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Incorporating Learning Objects in a Curriculum Re-design to Meet Needs of Students with Specific Learning Disabilities in Illinois Agricultural Education Programs

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A quasi-experimental pilot study of curriculum re-design using Learning Objects (LO) to instruct agricultural education students with Specific Learning Disabilities (SLD) was conducted in five high schools in the federally designated economically distressed area, the Illinois Delta Region. Six LOs were developed based on a unit of instruction in The Illinois Core Curriculum for Agriculture and designed in a manner appropriate to SLD students. Students were randomly assigned to treatment and control groups. Results from pre-posttests in this study found Learning Objects increased learning for both SLD and traditional students.

Keywords: agricultural education; learning disabilities (LD); curriculum redesign; learning objects; specific learning disabilities (SLD)

Introduction

Recently, educators and researchers have noted the pressing lack of instructional methods modified to meet or accommodate learning disabled agricultural education students' unique needs (Dormody, Seevers, Andreasen & VanLeeuwen, 2006; Pense, 2009; Easterly & Myers, 2011). In an attempt to address this necessity, a national mandate calling for appropriate vocational education for students with specific learning disabilities (SLD) has repeatedly been issued (Perkins, 2006). Furthermore, studies have clearly set out that a need exists for placing a high priority on teacher in-service for instructing the SLD student, and a need exists for re-designing the agricultural education curriculum to meet the needs for these students (Sorenson, Tarpley, & Warnick, 2010).

In response, only two studies have thus far sought to identify methods that can best meet the needs of SLD students in the agricultural education classroom; namely, inquiry based instruction (Easterly & Myers, 2011) and technology-assisted curricular redesign (Pense, Wakefield & Watson, 2010). With nearly one fourth of students enrolled in secondary agricultural education possessing an SLD (Dormody, Seevers, Andreasen & Vanleeuwen, 2006; Pense, 2009), further curriculum development and inquiry into appropriate teaching methodology for SLD students is clearly needed.

Learning Objects as an Instructional Aid

In an effort to address curriculum redesign appropriate to SLD students in the agricultural education classroom, Learning Objects (LO) became the focus of this study. LOs constitute a valuable and underutilized instructional/learning tool which can be readily implemented to develop and expand the impact of current

curriculums to meet the needs of the learning disabled student in the agricultural education classroom. LOs are defined as "interactive web-based tools designed to enhance, amplify and guide learning" (Baki & Cakiroglu, 2010, p. 1459). Learning qualities have been further emphasized; including a focus on "interaction and the degree to which the learner actively constructs knowledge" (Kay & Knaack, 2009, p. 148).

While little or no research on LO use in the agricultural education classroom has been published, studies of LOs used in k-12 mathematics and science have demonstrated its usefulness for instruction and learning. Kay and Knack (2009) conducted an evaluation of LOs used in 21 high school math and science programs and found positive correlations between pre- posttest scores and the student perceptions of LO learning, quality and engagement constructs. When selecting LOs, they concluded that key features should guide selection; including interactivity, clear feedback, graphics, design qualities, clear instructions, and transparency of use and organization.

In another study on LO use in secondary mathematics programs, Baki and Cakiroglu (2010) found that students evaluated LOs as highly sufficient in the categories of learning value, value added, design usability and technology function. Teachers in the same study found LOs provided interesting scenarios and problems, helped in student comprehension, and was motivational; thus, they concluded LOs were useful in constructing rich learning environments.

Learning Object Repositories

To allow LOs to be used with any learning management system, they should be compliant with the Sharable Content Object Reference Model (SCORM). This model comprises a set of technical standards for e-learning software products. One of the standards requires LOs to contain metadata, or descriptive information in tags, that support context sensitive retrieval by web search engines (Schlais & Ploetz, 2005). Thus, LOs can then be placed in a repository and made available to all educators.

