

THE INFLUENCE OF ENROLLMENT IN AGRISCIENCE COURSES ON THE SCIENCE ACHIEVEMENT OF HIGH SCHOOL STUDENTS

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Abstract

The primary purpose of this study was to determine if agriscience courses impact the science achievement of high school students. Objectives included describing students on selected demographics, measuring students' science achievement as measured by the Louisiana exit examination, and comparing science achievement of agriscience students with non-agriscience students. The population for this study was 11th grade students enrolled in public schools in Louisiana who completed the state mandated exit examination in 1998. The subjects for this study were a census of the defined population. The findings of the study indicated that agriscience students earned higher scores than non-agriscience students on the science portion of the exit examination. Agriscience students scored as high or higher on four of five science domain sub-scales. It was also found that agriscience students were more likely to pass the examination than non-agriscience students. It was concluded that participation in agriscience courses was beneficial to high school students. Recommendations were made that students be encouraged to enroll in agriscience courses, also recommended is further research to determine the impact of agriscience programs on science achievement of special education students as well as a longitudinal study to determine the impact of specific agriscience courses.

Introduction

Never has education been more important than in today's demanding world. Today one not only has to have a good education to find a good job but many times has to have a good education to find a job at all. Most people today who drop out of school or leave the educational system without the benefit of a set of successful educational experiences will find themselves restricted to unskilled, minimum wage jobs (Trexler & Barrett, 1992).

A good education is important for much more than just employment in today's demanding society. Life in modern society has reached the point that it is almost imperative that people have a quality education simply to develop everyday living skills in such areas as making effective decisions regarding purchases, making effective use of modern banking systems, utilizing household appliances and equipment effectively, etc. In addition, a good education is becoming increasingly

important for effective child rearing in today's society. Without a good education, individuals find many parts of the process of child rearing difficult if not impossible. Uppermost among these is working to ensure that their children receive a good quality education (National Research Council, 1999).

An attempt to meet the demands of the world is addressed in the vocational programs of the high schools. Vocational programs are designed to teach basic job entry-level skills in a variety of areas (Tenney, 1977). One of the curriculums at the high school level that addresses these challenges of the world is the agriscience program. This program is designed to provide a means for students to learn and develop those skills needed in today's world. The agriscience program addresses goals in science by teaching units on soils, cultivation of plant materials, producing livestock, animal genetics, natural resources, plant and animal nutrition, integrated pest

management, etc. Goals in math are addressed in units on agribusiness, entrepreneurship, project planning, construction, plumbing, electricity, surveying, etc., while goals in written composition, language arts, and social studies are targeted in units on parliamentary law, public speaking, leadership, officer duties, agribusiness, etc. (Moss, 1986). The agriscience program educates students to achieve in diverse areas that are very practical for dealing with the challenges in today's world.

Agriscience Education

Revolutions take place in many areas, but none were more significant than the revolution that took place in agriculture in the late 1800's. Farmers were finding a need for more and more information to be competitive in the market and also to meet the growing demand for a greater food supply. The result was the Hatch Act of 1887, which, through federal funding, created the experiment stations to perform scientific research in various areas of agriculture. This was significant because the term "agricultural science" was used in the preamble (Hillison, 1996).

Senator Dudley M. Hughes and Representative Hoke Smith, both of Georgia, saw a need to take "agricultural science" to the masses of farm children and sponsored the Smith-Hughes Act of 1917. The act provided federal funding for the instruction of agriculture in the local high schools. This also shifted the responsibility of governing from the United States Department of Agriculture (USDA) to the Federal Board of Vocational Education and placed more emphasis on the vocational aspect of instruction and less on the academic or science aspect (Tenney, 1977).

Recently, however, the science-based nature of this curriculum has returned to a position of prominence. In 1988, the National Research Council (NRC) recommended the acceptance of applied science courses to meet science elective requirements. In 1990 the Louisiana State Department of Education began allowing students who successfully completed Agriscience I and Agriscience II to apply

these courses toward a science credit (Louisiana Department of Education, 1997).

