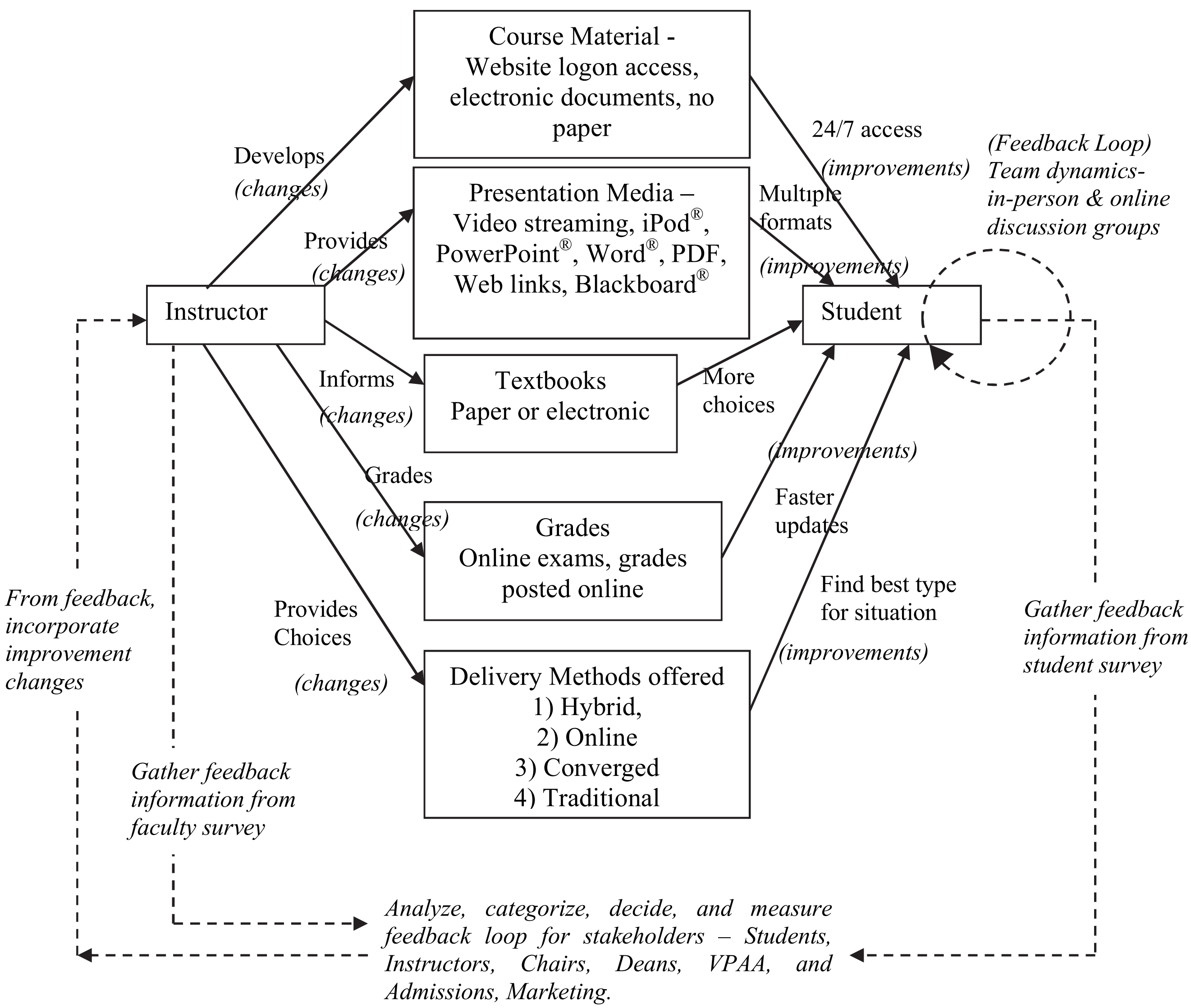
The next phase is the right side of the diagram inside the dotted circle representing the multiple modes of classroom learning situations. The typical approach for students is registering for one type of learning environment such as online or hybrid to fit their lifestyle or learning abilities. A newer section, converged, combines the two environments and the concept model illustrates the choices that students have at the beginning of a semester. The challenge is to gather enough data from nontraditional students to adequately predict the modality they will choose in the future so that the capacity is available for increased enrollment. The "predictive" model proposes to help guide faculty and the institution to make better future decisions about offering multiple classroom modalities.

