# Student outcomes assessment of a logistics and supply chain management major

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ABSTRACT

Assessment of specialized programs, such as the logistics and supply chain management program described here, may pose challenges because previous experiences are less widely shared than in the more mainline subjects. This case study provides one model that may guide other faculties facing a similar assignment. The report details the steps followed to assess an undergraduate program in Logistics and Supply Chain Management. The starting point was a two-stagecourse-mapping, which identified strengths and weaknesses of course coverage compared to college goals, and also compared to a set of topic areas recommended by faculty members. Next in the process was a survey of graduating students who responded to questions about basic concepts in their recently completed courses. The assessment was considered useful in providing a feedback path necessary for faculty to "close the loop" in course design and teaching. In addition, this case study showed how a process from a small liberal arts college may be adapted to a narrowly focused business program in a larger and more diverse university setting.

Keywords: outcomes assessment, college of business, education, major, logistics, supply chain
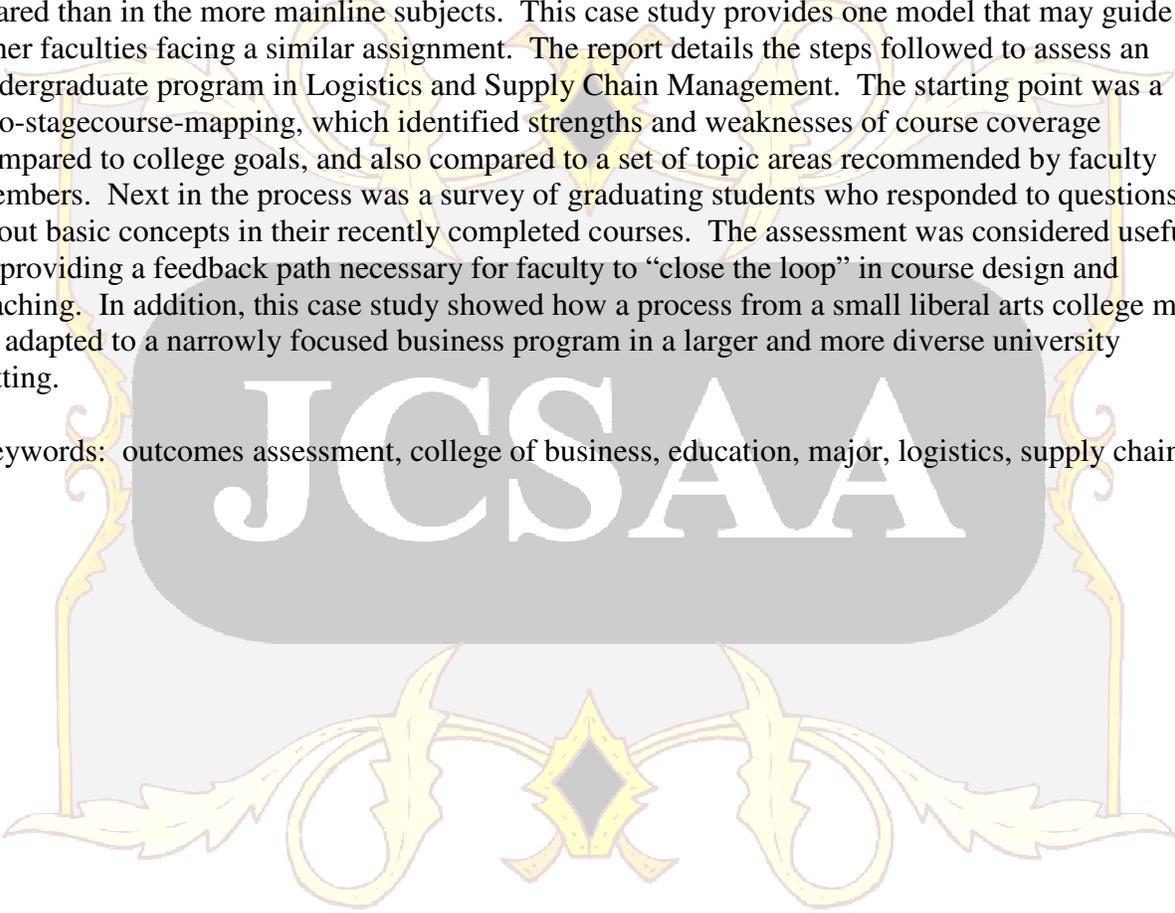
INTRODUCTION