In some instances, schools use a form of SCORM called Shareable Content Learning Objects (SCLO). However, SCLO is not quite SCORM compliant; the LOs would still be sharable, but could not be disassembled, could not be edited and resulting components could not be reassembled to address current pedagogical needs (Schlais & Ploetz, 2005).

Theoretical Framework

The framework for this study (Figure 1) was based on five theoretical concepts taken from other studies: inclusion (Bloom, Perlmutter & Burrell, 1999), student engagement (Shernoff, Csikszentmihalyi, Schneider & Shernoff, 2003), assistive technology (Forgrave, 2002), principles of curriculum re-design for the SLD student (Heward, 2009), and evaluation of learning objects (Kay & Knaack, 2009). These five components may be viewed as two phases in the development of Learning Objects for use in re-designing curriculum for SLD students.

Phase 1: Re-Designed Curriculum, Learning Object Development

Phase 1, the upper most part of the triangle in Figure 1, includes theoretical principles which must be taken into account when developing or re-designing technology assisted curriculum for the SLD student. These principles include inclusion, student engagement and assistive technology.

Inclusion

The inclusion aspect of the model comprises four major principles, including diversity, individual needs, reflective practice and collaboration (Elbert & Baggett, 2003). Diversity is brought about when SLD students interact with traditional students in the agricultural education classroom. Individual needs are observed when students select a career pathway and when the curriculum is adapted to the special needs of the SLD student. The instructor may also engage in reflective practice and make appropriate adaptations to the curriculum (Bloom et al., 1999). According to researchers in agricultural education (Dormody et al., 2006; Kessell, Wingenbach & Lawver, 2009), reflective practice and confidence were critical for the teacher who must develop "competency in working with disabled students"

(Dormody et al., 2006, p. 94). Reflection is particularly necessary when dealing with the challenges faced when instructing SLD students. Collaboration occurs not only when the teacher cooperates with parents, specialists, and community; but also when interaction takes place between the SLD student and his/her non-disabled peers.