Modern agricultural education still holds on to many of the links to the past, but it is also evolving and addressing new issues. Vocational agriculture has gradually evolved into agriscience or applied agriculture. The leaders in the program have realized that the majority of the country's work force is no longer composed of farmers and ranchers and that the basic concepts taught in agricultural courses can be applied in many other agriculturally linked careers and life skills. The benefits of National FFA Organization program and Supervised Agricultural Experience projects have helped to guide students toward careers and educational opportunities, as well as teaching responsibility to the young leaders of tomorrow (Russell, 1987).

Malpiedi (1989) defines agriscience as "the application of science in agriculture." In Louisiana, Moss (1986, p. 3) found that the "Basic Program of Vocational Agriculture in the Louisiana Curriculum Guide contained a total of 76 instructional objectives that were identified as science related." Awarding science credit for agriscience courses is also supported by research. Dormody (1993) states in a national study, 34% of the agriscience teachers are teaching courses in which science credit is received and during the 1989-90 school year, over 67% of the nation's agriculture departments and science departments had shared resources. Haggerton (1997, p. 2) states, "Agricultural science teachers are separated from other teachers by the fact that they are responsible for more than just classroom and laboratory instruction.... Due to the vast curricula offered in agricultural sciences at the secondary level, agricultural science teachers often are asked to teach subjects that may range from biological sciences to hunter safety." Johnson (1996b) reports that Arkansas agriculture teachers are very much in favor of granting science credit for agriculture courses. In a separate study Johnson (1996a) also identified that the parents of students support granting science credit for agriculture courses.

According to Connors and Elliot (1995), the conceptual framework for science

achievement should and can very easily incorporate agriscience into the secondary science program. Connors and Elliot (1995, p. 62) also recommend that, "Local school boards should study the possibility of offering science credit for agriscience and natural resource classes that contain a significant amount of science objectives" as a means of increasing science achievement scores. Also suggested in Connors and Elliot's (1995) study was the lobbying of universities to recognize agriscience courses as science credit for enrolling students.

According to Trexler and Barrett (1992, p. 7), "Agricultural education joins science education in the race toward scientific literacy." Today there are a few areas that one can examine to identify current links between education in the fields of science and agriculture to improve science literacy. These areas include resource sharing, science credit for agriculture courses, and the correlation of objectives between the science and agriscience curriculums. Frazee (1993) poses the question in his article, "How Much Science is Being Taught in Our Agriculture Curricula?" and answers the question by stating that many states are currently allowing students who are enrolled in agriculture classes to receive science academic credit required for graduation. In fact to answer his question Frazee states, "we can say in Texas that a majority of the curriculum is science based" (1993).

Even though the agriscience program is very beneficial to all students and addresses life skills, it has fallen under some criticism lately. While science teachers tend to see the value in agriscience courses, many counselors, administrators, and members of the education community who wish to emphasize the college preparatory courses have questioned its value (Johnson & Newman, 1993). There is no question that to insure the growth of the nation and its communities, young people must be prepared for a higher education in subject areas such as physics, trigonometry, American literature, etc. It is important that students be prepared for various college careers. However it must also be realized that not all of the high school population is going to obtain a college degree and not all must be trained for one. According to the

1990 census, 82.5% of the eighteen and over population of Louisiana is without a college degree. While the percentage of the population with college education is well under what it probably should be, it clearly establishes the fact that a majority of the high school students do not receive a college degree and, therefore, must be prepared to become functional members of the skilled work force. The agriscience program addresses skills in both vocational areas for the work force and also those areas of academia necessary for college (animal science, plant science, reproductive genetics, leadership, agribusiness, etc.).

With the importance of a quality education in society today, the need for determining if/when this quality education is indeed being provided becomes critical. This assessment typically takes the form of achievement testing (National Research Council, 1999).

Achievement as defined by Smith and Adams (1966) is a change in behavior in a desired direction, or very simply learning. Education is learning; therefore, the goal of education is achievement. It is very important that achievement is measured on a regular basis to inform educators of student ability. This allows educators to place students in courses that are designed to maximize their performance. It is also the primary gauge that educators use to guide the advancement of students through the educational process (National Research Council, 1999).

The education system tends to use standardized tests for most of its evaluations. A standardized test is defined by Payne (1997) as a systematic sample of performance obtained under prescribed conditions, scored according to definite rules, and capable of evaluation by reference to normative information. Standardized tests have become the primary means of evaluation throughout the United States of America. Politicians, school board members, and especially the newspapers utilize the performance of students to evaluate teachers, schools, and the entire status of education in the United States (National Research Council, 1999).