A minority of 475 accredited colleges of business offer specialized curricula in logistics and supply chain management. Ozment and Keller (2011, p. 77) identified 65 bachelors degree granting programs, resulting in a discipline "simply not large enough to provide an adequate number of graduates to meet the managerial needs of American business." Pohlen (2011, p. 85) traced this need back 50 years and concluded, "Today, the need for educating transportation and logistics professionals is as pressing and important as in 1960." To ease the burden of creating new programs, Naim et al. (2000) provided a course template "that may be adopted, and adapted, for the educational needs of the modern and future logistician." This paper provides a logical continuation for the logistics educators who next will need to assess the achievements of their programs so that necessary changes can be identified. The assessment instruments developed by logistics and supply chain management faculty at Iowa State University are provided for the adoption or adaption by colleagues at other institutions who may save considerable time by following the steps described, even including similarly worded questions in student surveys students. As a secondary objective, the project demonstrated the feasibility of applying assessment techniques from widely different educational environments to non-standard programs.

BACKGROUND

Alverno College vs. Iowa State University

Called the "single hot topic in higher education" (Allen, 2004, p. 93), the origins of post-secondary outcomes assessment have been attributed to two decades of experience at Alverno College in Milwaukee (Mentkowski, 2000, pp. xvi-xvii). Alverno's assessment of students and alumni began by identifying strengths and weaknesses of its approach to teaching, first by interpreting the contributions of students' total college experience, and then through a dialogue on the lasting effects of learning as it influences all aspects of their graduates' lives. The Alverno faculty approach to "learning that lasts" recognized that their graduates faced both traditional and non-traditional roles as "thinker, leader, parent, and citizen" (Mentkowski, 2000, pp. 4-5). Riordan (2005, p. 52), an Alverno College faculty member, was more succinct: "the aim of teaching is to help students get to the point where they don't need us." But can a concept developed at a small--2,759 undergraduates (Alverno, 2011)--Franciscan women's liberal arts college be applied to a narrowly focused logistics and supply chain management curriculum at a state university ten times as large?

The Iowa State University, College of Business (2010) *Strategic Plan* defines the core value of its teaching as providing students the "skills and experiences needed to succeed in a complex, technology-driven, global society." Assessment of student outcomes is integral to the college-wide plan and incorporated directly in the associated goal of strengthening undergraduate education to "improve student learning experience and performance on college learning outcomes across the curriculum."

For the 2010 spring semester, the business college enrollment of 3,226 included 126 students majoring in Logistics and Supply Chain Management, making it one of the smaller majors in the college. By contrast, the more popular traditional majors of finance (402), marketing (411), and accounting (440) each attract three times as many students (Iowa State

University, Office of the Registrar, 2010). In the competition for student awareness, faculty in a smaller program are very cognizant of the vulnerability of their curriculum. Since little has been published about assessing logistics programs specifically, it was necessary either to adapt previous techniques--e.g., general business knowledge or standardized test bank questions for selected textbooks (Downing 2010, McGraw-Hill 2010)--or develop the balance of the process from scratch. The latter approach was chosen, consistent with Allen's (2004, p. 94) criticism of standardized assessment because "it tends to miss the best features of a program. . . (and) . . . promotes a tendency toward checklists . . . and cookie-cutter approaches for reporting." Fenwick (2001, p. 68) also was critical of standardized testing because of its focus "on recall and formulaic problem solving that is isolated from learning contexts."