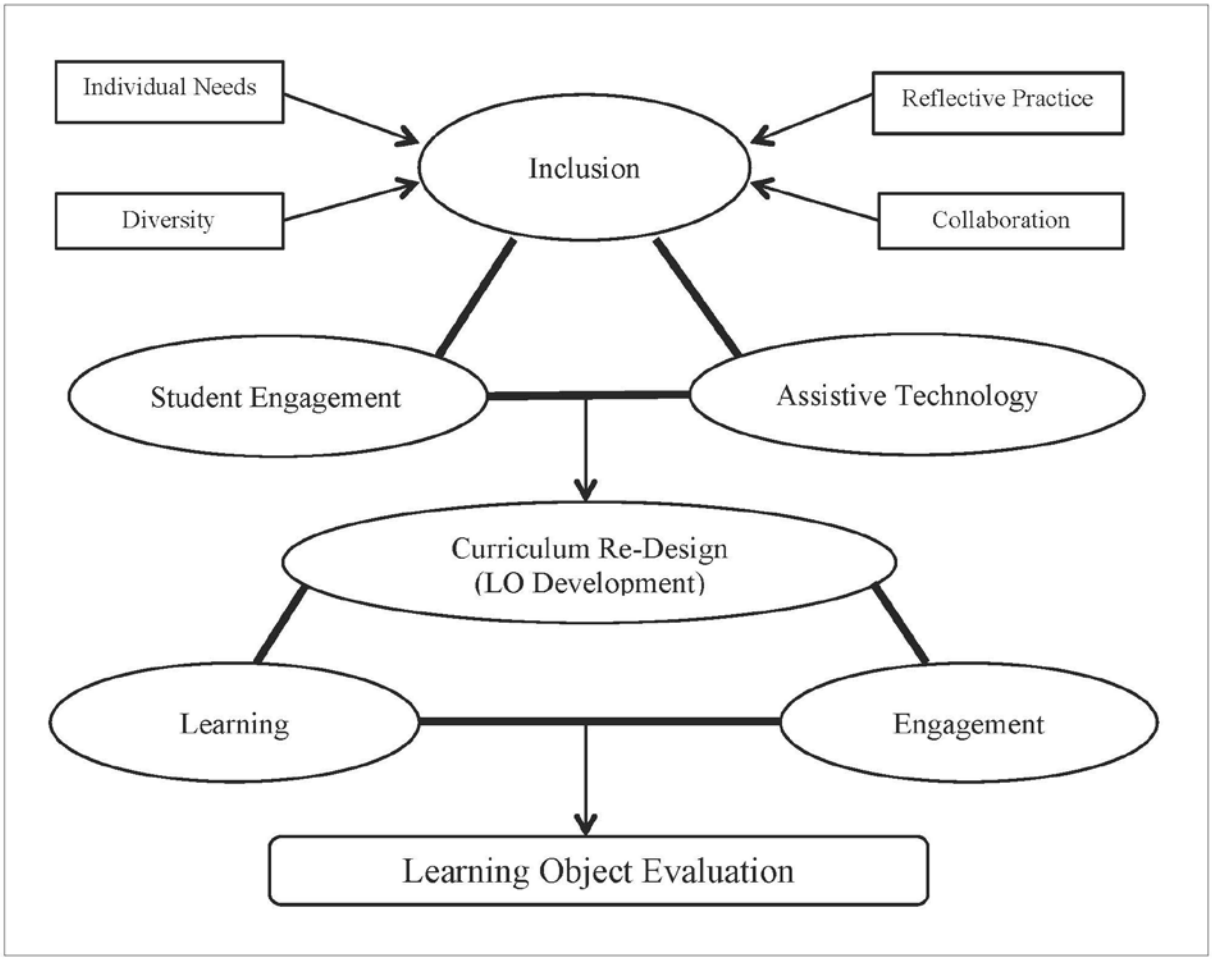

Figure 1. Conceptual Model of Curriculum Re-Design and Evaluation of Learning Objects for SLD Students

Student Engagement

The second concept in Phase 1 of the framework, student engagement, addresses student motivation and strategies to increase engaging tasks and activities in the curriculum. Shernoff, et al. (2003) posited that student engagement addressed motivation through the culmination of concentration, interest, and enjoyment. Similar to the concept of flow theory, in which "a symbiotic relationship between challenges and skills is needed" (p. 160); concentration, interest and enjoyment during a learning activity are also to be simultaneously experienced to create "flow" (p. 161).

Assistive Technology

Assistive technology, the third concept of Phase 1 in the framework, provides the accommodations needed by SLD students (Forgrave, 2002), and may aid in creating flow by balancing skill with challenge for each SLD student. Assistive technology helps deliver the information while enabling students to complete tasks more efficiently and independently; thus, leading to improved performance (Hasselbring & Bausch, 2005).

Phase 2: Curriculum Development & Implementation

While Phase 1 of the framework laid the groundwork for the process of curriculum re-design, Phase 2 provided a framework to actually develop, implement and evaluate LO use in the classroom. This phase of the framework included Curriculum Re-Design (LO Development), Learning and Engagement.

Curriculum Re-Design & LO Development

To help an SLD student better construct new knowledge, the LO development model of Schlais and Ploetz (2005), suggests the Textual, Conceptual and Practical (TCP) approach. This project was textual in that it used basic English phrases with a voice over on each slide; it was conceptual in its use of illustrations with text; and it was practical in that it provided practice/praxis and was self-paced. Such an approach has lent itself to better use of the downloadable material so that the LOs could be "disassembled, edited and the resulting components reassembled for use in contexts more appropriate to pedagogical needs" (Schlais & Ploetz, 2005, p. 2).

Learning

Student evaluation of the learning value of LOs was highest among four categories evaluated in Baki and Cakiroglu's study of secondary mathematics programs (2010). Teachers in the same study concluded that LOs were beneficial tools for learning; as LOs are implemented, increased learning takes place.

