NODAL DELIVERY EDUCATION: REMOVING DISTANCE FROM DISTANCE EDUCATION WHILE ACCELERATING AND ENHANCING THE LEARNING PROCESS

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ABSTRACT
Due to the challenges for students traveling across vast geographical distances to attend the Civil Engineering Tech (CET) program at Gateway Technical College in Wisconsin, USA, a new method of delivery was developed with various wired classroom “Nodes” located at different geographical campuses.

The delivery process developed was called Nodal.

Nodal is an advanced, brain-based accelerated delivery method taught across a video-over-IP medium. The instructor originates from a classroom at one location, and Nodal students simultaneously participate from specific Nodal classrooms at various locations. Teachers can share screens, print to remote classrooms, and take over remote computers showing students how to do something as if they were standing physically right behind them. Teachers can observe the students remotely via the webcam as if they were sitting live in class.

Nodal success in the CET program has allowed the program to expand beyond the traditional boundaries of Gateway’s geographical area. Last year Blackhawk Technical College entered into an agreement to open a CET Nodal lab for their students.

The success has also prompted the Electrical Engineering Tech and Mechanical Design programs at Gateway to adopt the Nodal delivery method into their programs this year and the Information Technology programs will begin using it next year.

The goal of Nodal is to provide students the feeling of being part of the classroom while separated geographically. Webcams and headsets provide in-class participation. However, Nodal is far more than just webcams and headsets.

One key to Nodal is the concept of PREPS (pre-recorded video lectures in Camtasia and/or Learning Objects developed in flash). These expand the classroom environment beyond the spatial constraints of time and geography. Students can work at their own pace, developing the basis of the class lecture prior to coming to class. There are also Prep Quizzes that the students must take anytime prior to the start of class. These automatically graded quizzes in Blackboard allow the instructor to quickly view the general level of understanding of the base concepts prior to class and orient the lecture accordingly. This process allows for an accelerated learning environment, and also an increase in comprehension during the “in-class” portion of the learning process.

Instructors are able to teach from anywhere. Classes have even been taught while an instructor was located in Poland and the students located in Wisconsin. Guest speakers also can now be from anywhere in the world instead of just those located geographically close to the campus.

Many projects are now multi-office designs in today’s Engineering profession. The Nodal method allows for students to interact across geographical distances, similar in nature to how engineers interact with their teams in the global environment.
Test results to date have shown no significant difference between students participating at the base classroom or from a Nodal classroom.

1.0 NODAL DELIVERY METHOD

“Life is no straight and easy corridor … but a maze of passages, through which we must seek our way, lost and confused, now and again checked in a blind alley.

But always, if we have faith, a door will open for us, not perhaps one that we ourselves would have ever have thought of, but one that will ultimately prove good for us.”[1]

–Spencer Johnson-

1.1 Initial Background
Gateway Technical College is located in SE Wisconsin (USA). It is a 2-yr associate degree college servicing a three county area covering 1162 square miles (300,760 hectares). Due to the extensive area covered, Gateway comprises 4 main campuses and 4 technical centers distributed throughout the three county area. Gateway has no student dormitories and is purely a commuter campus.

Pat Hoppe was hired in 1999 to lead Gateway’s Electrical Engineering Tech Program. Steve Whitmoyer was hired in 2000 to lead Gateway’s Civil Engineering Tech Program. Due to low enrollment numbers and therefore limited available resources, the Engineering Tech programs were only able to be offered at one of the 8 Gateway campuses and centers. The Racine Campus, located along Lake Michigan and the furthest point east in the entire district, was the campus that housed the Engineering Tech programs.

Due to this geographical location, some of the students had to travel over 50 miles (81 Kilometers), one way, in order to attend classes. This was a significant expense of time (over 2 hours of driving each day) and gasoline. As the price of gasoline dramatically increased between 2000-2003, the geographical location of the programs started to pose a serious obstacle to students in some parts of the district.

An alternative to the traditional program classroom offerings needed to be found in order to address this problem.

1.2 Alternative Delivery Methods
The changes to the Electrical and Civil programs were not just limited to new instructors. Before the new instructors started, it was decided that the 1st year of the Electrical Engineering Tech Program would be converted from a traditional lecture-lab program into a self paced, open lab program. The 1st year of the Civil
Engineering Tech Program was converted from a traditional lecture-lab program into an accelerated night program. The idea was that with the two new leads, the change in delivery formats would help increase enrollments.

