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## **The Impact of Integrated Delivery on Undergraduate Biology Research Course Outcomes**

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# The Impact of Integrated Delivery on Undergraduate Biology Research Course Outcomes

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**Description:** At Kean University, Adaptive Teaching Taxonomy (AT) methodology was previously used in research courses to expand traditional lecture based instruction. This approach had been restrictive since targeted teaching methods did not fully address student learning needs in the classroom. In spring 2017, an integrated electronic learning approach was piloted in Senior Biology Capstone sections. It was proven effective, since students in the electronically enhanced Capstone courses had earned higher final grades than those attending traditional sections. SPSS t-test results were significant at .01 with Electronic Delivery yielding a higher mean score (3.6/4.0) than Traditional Delivery (2.26/4.0) results.

**Key Words:** Electronic Media, Student Learning Styles, Adaptive Teaching Taxonomy

## I. Study Purpose

Educators increasing need to balance expertise, accumulated knowledge over long periods of time, with motivational considerations of changing technologies. Personal learning environments include a variety of tools, ranging from blogs to social networking tools. Traditional and online instruction still requires encouragement of students, cooperation, active learning, designated time on tasks, high expectations, and respect for diverse talents and learning styles (Siemens & Tittenberger, 2009).

Research has shown that technical tools influence the way the brain processes information. The procedure used for optimal selection of media begins with clarifying the learning intent, evaluating impact of the media, and finally choosing the appropriate technology. Technology includes a variety of sources: audio, video, games, simulations, online lectures, and combinations to support learning. Siemens & Tittenberger (2009) noted the new multi-literacy approaches require faculty to address instruction differently than in the past. Traditional educational practices have mostly included updating course content and ignoring the delivery of information in a technological world. Active experimentation is needed for academia to emerge with solutions that more accurately reflect the needs of learners.

## II. Theoretical Framework

Franzoni & Assar (2009) conducted a one-year study on enhancing learning through the use of adaptive teaching strategies and electronic media. Several hypermedia center models were examined (ARTHUR, CS388, MANIC, INSPIRE, Tangow, AES-CS, and PHP), but most contained limited accommodation of learning styles. Therefore, the researchers developed an adaptive taxonomy based on Felder and Silverman's learning styles model (2005 and 2007) and matched the characteristics to appropriate electronic media sources. Other researchers (Rose, 1998; Ford & Chen, 2001) had confirmed that when teaching styles closely matched the student preferred style of acquiring knowledge, learning became more natural and successful.

Franzoni & Assar (2009) organized a series of teaching strategies and electronic media grids for adoption in higher education. The initial use of this tool had been for educators to match the learning styles of participants to appropriate teaching strategies, before electronic media was incorporated into the teaching environment. Once appropriate teaching strategies were identified, electronic media was then selected to match the predominant learning style of the classroom. Franzoni & Assar (2009) realized that this approach was unrealistic, instead they recommended that classroom learning be supplemented with a variety of materials targeted toward the predominant learning styles of the class. They recommended other options that included presenting a set of two or three learning units on a rotational basis. Such an approach also allowed for successful development of team skills among students.

### III. Methodology

The Biology Senior Capstone course requires students to apply knowledge learned in general education and major field courses and develop a research study or field project. Therefore, the Capstone Research Model was developed by Knezek & James (2012) as a teaching strategy to ensure that student work was completed within the designated semester. This model enables students to successfully develop complex research sections from a series of manageable smaller assignments. For example, the *Research Proposal Assignment* becomes the *Introduction* section of the study, while the *Annotated Bibliography* is formed into the *Literature Review* section.

**Chart 1. Kean University Research Model**

Research Section	Content	Assignment
<i>Introduction</i>	Statement of Problem Sub problems Hypothesis (pro/con projected position) Delimitations Definitions/Abbreviations Assumptions Importance of Study	Approved Proposal
<i>Literature Review</i>	<i>Theory</i> : Report on What Other Researchers Discovered About the Problem <i>Related Studies</i> Description <i>Applied Studies</i> Description	Annotated Bibliography Article Reviews
<i>Methodology</i> Qualitative/ Quantitative Design	Procedure for Collecting Data to Prove/Disprove Hypothesis Sample Population Findings	Mid-Term Methodology Plan Expert Interview Development of Data Collection Tools

<b>Result</b>	Relationship of results to previous studies	Data Analysis
<b>Conclusion</b>	Acceptance or Reject of Hypothesis and Further Action	Data Results
<b>Reference</b>	Listing of research articles used and quoted in the study	Annotated Bibliography