Engagement

A high level of engagement was thought to be necessary if an LO was to be successful. Kay and Knaack (2009) cited Lin and Gregor (2006) when they identified engagement, positive affect and personal fulfillment as key factors in LO evaluation. Furthermore, self-efficacy was identified as critical in the process of engagement (Oliver & McLoughlin, 1999). Engagement was accomplished through the implementation of the six major principles for effective instructional design advocated by Heward (2009); including, big ideas – selected concepts that facilitate knowledge acquisition, conspicuous strategies – sequence of teaching to make learning steps explicit, mediated scaffolding – temporary learning support for students which is faded over time, strategic integration – instructional sequencing relating SLD and new knowledge, judicious review – adequate sequencing and scheduling of learning opportunities, and explicit instruction – presenting and monitoring repeated learning opportunities incrementally.

Learning Object Evaluation

The final component of the theoretical model (Figure 1) was evaluation of the LOs. Learning Objects have traditionally been evaluated through technical and instructional design issues, rather than employing issues based on pedagogy (Kay & Knaack, 2009). The emphasis on design had resulted in a model that was dated, while recent research cited by Kay and Knaack in 2009 (Friesen & Anderson, 2004; Krauss & Ally, 2005; Nurmi & Jaakkola, 2006) suggested students need to construct knowledge and participate in the learning process. One way this could be accomplished was by measuring the amount and quality of interactivity in an LO. While pointing and clicking may be passive, manipulation of tools in the LO require the user to test and evaluate *what-if* scenarios; which may result in stimulation/motivation (Kay & Knaack, 2009). This study chose the technical design issues which focused on usability as a measure of engagement and learning, in addition to measuring knowledge acquisition through traditional means.

Purpose/Objectives

The purpose of this study was to create and assess LOs based on a unit of instruction from

The Illinois Core Curriculum (Illinois State Board of Education, 2004) in a manner appropriate to the SLD student, administer the lessons to students in secondary agricultural courses, and compare gain scores through pre- and posttests for both treatment and control groups. The specific objectives were:

1. Develop a demographic profile of the participating schools in the curricular re-design study.
2. Develop reusable Learning Objects from a unit of study in the Horticulture Cluster of The Illinois Core Curriculum (Illinois State Board of Education, 2004) designed to assist students with Specific Learning Disabilities (SLDs).
3. Compare/contrast the gain scores of SLD students in agricultural education classes who were taught using the curriculum enhanced with Learning Objects to those of SLD students taught using the curriculum without Learning Objects.
4. Compare/contrast the gain scores of non-SLD students in agricultural education classes who were taught using the curriculum enhanced with Learning Objects to those of non-SLD students taught using the curriculum without Learning Objects.

Methods/Procedures

This study employed a pre- posttest design to measure the effectiveness of LOs incorporated into an agricultural education curriculum. The target population for the study included agricultural education students enrolled in Introduction to Agriculture courses (N = 98) in five high schools in the federally designated economically distressed area (Lower Mississippi Delta Region Initiatives Act, 1994), the Illinois Delta Region (Anna-Jonesboro H.S., Goreville H.S., Marion H.S., DuQuoin H.S. and Vienna H.S.). Of 42 secondary schools located in the Delta Region, five schools comprised a purposive sample selected for their location in the Delta Region, the schools possessing an agricultural education program, and administrator agreement to participate in the project by granting access to the research site. This study focused on students in the Illinois Delta Region because it has been suggested that serious socioeconomic problems in rural areas (Bajema, Miller & Williams, 2002) have resulted in more learning disabled students in these regions (Pense, 2009).

Curriculum Re-Design

A horticulture unit of instruction from the Illinois Core was employed in this study to create six LOs that would address the needs of SLD students (see Repository under Teacher Resources at http://teachag.siu.edu/). Technology choices were examined based on the recommendations of King-Sears and Evmenova (2007) that it be "efficient, cost effective and gets the job done" (p. 9). Microsoft® PowerPoint® software was therefore chosen as the medium.