Diverse objectives of assessment

Outcomes assessment supports a broad educational objective, such as that of California State University, Fresno (2010): "to advance student learning through improved curricula and instruction." Assessment is taken at the behest of a diverse set of organizations: state governments, accrediting boards, and university administrations. Allen (2004, pp. 94-95) challenged these mandates as sometimes generating "useless information that cannot be tied to program improvement" but she supported assessment that was the result of faculty asking, "Does what we do matter?" She recognized student outcomes assessment ultimately having a broader purpose, as a tool to "improve the quality of the field overall, as individual programs test or recognize the means to enhance their effectiveness." Fenwick (2001, p. 63) viewed student outcomes "as one dimension of a multifaceted program of faculty evaluation." She recognized the differences between learning and good teaching, and cited studies that explained—in addition to teaching--the institutional, dispositional, and social influences on learning. In contrast to measuring individual teaching effectiveness, Wergin (1999, pp. 1, 4) studied how academic departments were evaluated by their institutions. He noted "widespread discontent," and concluded, "The way an institution sees itself is reflected in how it evaluates." Riggio, Mayes and Schleicher (2003, p. 68) defined a narrower role for outcomes assessment "to demonstrate the career readiness of college graduates."

Common grounds for assessment

The body of work on student learning assessment introduces a more-or-less common set of terms. One sample set is California State University, Fresno's "Local Lexicon of Assessment Terms" (2009). Another often-cited list is from Martell and Calderon (2005, p. 2), who defined assessment as "an ongoing process aimed at understanding and improving student learning." They further explained the requirements of assessment to:
(a) identify learning goals and objectives . . . :
(b) set meaningful expectations . . . ;
(c) systematically gather, analyze, and interpret evidence to determine how well performance matches those expectations and standards; and
(d) use the resulting information to document, explain, and improve performance.

AACSB assessment support

The accreditation body for colleges of business, AACSB International, has sponsored conferences on assessment and published a two-volume series of "best practices" papers (Martell and Calderon, 2005, p. 15). The organization explains its "Assurance of Learning (AOL) standards," which require business schools to state their learning goals and demonstrate how they will improve their degree programs using evidence collected through direct measures (Trapnell, 2005, p. iii). The direct approach is based on demonstrations of knowledge by students, whereas an indirect approach might survey alumni or their employers about the learning obtained by a program's students. A repeated term in outcomes assessment literature is "closing the loop," considered "the most important part of the assessment process" in the accreditation process (Martell and Calderon, 2005, pp. 5, 8).

Assessment experiences of business schools

With accreditation as the driver, numerous business schools have taken the initiative to adapt the Alverno College assessment model to specialized programs in different settings. One documented example is the Girard School of Business and International Commerce at Merrimack College in Massachusetts, which traces its assessment program to the 2002 adoption of 12 learning outcomes, divided evenly between "general knowledge and abilities" and "business-specific knowledge and abilities" (Popper, 2005, p. 1). The general knowledge categories were: communications, analytical skills, cultural understanding and flexibility, ethical understanding and reasoning, reflective thinking, and adaptability. These served as the bases for the college-wide learning outcomes. The business-specific categories were: financial reporting, analysis, and markets; business environment; international perspective; how businesses serve customers; human behavior in organizations; and cross-functional integration. Other assessments of overall business programs, rather than specific majors, have been reported by Hawkins (2010) and by Sexton and Comunale (2010).

Specialied business curricula

Assessment of specialized business curricula has been led by the accounting profession. Following a 1990 report critical of accounting education as "slow to adapt" (Martinson and Cole, 2002), faculty were shown how to design and implement assessment programs in articles by DeMong, Lindgren and Perry (1994), Akers, Giacomino and Trebby (1997) Hill, Perry and Stein (1998), Lusher (2010), and Lui and Shum (2010). Other published studies described assessment experiences of programs in economics (Eschenfelder, Bryan, & Lee, 2010) and finance (Flanegin, 2010). The common attribute of these articles is that they pertain to traditional business school topics, rather than a narrowly defined area such as logistics and supply chain management, the subject of the current paper.