Since the application of principles and concepts is often difficult to assess and the agriscience program purports to provide

students with the academic preparation that is equivalent to that of many of the elective science courses offered in a state's high schools, the most appropriate technique for establishing the quality of the education provided through the programs would be through a standardized testing program (National Research Council, 1999).

Purpose and Objectives of the Study

The primary purpose of this study is to compare science achievement, as measured by the score on the science portion of the Graduate Exit Examination (GEE), of high school students in Louisiana by whether or not they are identified as an agriscience student. Specific objectives formulated to guide the research included:

1. To describe 11th grade high school students in Louisiana completing the science portion of the GEE by the following characteristics: (a) grade level, (b) age, (c) sex, (d) race, (e) special education or regular education, (f) 504 status, and (g) vocational program
2. To describe the science achievement, as measured by the scores on the science portion of the GEE, of 11th grade high school students in Louisiana.
3. To compare science achievement, as measured by the score on the science portion of the GEE, of 11th grade high school students in Louisiana by whether or not they are identified as an agriscience student.

Methodology

The target population for this study was defined as all students enrolled in public high schools in the state of Louisiana. The accessible population was defined as all 11th grade students enrolled in public high schools in the state of Louisiana who had taken part in the state mandated Graduate Exit Examination (GEE) in the spring of the 1997-98 school year and had valid scores in the data base established by the Louisiana State Department of Education. The subjects for this study were a 100% sample of the defined accessible population.

The instrument for this research was a computerized recording form. The variables of the investigation were copied directly from the archival data source, developed by the State's Division of Student Standards and Assessments, into the study's recording form. The variables transferred and studied included: (a) grade level, (b) age, (c) sex, (d) race, (e) special/regular education, (f) 504 status, (g) vocational program, (h) raw GEE science score, (i) scaled GEE science score, (j) raw domain scores. The items measured in the study were reviewed by a panel of experts in the field of agriscience education and research methodology in an effort to establish the validity and completeness of the instrument.

Data for this study were collected by retrieval of information from an archival data set established by the Louisiana State Department of Education. Permission was sought to acquire a copy of the information needed to accomplish the objectives of this study by contacting the Department's Division of Student Standards and Assessments. The Division of Student Standards and Assessments then transferred the requested data to Louisiana State University.

Findings

Objective One

The first objective of this study was to describe the 11th grade high school students in Louisiana completing the science portion of Louisiana's Graduate Exit Examination (GEE) on selected demographic characteristics. The demographic information analyzed is a result of the completion of the GEE answer document by the students participating in the examination. One of the characteristics on which students were described was their age at the time the GEE was completed. Student ages ranged from a low of 14.67 years to a high of 21.25 years with a mean age of 17.25 ($SD = .698$). Students were also described on the variable gender. The data indicated that there was a slightly larger sample of females tested than males. Females numbered 22,347 (53.78%) and males numbered 19,206 (46.22%) of the total sample.

The ethnic background or race of the students was examined, and the largest ethnic group in the sample ($n = 22,938$; 55.17%) was white. The second largest group in the sample ($n = 16,953$; 40.78%) was black. The remaining students included Asian ($n = 762$, 1.82%), Hispanic ($n = 697$, 1.68%), and Native American ($n = 225$, 0.54%).

In the next category, the students were classified on the educational program in which they were enrolled. This identified the students as regular education students or special education students (gifted or mild mentally handicapped). The majority of the students were classified as regular education students ($n = 31,944$, 92.13%). The minority group was the special education group accounting for 7.86% ($n = 2,728$) of the population.

Another aspect of educational classification is the students' 504 test modification status. This means that one or more special test modifications can be implemented for students with this designation. This group was a relatively small portion of the sample with only 514 students (1.24%). Most of the students in the study ($n = 41,218$, 98.8%) did not hold a 504 identification.

Students were also asked to report if they were in a vocational program on the GEE answer document. Of the students responding, 20,598 (49.4%) indicated they were in a vocational program, while 18,584 (44.4%) indicated they were not in a vocational program. Some students ($n = 2,582$, 6.2%) did not respond to this question.

The final characteristic to be described was the student's area of vocational study. Those students who indicated that they were in a vocational program were asked to indicate the specific program area in which they were enrolled. The sample of students who identified Agriscience as their area of vocational study included a total of 2,947 (14.24%) students.