The six principles of instructional design advocated by Heward (2009) guided the design of the LOs; including big ideas, conspicuous strategies, mediated scaffolding, strategic integration, judicious review, and explicit instruction. Teacher educators in agriculture education and special education validated the newly developed LOs using these principles. Such a validation process helps to ensure appropriate language and content in the newly developed curriculum (Wiersma & Jurs, 1990).

Students from two groups were then randomly assigned to treatment and control groups. All students received instruction using lecture and power point presentation from lessons in The Illinois Core Curriculum. Following instruction, the treatment groups worked through the newly developed LOs designed to enhance the daily lessons, while the control groups were given lab work unrelated to the lessons.

Ten intervening variables were identified by Joy and Garcia (2000) from a meta-analysis study by Rachal (1993) for studies of computer aided instruction. Seven of these were addressed in this study of LOs; including, random assignment of groups, pretesting to account for prior knowledge, grouping by student ability, accounting for differing learning styles through the six major principles for instructional design, teacher effects by utilizing five different sites and their instructors, instructional method by utilizing the state core curriculum as a basis of

instruction, and media familiarity by providing LOs through a simple but effective computer application.

Procedure

Pre-service agricultural education teachers (university students) were trained to administer the pre- and posttests, conduct instruction using the Illinois Core Curriculum, and supervise use of the newly developed LOs. The project workers then traveled to each of the five school sites during April and May, 2011 to administer the pretests to 97 students enrolled in Introduction to Agriculture courses. All students received instruction from the project workers using the lesson plans and power point presentations taken from The Illinois Core Curriculum for Agriculture. However, students were randomly divided into two groups: one group to be given the self-paced LOs after each lesson in Horticulture, and the other group to receive unrelated instruction in a laboratory setting from their usual teacher after each lesson. Students were told only one purpose of the study: to compare student performance through curriculum enhanced by the use of LOs with student performance through curriculum not enhanced with LOs. They were not told the study was targeting SLD students, in an effort to protect the SLD student from being singled out. Posttests were administered once all three lessons had been completed.

Items in the pre- and posttests numbered 24 and were multiple-choice. Students recorded their answers on a Mark Reflex® answer sheet by NCS. Due to student absences on either the pre- or posttest, only 83 useable pre- and posttest scores were obtained from the population (N = 98).

Instrumentation

To assess learning, pre- and posttests (parallel forms) were developed in an earlier project derived from the same unit of study in the Illinois Core Curriculum (Pense, 2009). Content validity was addressed by adhering to the original lesson plans in the core curriculum, and through review by a panel of experts consisting of two agricultural education professors and one special education professor. The pre- posttests were pilot-tested with 16 students enrolled in an Introduction to Agriculture course at Eldorado High School in Eldorado, Illinois. Initially, the pretest yielded a KR-20 reliability coefficient of .68 (Table 1).

An item analysis yielded a difficulty index score and a mean discrimination index for each of the 24 multiple choice questions. The same panel of researchers then determined whether to retain, reword or remove each test item. The pre- and posttests also underwent revision to ensure that each item was written based on Gronlund and Waugh's (2009) rules for multiple choice items. A second pilot test conducted with a different class of 17 students at Eldorado High School in Eldorado, Illinois, yielded a KR-20 reliability coefficient of .90 for the pretest. Developed from the revised pretest, the posttest yielded a KR-20 reliability coefficient of .78 (Table 1).

Table 1
Kuder-Richardson Formula 20 (KR-20) Reliability Coefficients for Pre- and Posttests Prior To and After Test Revision

	KR-20 reliability coefficients	
	1st pilot test	2nd pilot test
Pretest	0.68	0.90
Posttest	----	0.78

Note. Posttest was a parallel form constructed from 1st pilot test; resulting in a single reliability coefficient.