COURSE MAPPING STAGE I: "GENERAL LEARNING OUTCOMES" VS. COURSES

Faculty ratings of course contents

To begin the process, the faculty of Iowa State University's College of Business approved six General Learning Outcomes for the Bachelor of Science degree. These learning outcomes, with the corresponding objectives and measurement tools for each Logistics and Supply Chain Management course, are listed below and are shown in the course maps on the two pages of Table 1. The College of Business measures and reports these outcomes annually. Instructors for each course were asked to consider how their courses addressed each outcome using a four-step scale. An outcome was considered to be a "theme" of the course (with a rating of 3) if the skill or competency being taught cut across several content areas of the course, or was a pedagogical device utilized in a large part of it. At the next level, an outcome was labeled a "significant component" (and a 2-rating) if the skill or competency constituted a significant content area of the course. The two lowest attention levels were "introduced" (i.e., a 1 rating), if a topic area was not expanded upon to a great degree, or "not covered" (a 0 rating) if that was the case. To the extent that the labels are perceived similarly by the various faculty members, the averages may help identify courses within a curriculum that more strongly meet these college-wide goals. See Table 1, Appendix.

Learning outcome 1: The ability to recognize ethical, legal, and global implications in business decision making

Ethical, legal and global implications are themes in the Supply Chain Information Systems course and in the International Transportation and Logistics course, and are significant components in the courses on Principles of Transportation, the Transportation and Logistics Issues, Purchasing and Supply Management, and Strategic Supply Chain Management. In the remaining courses, these implications are either introduced or are not covered. The average score of 1.60 was in the midrange, compared to other learning outcomes.

Learning outcome 2: The ability to work in collaborative environments

Collaboration was a theme in the Supply Chain Information Systems and Demand Planning courses, and a significant component in seven of the remaining nine courses. With an average score of 2.00, this outcome ranked the highest of the six being considered.

Learning outcome 3: The ability to communicate effectively (writing, oral, visual, and electronic)

Communication abilities are significant components of eight courses in the Logistics and Supply Chain Management major and a theme in the Demand Planning course, all contributing to its second-place average score of 1.90.

Learning outcome 4: The ability to use quantitative and analytical methods to address unstructured business problems

Quantitative and analytical methods are themes of the Decision Tools and the Demand Planning courses, and are significant components of the Transportation Carrier Management and Issues courses. In five of the six remaining courses, quantitative and analytical methods are introduced, accounting for an overall midrange score of 1.50.

Learning outcome 5: The ability to use business technologies in creating value

Value creation is a theme in the Supply Chain Information Systems and Decision Tools courses, and is a significant component in the Transportation Carrier Management and Demand Planning courses. Instructors said value creation was introduced in the other six courses, giving this outcome a midrange score of 1.60.

Learning outcome 6: The ability to recognize the benefits and challenges of diversity

In the International course, diversity is a theme topic, but it is only introduced in five courses and not covered in two. With an average score of .80, the "diversity" learning outcome stands out as requiring the most attention, according to the course mapping displayed in Figure 1.

COURSE MAPPING STAGE II: BASIC CONCEPTS VS. COURSES

In departmental meetings, faculty members determined that graduating Logistics and Supply Chain Management majors should demonstrate basic knowledge of the following concepts:
Transportation management
Inventory management
Warehousing management
Purchasing and supply management
Cost concepts and analysis
Global logistics
Table 2 displays the course mapping that matches these concepts with the course material (as described in the *Iowa State University Catalog, 2009-2011*). Using the same scoring system employed above, the Transportation Management topic received the highest average score, 1.6. The averages for all the other concepts were clustered between .6 and .9. The ranking may indicate the importance of transportation within the Logistics and Supply Chain Management curriculum, or the need for additional attention to the remaining five concepts. Similarly, several of the existing courses (based on their catalog descriptions) were not close matches with the six listed learning objectives. The department faculty has been alerted to review and modify the objectives or courses, both of which are valid applications of student outcomes assessment. See Table 2, Appendix.