Objective 2

The second objective of this study was to describe the science achievement of 11th grade high school students in Louisiana as measured by their scores on the science portion of the GEE. Student scores were

examined in terms of raw score, scaled score, and domain scores.

The analysis of data began by eliminating all scores of zero from the sample. Information was obtained from administrative staff and counselors at the high school level explaining that all answer documents must be submitted and scored for all students, regardless of whether or not they participated in the actual examination process. The data was then examined for students with a score of zero on all parts of the examination (this was done by examination of the raw data). These individuals were determined to have scores resulting from not completing the test, and they were thus eliminated from the analysis of data to accomplish the study objectives relating to achievement scores. Also eliminated from the sample were all students who were identified as members of a special population, those identified as special education or 504, as these students were given modifications and assistance in completing the examination (i.e. test read aloud to them). The basis for elimination of these scores was to have appropriate comparison groups in the event that one of the groups had more gifted or mild mentally handicapped students enrolled in them that may skew the results. This left a sample of 31,497 students to be used in the analysis of objectives 2 and 3.

The first scores examined in the analysis of the data were the overall raw scores achieved on the science portion of the GEE. The range of possible scores on the test was from a low of zero to a maximum score of 59. As explained earlier, students who scored "0" on all sections of the test were eliminated to avoid having the absentee scores recorded and artificially creating a positive skew in the data. Therefore, the range of scores in the data was from a low of one to a high of 59. The mean score was 35.76 ($SD = 9.68$). The most frequently occurring score was 39 ($n = 1,187$, 3.77%). The GEE is a standardized test in which raw scores are converted to a scaled score for normative purposes. When examining the data in the form of scaled scores, they ranged from a low of 1005 to a high of 1092. The analyzed data showed a mean of 1049.04 ($SD = 7.93$) and a mode of 1049.

When examining the requirements placed by the Louisiana State Department of Education, a scaled score of 1042 is considered to be a passing score. Meeting the established passing requirements were 26,408 students (83.84%). This left 5,089 (16.16%) students taking the exam unsuccessful in their attempt to meet achievement levels required on the science portion of the examination for graduation from high school.

The domain scores on the science portion of the exam are in the areas of scientific method, biology/general science, chemistry/physical science, earth and space science, physics/physical science. Domain 1 was in the area of the scientific method. It contained a total of seven questions and scores ranged from zero correct answers, ($n = 652$, 2.1%) to seven correct answers, ($n = 5063$, 16.1%). There was a mean score of 4.55 with a standard deviation of 1.87. The mode was six, with a total of 6,843 students achieving that number of correct responses.

Domain 2 is in the area of biology/general science. It was one of the larger portions of the examination with twenty-two questions asked. Scores ranged from zero correct answers, ($n = 5$, <0.01%) to 22 correct answers, ($n = 108$, 0.3%). The mean score was 13.144 ($SD = 3.64$). The mode was 14, with a total of 3,300 students achieving that number of correct responses.

Domain 3 contained questions in the area of chemistry/physical science. There were eleven questions with student scores ranging from zero correct answers, ($n = 135$, 0.4%) to eleven correct answers, ($n = 2283$, 7.2%). The mean score was 6.619 ($SD = 2.63$). The mode was six, with a total of 3,942 students achieving that number of correct responses.

Domain 4 contained questions in the area of earth and space science/general science. There were eight questions with student scores ranging from zero correct answers, ($n = 160$, 0.5%) to eight correct answers, ($n = 2605$, 8.3%). The mean score was 5.210 ($SD = 1.75$). The mode was six, with a total of 6,840 students achieving that number of correct responses.

The final domain, Domain 5 contained questions in the area of physics/physical science. There were eleven questions with student scores ranging from zero correct answers, ($n = 110$, 0.3%) to eleven correct answers, ($n = 545$, 1.7%). The mean score was 6.235 ($SD = 2.27$). The mode was six, with a total of 4,975 students achieving that number of correct responses.