Results/Outcomes

Demographic data for the study sites (Table 2) was retrieved from the Illinois Agricultural Education website: http://www.agriculturaleducation.org/. Each research site was a high school incorporating grades 9 through 12, and were located in rural

settings; specifically, in the Illinois Delta Region, a federally designated economically distressed area. The student population of each school ranged from 184 to 1115. Three of the schools used the traditional 50-minute Carnegie unit based on seven- to eight-period schedules on an 18-week semester. Two of the schools employed a four-block schedule. The number of minority students in the agricultural education program at each site was negligible, with a maximum of two in any one program. Representation of SLD students at each site ranged from 6 to 25 per program.

In three of the five schools tested in the study, male students outnumbered the female students (Table 3); 22 males and 5 females in school 1, 13 males and 5 females in school 3, and 16 males and 5 females in school 4; as opposed to 11 females and 6 males in School 2 and 10 females and 7 males school 5. Intervening factors resulted in a small number of SLD students (Table 3) who completed both the pre- and posttests, ranging in number from no SLD students in school 4 to four SLD students in schools 1, 3, and 5.

Table 2
Demographic Information on Five Schools in the Study and One School in the Pilot Test

	Research sites					
	Pilot	Sch. 1	Sch. 2	Sch. 3	Sch. 4	Sch. 5
School type	Rural	Rural	Rural	Rural	Rural	Rural
Grade levels	9-12	9-12	9-12	9-12	9-12	9-12
Student population	345	530	184	1115	423	353
Class schedule	7 Per.	7 Per.	7 Per.	7 Per.	4 Blk.	4 Blk.
Minority students	2	1	1	2	1	2
IEPs in ag program	25	20	6	14	6	20

Note. Sch.= School, Per.= Period, Blk.=Block

Table 3
Number of Students in Study by Gender and Type of Student

	Research sites									
	Sch. 1		Sch. 2		Sch. 3		Sch. 4		Sch. 5	
	Trad	SLD	Trad	SLD	Trad	SLD	Trad	SLD	Trad	SLD
Male	18	4	5	1	10	3	16	0	5	2
Female	5	0	10	1	4	1	5	0	8	2
Total	23	4	15	2	14	4	21	0	13	4

A series of LOs were constructed for a unit of instruction in horticulture; being redesigned by a subject matter specialist to include objectives, learning activities and evaluation instruments. These LOs were produced using Microsoft Power Point. They contained voice-over recordings, employed interactive components to increase student learning and retention for the SLD student, and were housed in a repository under Teacher Resources at http://teachag.siu.edu/. The six LOs addressed the following three subject areas: Lesson 1 – Understanding horticulture; Lesson 2 – Determining the importance of the horticulture industry; Lesson 3 – Exploring career opportunities in horticulture.

Both the treatment and control groups of SLD students (Table 4) scored higher in the posttest over the pre-test. The treatment group, students who were given access to LOs, obtained a mean score of 11.0 (*SD* = 3.16) in the pre-test, and obtained a mean score of 16.33 (*SD* = 5.61) in the posttest. The total gain score computed from these results for the treatment

group was 5.33. The control group of students who did not receive access to the LOs obtained a mean score of 9.43 (*SD* = 2.76) on the pre-test, and obtained a mean score of 10.14 (*SD* = 4.67) on the posttest. The total gain score for the control group was 0.71.

Table 4
SLD Student Pre- Posttest Mean Scores and Gain Scores for Treatment & Control

	SLD student mean scores						
	Pre-test			Posttest			
Groups	n	*M*	*SD*	n	*M*	*SD*	Gain Score
Treatment	6	11.00	3.16	6	16.33	5.61	5.33
Control	6	9.43	2.76	6	10.14	4.67	0.71
Gain score difference							4.62

Note. Gain score was calculated as posttest minus pre-test.

The treatment and control groups of the traditional students (Table 5), also consistently scored higher in the posttest over the pretest. The treatment group of traditional students who were given access to LOs obtained a mean score of 13.05 (*SD* = 3.06) in the pre-test, and obtained a mean score of 17.73 (*SD* = 3.52) in the posttest. The total gain score computed from these results for the treatment group of traditional students was 4.68. The control group of traditional students who did not receive access to the LOs obtained a mean score of 13.03 (*SD* = 3.41) on the pre-test, and obtained a mean score of 16.92 (*SD* = 3.83) on the posttest. The total gain score for the control group of traditional students was 3.89.