BASIC LOGISTICS CONCEPTS RETAINED BY GRADUATING SENIORS

The next step was to request faculty members to submit multiple-choice questions focusing on the six concepts. They were reminded to make their question very basic; that is, correct answers should be realistically expected from a typical student who has completed the course taught by the participating faculty but has not studied in advance for the assessment quiz.

The initial student outcomes assessment instrument contained seven questions. It was administered to 28 graduating students who were enrolled in either the Principles of Transportation course (required for the major) or the International Transportation and Logistics course (an "elective" for the major). Volunteering students were invited to take the quiz strictly as a service to the College of Business. While they were free to decline the invitation, all of the eligible students chose to participate. This process would be termed "accidental sampling" since the students quizzed were those that were "readily available and convenient" (Wikipedia, 2011). Although nonrandom and not necessarily representative of the population, such sampling is often used for pilot testing of surveys. The students were given instructions for logging on at the computer lab, with the assurance that the process would take no more than 20 minutes. Thirteen of the students were Logistics and Supply Chain Management majors, including three with a second major in Finance and one whose second major was Marketing. The 17 "other" majors included students in Finance, Management, Operations, Marketing, and International Business. Figure 1 compares the percentages of Logistics-oriented students answering each question correctly with their fellow students from the "other" majors who responded correctly on each item. See Figure 1, Appendix.

Question 1: Transportation management

A manufacturing company owns and manages a fleet of trucks that haul its supplies and finished products. What type of carrier is this?
a. common
b. contract
c. exempt
d. private
The question is based on the definition of a private carrier, and was correctly answered by 89 percent of the responding students. The Logistics and Supply Chain Management majors had 92 percent correct, compared to 87 percent of the "other" majors.

Question 2: Global logistics

What term describes the transporting of a shipment first across the Pacific Ocean on a container-ship, then rail to Chicago, then by truck to Des Moines?
a. bimodal
b. hub-and-spoke
c. intermodal
d. intramodal
The correct answer is "intermodal," as chosen by 82 percent of the students. Among the Logistics majors, 85 percent answered correctly, as did 80 percent of the other majors.

Question 3: Inventory management

The Economic Order Quantity method is based on what overall objective?
a. lowest inventory holding cost
b. lowest total cost
c. reduced ordering cost

d. reduced inventories

Not quite a third (32 percent) of the sample answered "lowest total cost," making this outcome the least successful of the group. Only 38 percent of the Logistics majors recalled the basis for EOQ; 27 percent of the other majors answered it correctly. To use outcomes assessment properly, the conclusion to be drawn is that faculty will be well-advised to stress the total cost objective as much as recalling the EOQ formula.

Question 4: Warehousing management

If a company requires storage space for only three months per year, what type would you suggest?
a. bonded warehouse
b. break-bulk warehouse
c. private warehouse
d. public warehouse

More than four out of five students (i.e., 82 percent) recommended "public warehouse" for temporary storage capacity. Among Logistics majors, 92 percent were correct, as were 73 percent of the other majors.

Question 5: Purchasing and supply management

The selection of a supplier because they are also a customer of the buying firm is commonly referred to in purchasing as:
a. buy-back
b. countertrade
c. a consortium
d. reciprocity

Overall, 57 percent of the students had no trouble in selecting "reciprocity" for this one. This question was answered correctly by 69 percent of the Logistics majors and by 47 percent of the other majors.

Question 6: Transportation management

The acronym F.O.B. in transportation is interpreted as meaning:
a. freight on board
b. freight overboard
c. free on board
d. foreign order bill (of lading)

Three out of four students answered "free on board," with 77 percent of the Logistics majors responding correctly, followed by 73 percent of the other majors. It should be noted that Transportation was the only concept given two questions in this initial test.