This flexible format further enabled Kean faculty to incorporate electronic media modes into the model. Since Franzoni & Assar (2009) had adopted Felder & Solomon’s (1988) learning styles, students became fully engaged in learning throughout their research experience. Also, this approach enhanced communications between faculty, student peers, future employers, and graduate representatives. Students were required to complete a series of twenty-two assignments, but remained enthusiastically engaged in the work, since it was required for the professional websites. These sites contained four sections: *Background* (picture, description of career goals and plans), *Resume*’ (the document, curriculum vitae, and reference page), *Research Assistant* (listing of research skills demonstrated during the semester and work samples), and *Research* (proposal, research paper, poster and grant writing exercise). When preparing for employment or graduate school interviews, the sites are readily available to share with future educators or employers.

Franzoni & Assar (2009) had matched electronic media to Felder’s (1988) eight learning styles, so Kean faculty were able to use their work and align course assignments with the corresponding media type. *Audio* was matched to interviews, presentations, and role play exercises; while *Collaboration* supported team-based activities involving group assignments. *Communication* and *Presentations* involved verbal learning; while *Diagramming*, *Reading*, and *Search* promoted the use of visual and analytical assignments. *Tutoring* involved peer leadership exercises. Lastly, *Video* technology was dedicated to taping of University-wide presentations.

#### IV. Results

In spring 2017, a study was conducted involving four sections of Biology Senior Capstone courses. Two sections included electronic media delivery, while traditional instruction was used in the control sections. Final grades were examined to determine program success. An SPSS independent t-test confirmed that results were significant at .01 level for *Electronic Learning*. Also, the mean score was 3.35/4.0 for *Electronic*, while *Traditional* netted a 2.67/4.0 score.

**Table 2. Electronic vs. Traditional Learning Grades**

	Learning	N	Mean	Std. Deviation	Std. Error Mean
Grades	Electronic	42	3.3476	.64590	.09966
	Traditional	33	2.6667	.98953	.17225

When considering between group grade distributions, 97% of students in the *Electronic* courses earned *A/B* grades in comparison to 46% of the *Traditional* cohort. Forty percent of students from the *Traditional* sections earned *C* grades and none for the *Electronic* students. Lastly, three times as many *Traditional* students (12%) had failed the course.

#### **IV. Conclusions**

The purpose of this study was to improve the instructional quality of BIO Capstone courses by utilizing learning-centered instruction and matched electronic media. An experimental design was conducted in this study with a two-tail t-test measuring group mean differences. It was proven that students, participating in enhanced Capstone courses, earned higher final grades than those attending traditionally instructed sections.

#### **V. Educational Implications**

Results of this study will help to improve Capstone instruction in other disciplines, since electronic media addresses all types of student learning styles. However, more work needs to be done with faculty involvement, especially with those who are uncomfortable interfacing with electronic media. Finally, adoption of electronic technology in the classroom has the potential to reach a broader spectrum of student learners, even beyond the millennial generation.

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Table 2. Learning Styles and Electronic Media Relationships

<b>Electronic Media</b> (Franzoni & Assar, 2009)	<b>Examples</b>	<b>Supported Learning Style</b>	<b>Capstone Model Exercises</b>
<b>Audio</b>	Audio Recording Audio Conference	Verbal Sequential	Field Expert Interview
<b>Collaboration</b>	Forums Online learning communities Weblog or blog Wikis	Sensitive Visual Active Global	Resume' Development Research Article Review Website Development Grant Writing Defensive
<b>Communication</b>	Chat (Messenger) E-mail	Active Global	Research Proposal & Critique
<b>Diagram</b>	Animation Graphics Pictures Simulation	Sensitive Visual	Annotated Bibliography Presentation Lab Report Review Methodology Section Data Analysis Research Poster
<b>Reading</b>	Digital magazines Digital newspapers eBooks Hypertext (web pages) Slideshows	Visual Reflexive Sequential Global	Article Review Literature Review Lab Report Review

<b>Search</b>	Internet research	Intuitive, Active, Reflexive, Global	Literature Review Grant Writing Exercise
<b>Tutoring</b>	Course Legacy System Student Response System Tutorial systems WebQuest	Intuitive Reflexive	Annotated Bibliography Critique Mock Interview Exercise Lab Report Review Research Poster Critique
<b>Video</b>	Podcast Recorded live events Videoconference Videos Web seminars (broadcasts)	Verbal Visual	University Research Day Submission & Presentation Conference Presentations