FIGURE 1
MODEL USED TO PREDICT STUDENT DECISION MAKING AND ACTION TO CHOOSE AMONG MODALITIES GIVEN DIFFERENT TECHNOLOGIES



The concept map shown in Figure 2 illustrates interactions between instructor and student between both a hybrid and an online classroom setting (with the exclusion of the converged environment for sake of clarity) (Wiles, 2011). The boxes and the arrows illustrate the dynamics of the course components within the hybrid and online classrooms between the student and the instructor. The italicized text and dotted lines demonstrate the complex adaptive change balance loop of gathering survey information, analyzing, categorizing the information, and disseminating any changes that come about (Meadows, 2008). Changes are incorporated and managed for future data surveys, and the process continues.

FIGURE 2



THE SURVEY RESULTS

To avoid adding additional questions to the end-of-the-semester SCE, I developed and administered an independent ad-hoc survey to 984 engineering students. There were 169 total responses (17.2% response rate) with 89 usable responses (52.7% usability rate). The survey questions were designed to address the delivery method holistically and not inquire about standard SCE questions such as "Was the instructor knowledgeable about the subject?" The following questions in Table 1 were asked among the current students. The survey utilized a Likert scale 1-5 strongly agree to strongly disagree and the positive responses in Table 1 reflect the "agree" and "strongly agree" responses combined.

TABLE 1
SURVEY QUESTIONS ASKED

Question Number	Survey Item	Percentage of Positive Responses
1	For my busy schedule, I prefer online classes *(to capture lifestyle reasoning)*	52%
2	Live webcast lectures are fine as long as I can ask a question *(this is the synchronous converged modality)*	79%
3	I have enrolled in an online class and wished it were hybrid *(this is to capture a realization of regret)*	39%
4	I have enrolled in a hybrid class and wished it were online *(this is to capture a realization of regret, the opposite approach)*	31%

Demographic questions were also included in the survey. As seen in Table 2, the majority of the age groups or 60.7% were between 18 and 25 years of age representing the traditional student group. Another large chunk or 38.2% represented ages between 26 and 65 years old or the nontraditional student group.

TABLE 2
FREQUENCY DISTRIBUTION OF STUDENT AGE GROUPS

Age Group	Frequency	Percentage
Below 18 years old	0	0
18 to 25 years old	54	60.7
26 to 35 years old	18	20.2
36 to 45 years old	15	16.9
46 to 55 years old	0	0
56 to 65 years old	1	1.1
Above 65 years old	0	0
Prefer not to mention	1	1.1
Total	89	100.0

Table 3 shows the results of participants who indicated the delivery methods, modalities, or class types experienced. The frequency is higher than the number of participants because the students could select more than one. Students may have experienced online or hybrid classes separately but perhaps not the converged class. Others, such as 37.7%, selected prior experience with the converged class.

TABLE 3
FREQUENCY DISTRIBUTION OF CLASS TYPES TAKEN

Type of Class Taken (check all that applies)	Frequency	Percentage
Hybrid class	63	26.8
Online class with a live instructor (synchronous)	44	18.6
Online class with NO live instructor (asynchronous)	40	16.9
Converged class (combinatory)	89	37.7
None	0	0
Total	236	100.0

A survey of professors, chairs, deans, or other stakeholders may involve questions regarding the administration of these delivery methods such as 1) technical needs, 2) teaching assistants, 3) budget concerns, 4) supplies, and 5) other topics. This study did not include a survey of these stakeholders.

MEASURING RESULTS AND EFFECTIVENESS

This one-time survey from the 89 usable student responses is telling and indicates a measurable baseline to help determine through future surveys if there is a rise in interest, a trend, or a decline over time. The interpretation of the descriptive data from Table 1 indicates a surprisingly mediocre 52% agreement to take online classes due to their busy schedule (Survey Item #1). There may be other factors in addition to "busy schedule" not captured in this survey leading to this unexpected mediocre response. In Survey Item #2, a large percentage 79% agreed that if a live broadcast of an online course was given, there should be a synchronous learning environment where students and instructors can converse in real-time. This could indicate an overwhelming need for students to get their answers resolved quickly so that they can move ahead with their studies. Survey Item #3 and #4 are similar but the low agreement percentages (39% and 31% respectively) could indicate that students are less regretful or, in other words, correct in choosing the right delivery format to fit their needs roughly two-thirds of the time.