Question 7: Cost concepts and analysis

What cost category increases as volume increases and decreases as volume decreases?
a. break-even cost

b. fixed cost
c. revenue
d. variable cost

Considering the entire sample, 89 percent answered correctly with "variable cost." All the Logistics majors were correct, as were 80 percent of the other majors.

Responses vs. majors

A basic chi-square test on the 2 by 7 matrix of correct responses tested the null hypotheses that the portions of correct answers do not vary by major. This hypothesis was rejected (at the $p = 0.0007$ level), supporting the discussion of results by major (for this sample of 28 students). Logistics and Supply Chain Management majors were correct 79 percent of the time, and all other majors were correct 67 percent of the time; 72 percent of all responses were correct (regardless of major). If the traditional letter grades were applied to these percentages, the Logistics majors would garner an average grade of C+ and the other majors would take home a D+. This may be a harsh conclusion since the students were not given the opportunity to prepare as they would have for most other evaluations during their college career. But this initial exercise in assessing specialized learning suggests that there is room for improving the understanding and, especially, recall of the basics.

CLOSING THE LOOP

College outcomes

The ultimate value of a Student Outcomes Assessment program will be seen in improvement of the major as the results become the basis for changing the individual courses and the overall major. Based on the first exercise in course mapping, the Logistics-oriented faculty has indicated that all College of Business learning outcomes were being addressed in at least some of the courses offered. Using the arbitrary scores assigned, the first five outcomes showed average scores between 1.5 and 2.0 for the ten courses mapped. Only the last learning outcome, "Recognize the benefits and challenges of diversity," received what must be considered a low overall score. The faculty is to be commended for its strong attention to a majority of the desired college outcomes, and challenged to increase the coverage of the "diversity" outcome in future semesters.

Knowledge of concepts

The expectation that the questions on basic concepts would be correctly answered by students who had just completed senior-level courses was met by nearly three out of four students. Since each question had four possible choices, "chance" would have given correct responses only 25 percent of the time. Considering only students majoring in Logistics and Supply Chain Management, the correct answers were provided nearly 4 out of 5 times. Therefore the outcome measured by this "one-shot" instrument must be considered encouraging, even though no overall responses exceed 90 percent. The assessment report was distributed to department faculty members, who were encouraged along two lines:
1. to recognize the effect of their courses in students' overall knowledge, and

2. to participate in future assessments by providing additional questions that they consider basic and essential to a supply chain professional.

       The learning "gaps" are of at least two different types: first, the unmet learning objectives of the curriculum in Logistics and Supply Chain Management; and second, the weaknesses of the assessment process in its developing stages. Given sufficient time and resources, both gaps—to the extent that they exist--should be reduced.

CONCLUSION: AN ADAPTABLE TOOL FOR SPECIALIED PROGRAMS

       Student outcomes assessment of the Logistics and Supply Chain Management major at Iowa State provided both rewards and frustrations. The first reward came in the form of a workable process that provided initial evidence of areas within the curriculum that were attaining their goals and those areas requiring attention, thus meeting the first objective of the project. Another benefit, the process involved the students, enhancing what Haworth and Conrad (1997) referred to as a participatory culture that strengthens program quality. The frustration came with feelings of "reinventing the wheel," as business college faculty grappled with differences between the Alverno College model ("we are far more diverse," "as a private school, they have more resources for this sort of exercise," "we are a research institution," etc.) and the limited number of prior models that could be applied to specific, specialized programs. The receipt of a renewed accreditation from the AACSB gave tangible evidence that the secondary objective of applying Alverno's general model to a non-standard undergraduate major was also attained.