The Technical College System in Wisconsin is unique in the sense that it hires people from industry (typically non-educators) as its faculty. The required level of prior work experience makes sure that the instructors understand their areas of expertise. The WTCS faculty are leaders in their professions, not teachers. Therefore, the new faculty are required to take teaching classes as part of their certification process in order to learn how to teach.

Mr. Hoppe and Mr. Whitmoyer were both engineers hired to teach. Because of this, they had no fixed perceptions (or fixed indoctrinations) of how to teach. Between 2000-2004, just as Engineers do, they tested and evaluated their teaching performances each year …modifying their approach to improve each following year.

Each instructor started from completely different educational delivery methods (self paced versus accelerated). By 2004, each had modified their respective delivery methods to the point where their respective delivery methods were more similar to each other than each of the original delivery method from which they originated.

However, while their teaching methods had improved … the issue of geographical limitations had not been addressed.

Various educational models that would help address the distance issue were investigated. Pure Internet Delivery, Correspondence Delivery, ITV, and others were looked at but found lacking in terms of addressing the needs of the students and effectiveness desired in a delivery method.

Today’s students want and expect to complete their assignments faster, spend less “wasted” time learning through inefficient modes, and seem to demand more and more personal “attention” from the professor. Compounded with this student expectation is the fact students have an increasing variety of different options available to them, especially with Internet-based classes popping up everywhere offering pseudo-alternatives to service their educational needs. The days of traditional lecture only classes where the students were expected to sit down, only speak when permitted to ask a question, listen to the wisdom imparted to them via a well scripted lecture, and then expected to go off silently and figure out the meaning and application are quickly disappearing from the educational landscape.

On the other hand, it seems that students were entering the classes less prepared than in the past. For whatever reasons, teachers were finding that they
had to spend more time reviewing concepts and applications that students were expected to know before class started.

1.3 Inspiration For A New Delivery Method
In 2005 Pat Hoppe and Steve Whitmoyer, along with Gateway’s Executive VP/Provost Zina Haywood, attended the National Institute for Staff and Organizational Development (NISOD) conference in Austin, Texas.

The value of the conference was the exposure to a wide variety of different technologies and delivery methods. Over lunch, the three sat down and mapped out on the back of napkins a new delivery method, infusing various pieces of technology with the existing delivery methods they had been employing and modifying since 2000.

Thus the birth of the Nodal delivery method....

Nodal is an advanced, brain-based accelerated delivery method taught across a video-over-IP medium. A classroom is located with live students at one location, and Nodal students simultaneously participate from specific Nodal classrooms. Each student has his/her own computer with headphones and a webcam. Teachers and students have the ability to visually see each other. Teachers can share screens, print to remote classrooms, and take over remote computers showing students how to do something as if they were standing physically right behind them.

Instructors have found it very valuable to actually see the physical facial reactions of the students, something lacking in most distance delivery methods. Students have also expressed positive reaction to being able to visually see the facial expressions of the instructor.

While the technology incorporates Video-over IP technology, the VoIP is not the only component to the Nodal delivery method. The Nodal delivery method parallels the concepts laid out in the 6-step M.A.S.T.E.R. plan discussed by Colin Rose and Malcolm Nicholl in their book “Accelerated Learning for the 21st Century”. The M.A.S.T.E.R. plan calls for the following:\footnote{2}

1) Motivation of the mind
2) Acquire information
3) Searching meaning
4) Triggering memory
5) Exhibiting the knowledge
6) Reflection on what was learned

The following are the components used to successfully implement these concepts in the Nodal Delivery Method:

1-4 WII-FM
WII-FM is an acronym standing for “What’s In It – For Me?” [2] This sets the stage for the entire class and program. These activities provide for the mental motivation and buy-in to the program by the students.

- **Welcome Bags**: At the beginning of the first semester students are handed welcome bags. These bags contain miscellaneous promotional items (mini scales, pens, pencils, highlighters, etc.) from various potential future employers (engineering & architectural firms, construction companies, manufactures, etc.) along with business cards and info regarding the company. From day one the students have already started on a set of business contacts, showcasing potential directions for their upcoming studies.