Objective 3

The final objective of this study was to compare the science achievement of 11th grade high school students in Louisiana as measured by their scores on the science portion of Louisiana's graduate exit examination (GEE) by whether or not they were identified as agriscience students. Data were broken down into several areas for analysis. All 11th grade students remaining in the sample were categorized into an agriscience sample ($n = 2272$, 7.21%) and a non-agriculture sample ($n = 29225$, 92.79%). The two study groups were then compared on their overall scaled science scores, on their overall raw science scores, on each of the five domain raw scores of the GEE, and by whether they passed or failed the exam.

When examining the total science achievement by the two 11th grade groups, an independent t-test procedure was utilized to compare the mean raw and scaled scores as well as the raw scores for each of the five domains. When comparisons were made, significant differences were found in six of the seven categories. Agriscience students achieved a mean scaled score of 1049.54 and non-agriculture students had a mean scaled score of 1049.00 ($t_{31495} = 3.09$, $p = 0.002$). This comparison showed that agriscience students scored significantly higher on the overall scaled score than non-agriculture students. Also significant was the comparison of overall raw scores; agriscience students had a significantly higher mean overall raw score of 36.38 than non-agriculture students with a mean overall raw score of 35.71 ($t_{31495} = 3.16$, $p = 0.002$) (see Table 1).

Table 1
Comparison of raw and scaled scores between agriscience and non-agriscience students on the science portion of the GEE

Variable	<u>n</u>	<u>m</u>	<u>SD</u>	<u>t</u>	<u>df</u>	<u>p</u>
Scaled Score						
Agriscience	2,272	1049.5383	7.697	3.09	31,495	.002
Non-Agriscience	29,225	1049.0045	7.957			
Raw Score						
Agriscience	2,272	36.3803	9.263	3.16	31,495	.002
Non-Agriscience	29,225	35.7134	9.710			

When examining the raw domain scores, results were generally similar to those found in the overall scores; however, some differences were identified. The agriscience group had a significantly higher mean score in the domains of the scientific method ($t_{31495} = 6.10, p < .001$), biology/general science ($t_{31495} = 6.33, p < .001$), and earth and space science/general science

($t_{31495} = 4.66, p < .001$). On the other hand, the non-agriscience group had a significantly higher mean score than the agriscience students in the domain of chemistry/physical science ($t_{31495} = -5.04, p < .001$). When examining the fifth domain, physics/physical science, no statistically significant difference was found ($t_{31495} = .54, p = 0.589$) (see Table 2).

Table 2
Comparison of domain scores between agriscience and non-agriscience students on the science portion of the GEE

Variable	<u>n</u>	<u>m</u>	<u>SD</u>	<u>t</u>	<u>df</u>	<u>p</u>
Scientific Method						
Agriscience	2,272	4.7835	1.777	6.10	31,495	< .001
Non-Agriscience	29,225	4.5344	1.882			
Biology						
Agriscience	2,272	13.6105	3.534	6.33	31,495	< .001
Non-Agriscience	29,225	13.1081	3.650			
Chemistry						
Agriscience	2,272	6.3508	2.632	-5.04	31,495	< .001
Non-Agriscience	29,225	6.6404	2.638			
Earth Science						
Agriscience	2,272	5.3754	1.656	4.66	31,495	< .001
Non-Agriscience	29,225	5.1972	1.765			
Physics						
Agriscience	2,272	6.2601	2.303	0.54	31,495	.589
Non-Agriscience	29,225	6.2333	2.277			

In addition to comparing the raw, scaled, and domain scores achieved by agriscience and non-agriscience students in the 11th grade, the passing status of students by whether or not the student was identified as an agriscience student was also examined. Passing status was defined as achieving a scaled score of 1042 or higher on the science portion of the GEE.

To accomplish this portion of the objective, a chi-square test of independence to determine if the variables passing status and agriscience status were independent was

utilized. The calculated chi-square was statistically significant indicating that the variables were not independent ($X^2_{(1)} = 19.744$, $p < 0.0001$). The nature of the association between these variables was that a greater percent of the 11th grade agriscience students (87.1%) passed the examination than did the 11th grade non-agriscience students (83.6%). Conversely, a larger percentage of the non-agriscience students (16.4%) failed the science portion of Louisiana's GEE than did the agriscience students (12.9%) (see Table 3).