Table 5
Traditional Student Pre- Posttest Mean Scores and Gain Scores for Treatment & Control Groups

	Traditional students						
	Pretest			Posttest			
Groups	n	*M*	*SD*	n	*M*	*SD*	Gain Score
Treatment	36	13.05	3.06	36	17.73	3.52	4.68
Control	35	13.03	3.41	35	16.92	3.83	3.89
Gain score difference							0.79

Note. Gain score was calculated as posttest minus pre-test.

It should be noted, however, that the overall score achieved by the SLD students in the posttest was only 33% (*M* = 16.33, *SD* = 5.61) and the overall score achieved by the traditional students in the posttest was only 35% (*M* = 17.73, *SD* = 3.52).

Conclusions

These findings should not be generalized beyond the population of this pre- posttest quasi-experimental study. The amount of data generated, however, carries implications for all agricultural education programs. Analysis of the major findings for objectives three and four led to the following conclusions:

1. Learning Objects, as one form of a re-designed curriculum in agricultural education, made a positive difference in student knowledge acquisition for SLD students (treatment group mean gain score was 5.33; gain score difference between treatment and control group means was 4.62).
2. Learning Objects, as one form of a re-designed curriculum for agricultural education, made a positive difference in

student knowledge acquisition for non-SLD students (treatment group mean gain score was 4.68; gain score difference between treatment and control group means was 0.79).
3. Learning Objects as a form of a re-designed curriculum for SLD students resulted in greater gain scores for SLD students than for non-SLD students in agricultural education.
4. Overall mean scores in the posttest were low for both groups of students; SLD student mean score in the posttest was 33% (M = 16.33, SD = 5.61), while the traditional student mean score in the posttest was 35% (M = 17.73, SD = 3.52).

Implications

A primary goal of learning objects is to provide a repository of teaching materials that can be combined into multiple lessons. For example an introduction to a horticulture lesson might have a component on definition of key terms. The definition of each term could be an LO. The instructor would link together the LOs of the number of definitions appropriate for one or a group of SLD students to use in a single lesson. Depending on the type and level of a student's SLD, a teacher could string together different sets of LOs to best meet the ability level of the student. For example a lesson for one SLD student may include only the essential definitions and examples related to Horticulture, but for another SLD student additional background and application material may be incorporated into a lesson.

In this case, a key requirement of an LO repository is that it contain an appropriate amount of content on a subject, and the content be "broken" into relatively small chunks with the idea that each chunk would only be a small part of a lesson. The LO material must also be provided in such a manner that teachers can readily string together LOs for lesson development. Each LO may contain link(s) to background or example material and the instructor may need control to turn the background/example links on or off for different students.

Given that nearly 23% of students in the agricultural education classroom possess specific learning disabilities, the agriculture industry risks losing nearly a quarter of its workforce. Learning Objects are yet another tool available to the agricultural education instructor for effectively meeting the needs of not only SLD students, but also the traditional students in the classroom. By utilizing such methods, the needs of all students are met and the future workforce is protected.

Recommendations

Since curriculums can effectively be redesigned with LOs to improve learning for SLD and traditional students, additional work is needed to:

1. Determine the appropriate subject matter size of LO content for inclusion in lessons for SLD students.
2. Develop and implement methods for agricultural education teachers to integrate LOs into lesson plans for SLD students, while minimizing preparation time.
3. Query agriculture teachers to provide recommendations on the amount of subject matter to include in each LO.
4. Establish appropriate LO cataloging and metadata requirements for SLD students in agricultural education.
5. Evaluate software tools and provide recommendations on best practices for linking LOs in lesson preparation for SLD students in agricultural education.

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