- **Engineering Tech Wing Lanyards**: At the beginning of the 1st semester, each student is handed an Engineering Tech Wing lanyard. This not only provides them with a place to hold their student ID cards, but gives them a sense of belonging right from the start with all the other engineering tech wing students.

- **Guest Speakers**: Many guest speakers are brought in from industry during the first semester to infuse by association into the students the purpose and value of the program. By having a wide range of speakers covering various topics, it gives credibility and value to the instructors and to the program. The advantage to the VoIP system is that guest speakers can be brought in and contribute from anywhere in the world.

- **Transfer Banners**: Gateway Technical College grants 2-yr technical associate degrees. By hanging the banners of the engineering school to which students can transfer, they see daily that they have educational options beyond their current program.

- **International Involvement**: Thru a variety of joint project efforts, students are able to see that the educational components taught here in SE Wisconsin are valid and used throughout the world. There is more regarding the International components later in this paper.

Orientations are held for new Nodal students at the beginning of the semester. This gives the instructors and the remote students the ability to meet face to face prior to the start of class, and gives the students the opportunity to become familiar with the basics of the technology which they will be using to join class. This initial interaction has been found to be vital in developing the buy-in from the students. Then from time to time (once a month or maybe twice a semester depending on the flow of the class), instructors will teach from the Nodal Labs and broadcast back to the primary classroom.

### 1-5 Class Preps

Effective methods are used to help students acquire information. Students absorb, especially base information, at varying rates. There are also differences between students with regards to how they best acquire base knowledge through
varying combinations of seeing, hearing, or being physically involved with the process.

![Learning Curve Diagram](image)

**Learning Curve**

Figure 1: Hypothetical Learning Curve

Figure 1 shows a hypothetical learning curve with regards to student understanding versus time. The student’s exposure to the instructor during lectures is a vital component of the learning process. The time spent is very valuable to the student because the student has access to a leading expert in the subject matter.

The dash line represents a typical lecture conducted without student preps prior to class. This demonstrates that a majority of student understanding is achieved outside the classroom, after the lecture has concluded, absent of the expert.

The solid green line represents preps conducted by the students prior to class … and the effective increase in student understanding given the same amount of in-class lecture time following the prep. The students are more prepared to understand the instructor because they have an initial basis of understanding from which to build upon. The instructor can answer higher level questions and provide deeper insight to the subject matter.

It’s important that the preps are able to stimulate each type of learner (visual, auditory, kinesthetic). The preps use a variety of mechanisms to facilitate this.

**CAMTASIA®**

Camtasia is a product of the TechSmith Corporation ([www.techsmith.com](http://www.techsmith.com)). Camtasia is a screen capture program which records the images displayed on the screen (or a portion of the screen) to a video file combined
with a voice recorded simultaneously from a microphone. According to TechSmith’s website:

“Camtasia Studio is a complete solution for quickly creating professional-looking videos of your PC desktop activity. Anyone can Record and create a full-motion video tutorial or presentation, in real-time, and publish it in the format of their choice.

Unlike other applications that require you to assemble screenshots into a simulated animation, Camtasia Studio records your screen in real-time with the highest quality video of any screen recording application” [3]

Camtasia recordings are very effective for preps because students can visualize the material being shown via the recording (visual), hear the presentation of the instructor (auditory), and just as important, are able to pause the recording in order to attempt or duplicate what is being discussed (interactive kinesthetic).

These are extremely useful when teaching the mechanics of a software program. In a traditional software training class, most of the instructor’s time is spent walking around answering the same basic questions regarding mechanics (how do I do this?). The beautiful part of a recording like Camtasia is that 95% of the mechanical aspects of how to operate the software can be answered for the student via the recording, allowing the instructor’s time in class to be freed up to answer the higher level questions of why, not how. In addition, it allows the student to progress at their own rate, pausing every so often and attempting to duplicate the actions in the software. If they were successful, they continue. If they were not successful at duplicating the actions, they can rewind that portion and review it over and try again.

The Camtasia recordings are also very useful to help develop mathematical operations. The students can watch a portion of the lecture, develop notes at their own pace, and try to duplicate the math calculations.