       Future assessments of the Logistics and Supply Chain Management major should expand the question pool, allowing additional topics to be included and permitting multiple measures for each topic. Rather than depending on volunteer subjects, a random selection of participating graduates will allow statistical support of more generalizable conclusions. The potential external merits of this report lie in the wider use of student outcome assessments among other specialized programs. If they happen to be related to Logistics and Supply Chain Management, some of the survey question could be reused directly, while others will require clarification and revision. Mentkowski (2000, p. xviii) recommends that assessment procedures "be adapted, not adopted" by faculty in other schools. If others build upon the Iowa State logistics and supply chain management faculty experience, both the process and the overall effectiveness of logistics education will improve, resulting in two highly desirable outcomes.

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Table 1. Course mapping Stage I: College learning outcomes vs. logistics courses.

Course Number and Title:	LSCM 360	LSCM 440	LSCM 460	LSCM 461	LSCM 462	LSCM 466
Learning Outcomes	Business Logistics	Supply Chain Information Systems	Decision Tools for Logistics and Ops Mgt	Principles of Transportation	Transportation Carrier Management	International Transportation and Logistics
Transportation management concepts	Introduced	Not Covered	Sig. Component	Theme	Theme	Sig. Component
Inventory management concepts	Introduced	Not Covered	Introduced	Not Covered	Not Covered	Introduced
Warehousing management concepts	Introduced	Not Covered	Introduced	Not Covered	Not Covered	Not Covered
Purchasing and supply management concepts	Introduced	Not Covered	Sig. Component	Not Covered	Not Covered	Not Covered
Cost concepts and analysis	Introduced	Not Covered	Introduced	Sig. Component	Not Covered	Not Covered
Global logistics concepts	Not Covered	Not Covered	Not Covered	Not Covered	Not Covered	Theme

Legend:
Theme = The skill/competency cuts across several content areas of the course, or is a pedagogical device utilized in a large part of the course.
Significant Component = The skill/competency constitutes a Sig. content area in the course.
Introduced = The skill/competency is introduced in the course but not expanded upon to a great degree.
Not Covered = The skill/competency is not addressed in this course.

Table 1 (continued). Course mapping Stage I: College learning outcomes vs. logistics courses.

Course Number and Title:	LSCM 469	LSCM 485	LSCM 486	LSCM 487	Average Score
Learning Outcomes	Transportation and Logistics Issues	Demand Planning and Management	Principles of Purchasing and Supply Mgt	Strategic Supply Chain Mgt	Theme = 3, Sig. Comp. = 2, Intro = 1
Recognize ethical, legal, & global implications in business decision making	Sig. Component	Introduced	Sig. Component	Sig. Component	1.6
Work in collaborative environments	Sig. Component	Theme	Sig. Component	Sig. Component	2.0
Communicate ideas (written, oral, visual, and electronic)	Sig. Component	Theme	Sig. Component	Sig. Component	1.9
Use quantitative and analytical methods to address unstructured business problems	Sig. Component	Theme	Introduced	Introduced	1.5
Use business technologies in creating value	Introduced	Sig. Component	Introduced	Introduced	1.6
Recognize the benefits and challenges of diversity	Introduced	Not Covered	Introduced	Introduced	0.8

Table 2. Course mapping Stage II: Direct measures of learning vs. logistics courses.

Course Number and Title:	LSCM 360	LSCM 440	LSCM 460	LSCM 461	LSCM 462	LSCM 466
Learning Outcomes	Business Logistics	Supply Chain Information Systems	Decision Tools for Logistics and Ops Mgt	Principles of Transportation	Transportation Carrier Management	International Transportation and Logistics
Transportation management concepts	Introduced	Not Covered	Sig. Component	Theme	Theme	Sig. Component
Inventory management concepts	Introduced	Not Covered	Introduced	Not Covered	Not Covered	Introduced
Warehousing management concepts	Introduced	Not Covered	Introduced	Not Covered	Not Covered	Not Covered
Purchasing and supply management concepts	Introduced	Not Covered	Sig. Component	Not Covered	Not Covered	Not Covered
Cost concepts and analysis	Introduced	Not Covered	Introduced	Sig. Component	Not Covered	Not Covered
Global logistics concepts	Not Covered	Not Covered	Not Covered	Not Covered	Not Covered	Theme

Legend:
Theme = The skill/competency cuts across several content areas of the course, or is a pedagogical device utilized in a large part of the course.
Significant Component = The skill/competency constitutes a Sig. content area in the course.
Introduced = The skill/competency is introduced in the course but not expanded upon to a great degree.
Not Covered = The skill/competency is not addressed in this course.