In Table 2, the age group demographics yielded 60.7% traditional students or between the ages of 18 and 25 leaving 38.2% between the ages of 26 and 65, with 1.1% preferring not to answer. This can be useful in knowing that of our current students; roughly, 4 out of 10 students studying in engineering technology are nontraditional students. Table 3 indicates responses to the type of delivery method classes taken in the past. The respondents experienced 26.8% of the hybrid classes and 37.7% of the converged class (synchronous online with a hybrid class at the same time), whereas a close tie exists between the two types of online classes. The online class without a live instructor (an asynchronous class) was experienced by 16.9% of the respondents while an online class with a live instructor (a synchronous class) was experienced by 18.6% of the respondents. There is not enough data from this survey to conclude any favoritism of one over the other.

To effectively utilize this data to change this complex adaptive system, the identification of improvement possibilities, the discovery of how the students are categorized by the registrar's office, along with advertising, all play a major part in measuring success. Warner (2010) stated an old business school adage "What gets measured gets done." (p. 10). It would be important for a higher educational institution to adopt some business tactic by measuring the outcomes and manage those outcomes to either increase productivity (increase enrollment) or prevent repeating the same mistakes again. Being able to measure the results and discover its effectiveness will be a challenge but very possible to accomplish once a process has been established.

IMPLEMENTING AND MANAGING THE CHANGE

Moving forward from this ad-hoc survey, the faculty identifies, categorizes, and agrees upon the resultant data before incorporating improvement changes into the course system structure. Major changes may involve dissolving a delivery method altogether if the results are unsatisfactory. Other changes may involve improving the current course delivery method such as incorporating links to a video server for archived video recordings or perhaps Facebook® or other social media outlet. Implementing the changes will involve a strategic approach by delegating the task to the faculty member(s) whose course(s) are affected. Once these changes are made, an adaptable change marketing scheme may be initiated to let prospective students know about the improved offering. Perhaps including "Night classes to fit your lifestyle!" or "New daycare center!" or the like will attract more nontraditional students. Methods of advertising and marketing that seem to work well are Google Ads®, Linked In® and other forms of web advertising to recruit nontraditional and adult prospective students (Recruit more students by partnering with an outside company, 2006). Another way is to collaborate with an outside company to share in the advertising costs (Online advertising is top priority for many adult programs, 2009). Traditional methods such as billboards and radio are other ways to reach the nontraditional types. Finding a proven method of advertising is a feat unto itself involving extensive source tracking and feedback relationships in place to measure its effectiveness. A separate study may need to be performed to determine the best advertising path to take.

CONCLUSION

This paper addressed the gap of increasing enrollment of nontraditional engineering technology students by offering different delivery modalities to match their lifestyle or learning ability. The concept maps illustrated how stockholders are involved and how best to communicate changes, as well as a planned execution. There was an attempt to eliminate undesired chaos that can exist in any complex system by using feedback loops and align the needs of the students with the modality offerings to promote continuous improvement. The survey showed a need for different types of modalities with a fondness of the online types of format. It was interesting to discover that 38.2% of the current engineering technology students at this university are nontraditional. Upwards of 37.7% of these students (nearly all) experienced the converged class (synchronous online with a hybrid class at the same time), whereas they were nearly tied in their preference between a synchronous and an asynchronous online learning modality.

According to a report released by the U.S. Education Department, almost 75 percent of today's college undergraduate students on a national level are considered nontraditional students (Evelyn, 2002). The new implementation of introducing the converged, online, hybrid, or traditional course delivery options will be monitored closely to determine if our time, effort and money are being properly spent. There will be adjustments within the course content themselves in a continuous improvement plan as well as taking a look at the entire system to determine student understanding, how it affects enrollment potential, the satisfaction of student needs, and continuous improvement plans. Changes within our control will be constant to reach a level of competence expected over time and also keeping pace with technological advancements such as new tools we can utilize. The challenge for our department will be to access viable feedback data and properly surmise the proper course to improve the offerings, provide capacity, and ultimately increase enrollment of nontraditional students at this state university.

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