There are two typical ways instructors have used Camtasia files. Initially they were handed out on CDs. This allowed the student to view the files anytime at their convenience. Recently with the increase of home internet availability, the Electrical Engineering Tech department is placing their Camtasia files on a separate web hosting service so students just have to access the internet to view the files. By hosting them on the internet, instructors can post their Camtasia files and students have access instantaneously because the files do not need to be burnt to a CD.

Camtasia recordings are not the only effective way to create interactive learning. Learning Objects are another useful set of tools used in Preps. These are small
flash-based interactive modules. Instead of eating a whole block of cheese at once, the idea behind learning objects is to break up lectures into small chunks of concepts … or kernels of learning. [4]

One of the advantages of these learning modules (Camtasia, Learning Objects, etc) is that the learning modules can be utilized to help students develop a basic conceptual understanding of the topics to be covered in the classroom lectures prior to the classroom lectures … allowing the precious time spent interacting with the professor to be used to greatly enhance the student’s understanding of the topic versus spending the time laying down the basic conceptual groundwork. This more efficient utilization of the professor’s time allows the student to view the interaction with the professor more favorably.

Another side benefit to the learning modules is that student demands for more personal “attention” from the professor is somewhat satisfied because the professor is there, on the Camtasia recording, willing to explain the basic concepts of the topic whenever the student wishes.

Requiring a learning map or mind map is a very effective way to have the students create quickly accessed summary notes from each prep. The students can take traditional notes during the prep, but creating a single page mind map at the end of each prep is a great tool in tying all the information together and summarizing the notes. This single mind map then can be modified and updated during the lecture, enhancing the learning opportunity of the student.

Prep quizzes are also a very important part of the prep process. These prep quizzes are available to the students anytime from the ending of the prior class up to 5 minutes before the start of the class for which the prep applies. Students can take these prep quizzes online, anytime, at their own pace. We have the prep quizzes automatically graded by the course software (we currently use a course shell software called Blackboard©). This prep quiz encourages the students to do the preps. However, even more importantly, the prep quiz results can be observed by the instructor right before class. This allows the instructor to see what was generally understood by the preps and what wasn’t, thereby allowing the first 5-10 minutes of class to be dedicated to targeting these “missing concepts” instead of wasting significant and valuable time covering aspects already understood.

One of the advantages of the Preps is students develop a basic conceptual understanding of the topics to be covered in the classroom lectures prior to the classroom lectures … allowing the precious time spent interacting with the professor to be used to greatly enhance the student’s understanding of the topic versus spending the time laying down the basic conceptual groundwork. This more efficient utilization of the professor’s time allows the student to accelerate their learning process and view the interaction with the professor more favorably.
1-6 Review Material – Benefits of Class Prep Recordings

Each engineering tech class assumes and requires that the student is coming in with a skill set based on prior required classwork.

Whether due to a lack of successful education in prior classes, or the fact that the application of the required background skills has become “rusty” over the break (typically found over the longer “summer” break) between classes … an instructor may not be able to assume that the students have a fully functioning background skill set.

Traditionally significant time is typically spent reviewing previous materials from prior classes and bringing the students up to speed in order to effectively teach the material in the current class. The advantage of having the preps from the previous classes either on CD or available across the internet is that the students can spend the time either reviewing (or in some cases learning) the expected basics prior to the start of the class…thus allowing the instructor to not waste time reviewing material previously taught.

These learning modules are by no means intended to be a substitution for the classroom experience. By themselves, the learning modules also have limitations. But used in coordination with the live interaction of the traditional classroom experience, they can greatly enhance the classroom experience making the time spent in the classroom more useful in developing the student’s understanding. It also allows for the expansion of the class beyond time constraints of the traditional classroom, both in learning and in review.

1-7 Real World Project-Based Applications

While significant time is required to get the mind motivated and effectively acquire base information thru Preps thereby allowing time with the “expert” spent in class searching for meanings … the information needs to be used and applied.