Table 3

Chi-square analysis of agriscience classification by whether students passed or failed the science portion of the GEE

Passed Examination	Agriscience Classification	
	Agriscience	Non-Agriscience
Yes	1,980 (87.1%)	24,428 (83.6%)
No	292 (12.9%)	4,797 (16.4%)
Totals	$\underline{n} = 2,272$ (100%)	$\underline{n} = 29,225$ (100%)

Note: Chi-Square = 19.74379, $p = 0.00001$.

Conclusions and Recommendations

Conclusions

1. The 11th grade students in Louisiana's public high schools are predominately white in their ethnic makeup with black students making up the largest minority group.
2. Louisiana's 11th grade high school population has a relatively small number of special education and 504 students.
3. The majority of students taking the science portion of the GEE have participated in some type of vocational program.
4. Most 11th grade students in Louisiana are successful in their attempts to pass the science portion of the GEE.
5. Agriscience students achieved significantly higher overall scores than non-agriscience students on the

science portion of the GEE. The importance of this difference was substantiated in a personal communication with Dr. Phen Chou, a psychometrician for the Student Standards and Assessments Division of the Louisiana State Department of Education. She stated that a "statistically significant difference would be important and of interest" to her as a staff member of the LSDE (personal communication, June 30, 2000).

6. Agriscience students scored as well as or better than non-agriscience students in four of the five domain areas of the science portion of the GEE.
7. Non-agriscience students had higher chemistry domain scores than agriscience students.
8. Agriscience students were better prepared to pass the 11th grade

science portion of the Louisiana GEE than non-agriculture students. The importance of this conclusion was further emphasized by Dr. Scott Norton, Director of the Division of Student Standards and Assessments LSDE, who stated that "in our experience, with a difference in pass or fail rates of 2% or more, we would have to take a look at it. An increase in 2% on a state wide level could impact some 2,500 students" (personal communication, June 30, 2000).

Recommendations

The findings and conclusions of this study served as the basis for making the following recommendations for practice and further research.

1. High school students in Louisiana should be encouraged to enroll in agriscience courses. There are several potential aspects to making enrollment in agriscience courses a reality for more students.
 - a. Courses must be available for students to enroll in them. Currently, agriscience courses are offered at slightly more than half of the public high schools in the state and very few of the private schools. In addition, schools with existing agriscience programs often are unable to admit all of the students seeking admission into agriscience courses. Therefore, schools with existing programs that are unable to meet the current demand should expand the program to include more agriscience teachers and consequently more agriscience course offerings. In addition, schools that do not currently include agriscience among their curricular offerings should investigate the interest in agriscience and where feasible add a program to the school's curriculum.
 - b. Another aspect of encouraging students to enroll in agriscience courses is the support of local school administrations. Some possible ways that this group could demonstrate support for the program include: (1) Administrators should be willing to approve Louisiana's state adopted policies for agriscience courses as a substitute for science credit for graduation requirements; (2) Administrators should identify ways to recognize the accomplishments of agriscience programs and the students enrolled in those programs; and (3) Administrators should work with agriscience teachers to facilitate the participation of students in the many activities available through the agriscience program.
 - c. Agriscience programs must be supported by the state. State agencies should take an active role in providing leadership, guidance, funding, and support for the promotion of this program. It is significant that the current policy of Louisiana's State Department of Education is to accept the completion of Agriscience I and II courses as a substitute for a required science credit for graduation. However, other state entities, such as Louisiana's TOPS (Tuition Opportunity Program for Students) Program should be encouraged to recognize agriscience courses as substitutes, replacements, or possibly new courses to be accepted in the area of science to meet necessary requirements for students to obtain college funding. This would be especially valuable for students planning to attend college to major in agriculturally related fields.
 - d. Colleges and universities should support and encourage agriscience programs. They should develop communication

- links with programs to support agriscience education and its impact on student achievement. They could also encourage enrollment in agriscience courses by recognizing these courses as possible courses to be accepted in the area of science to meet necessary requirements for student admission into their college programs.
2. Recommendations for future research may include the following:
 - a. A follow-up study should be undertaken to determine the impact of agriscience courses on the science achievement of special education students. This population could potentially benefit even more from this applied science curriculum than the population of regularly enrolled students because of the importance of applied instruction for these students.
 - b. Additional research should be conducted of a longitudinal nature in which a group of students is identified and tracked throughout their high school years. The study should determine if specific agriscience and/or science courses have more of an impact on science achievement than others.

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