Table 2 (continued). Course mapping Stage II: Direct measures of learning vs. logistics courses.

Course Number and Title:	LSCM 469	LSCM 485	LSCM 486	LSCM 487	Average Score
Learning Outcomes	Transportation and Logistics Issues	Demand Planning and Management	Principles of Purchasing and Supply Mgt	Strategic Supply Chain Mgt	Theme = 3, Sig. Comp. = 2, Intro = 1
Transportation management concepts	Sig. Component	Not Covered	Introduced	Sig. Component	1.6
Inventory management concepts	Sig. Component	Not Covered	Introduced	Sig. Component	0.8
Warehousing management concepts	Sig. Component	Not Covered	Not Covered	Sig. Component	0.6
Purchasing and supply management concepts	Introduced	Not Covered	Theme	Sig. Component	0.9
Cost concepts and analysis	Introduced	Not Covered	Introduced	Sig. Component	0.8
Global logistics concepts	Introduced	Not Covered	Introduced	Sig. Component	0.7

Figure 1. Correct responses: basic concepts questions 1–7, logistics majors vs. others.
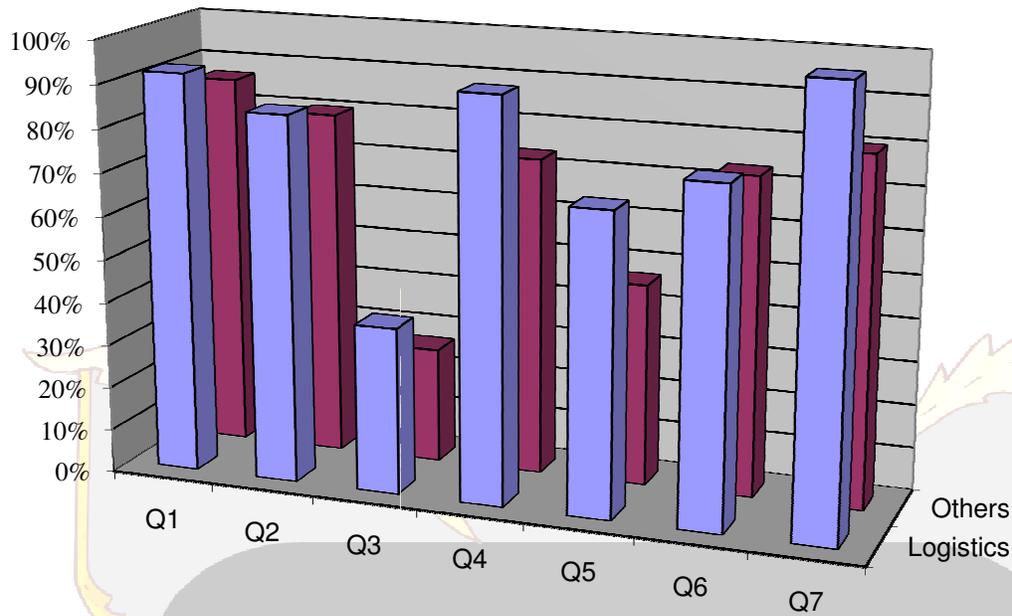
	Q1	Q2	Q3	Q4	Q5	Q6	Q7
Logistics	92%	85%	38%	92%	69%	77%	100%
Others	87%	80%	27%	73%	47%	73%	80%