Rose and Nicholl’s [2] bring out a very important point regarding remembering and understanding materials. A person typically remembers

- 20% of what they read
- 30% of what they hear
- 40% of what they see
- 50% of what they say
- 60% of what they do
- 90% of what they see, hear, say and do

This is where project-based applications come in. These real-world project-based assignments allow students to apply their knowledge towards solving aspects that they can relate to.
For example, our traditional AutoCAD class initially taught how to draw lines, draw circles, create text, etc. A student would spend 5-6 weeks learning the basics creating simple stick-figure plots to demonstrate each tool. Instead, now the students are handed property descriptions for their first assignment along with a project Camtasia file explaining how to read a property description and taking the student thru the process to draw one of the properties. The students are then expected to draw three more property maps without the aid of any Camtasia file. Through the process students learn CAD skills regarding how to draw lines, place text, plot, coordinate systems, referencing, etc. They also learn about property maps, how to read them, how to find government control markers, how to reference these control markers, etc. Students have a direct visual purpose to all the CAD skills they are learning, and in the process also become cross-trained at the same time in land surveying principles.

By bringing in industry-based projects, students also have the ability to expand beyond the basic scope of the project rubric. In our cost estimating classes, there are 4 times during the semester that different company representatives present to the students a project that their respective company has recently completed an estimate for. The students are broken up into teams of two students each, and the students goal is to estimate the project, getting as close to the “experts” number as possible. This gives the students insight regarding different approaches to estimating done by various companies. In addition, the teamwork component is invaluable in the expansion of student learning because they help each other overcome potential individual deficiencies (lack of plan reading ability, calculation struggles, etc.).

The Nodal VoIP also is very useful because students learn to work as teams across geographical distances. This is desired by industry because more and more projects are being worked on by teams comprising individuals in different regional offices or different companies. In order to save time and expense, many firms are using varying forms of VoIP to conduct project meetings and coordination events. Thus, the use of VoIP in the Nodal classrooms is a very beneficial side skill set that students learn and become familiar with.

1-8 International Efforts

The need for student learning with others from around the world is greater today than at any time in the history of the world. Realizing that the information, the laws of physics/math, and the engineering principles taught not only apply in our local geographical area … but that these same principles, these same functions apply everywhere around the world. This is very important to helping students understand the importance of what they are learning.

The vast majority of students attending Gateway are from the local area. The Nodal system allows these students the opportunity to interact and share learning experiences with students from other areas, other cultures.
Initial efforts have included shared lectures with students in other countries. Gateway has also engaged in student exchanges and joint student projects.

One of the exciting new mediums that offers significant potential in project coordination is the medium of virtual worlds. For the past year we have established an Engineering Tech Wing outpost in a virtual world called Second Life. [5] This medium allows students to visualize aspects better because of the joint shared experiences. Through role playing, joint tasks, and/or team projects...this medium offers exciting opportunities to enhance the educational experience.

1-9 Nodal Student Performance

One of the primary initial concerns was that Nodal students' performance would suffer versus students who had the instructor present. While the student performance in Nodal classrooms have paralleled the student performance in the primary classroom, until this year there has not been statistically enough students to numerically judge the performance. The following are the results of student performances in two major classes (1st semester Building Materials and 2nd semester Structural Mechanics tests).

<table>
<thead>
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<th>Building Materials Class Fall Semester 2008 Midterm</th>
<th>Structural Mechanics Class Spring Semester 2009 Midterm</th>
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<tr>
<td>Total Students:</td>
<td>38</td>
<td>29</td>
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<td>Students</td>
<td>27</td>
<td>20</td>
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<tr>
<td>Nodal Classrooms</td>
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<td>9</td>
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<tr>
<td>Average</td>
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<td>68.2%</td>
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<td>Standard Deviation</td>
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<td>100.0%</td>
</tr>
<tr>
<td>Low Score</td>
<td>31.8%</td>
<td>31.5%</td>
</tr>
</tbody>
</table>

1-10 Conclusions

As Alan November stated [6]:

1. “We need to teach our students to deal with massive amounts of information”.
2. “We need to teach our students global communication”
3. “We need to teach our students to be self-directed and understand how to organize more and more of their own learning”
The Nodal Delivery method addresses these concerns and allows for accelerated learning extending the learning experience beyond the time and physical constraints of a traditional classroom.

Using a Nodal delivery method has had a positive effect on enrollment and proved to be an efficient and effective method to deal with student transportation and program duplication issues at a multi-campus institution. The technology has enhanced student learning and is being replicated by other program areas.

2.0 REFERENCES

3. www.techsmith.com
4. www.wisconline.org
5. www.secondlife.com