AGRICULTURAL EDUCATION COMPETENCIES AND PROGRESS TOWARD A DOCTORAL DEGREE

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Abstract

This study was designed to describe the compilation of doctoral students' knowledge, skill, and abilities as they progressed toward a degree in agricultural education. A census of beginning, middle, and end of program doctoral students at Texas A&M University was conducted. An 85% response rate was achieved. Data for the study were collected by mailed questionnaire and online through the Internet. Study findings showed that as doctoral students progressed toward a degree, their Foundations Knowledge, Applications Knowledge, International Knowledge, Social Skills, Content Skills, Process Skills, Complex Problem-Solving Skills, Systems Skills, Resource Management Skills, Verbal Abilities, Idea Generation and Reasoning Abilities, Auditory and Speech Abilities, Attentiveness Abilities, and Perception Abilities increased. Recommendations for validating and authenticating study findings are provided. This study provides a model for benchmarking competencies and provides a taxonomy from which to study and understand/consider agricultural education competencies.

Introduction

A successful agricultural education doctoral student and graduate will draw on a variety of academic fields, knowledge bases, and contextual applications to achieve his or her personal and professional goals. Further, he or she will rely on a unique bundle of knowledge, skills, and abilities that are acquired and strengthened through life experiences and education to achieve his or her personal and professional goals. For doctoral students, graduate school is an opportunity to gain not only new knowledge, but also acquire and strengthen skills and abilities needed to be professionally successful. Knowledge is a body of information, supported by professionally acceptable theory and research that students use to perform effectively and successfully in a given setting. Skill is a present, observable competence to perform a learned psychomotor act. Effective performance of skills requires application of related knowledge and helps make possible the acquisition of new knowledge. Ability is a present competence to perform an observable behavior or a behavior that results in observable outcomes. Collectively, knowledge, skills, and abilities are referred to as competencies. Competencies are behavioral dimensions that help to identify effective from ineffective performance (Maxine, 1997).

In agricultural education, numerous studies have been conducted to look at specific student competencies within specific contexts. Place and Jacob (2001) found that Extension employees needed resource management competencies such as time management, workplace, and stress management to be effective. McCormick and Whittington (2000) found that students needed well-developed abilities to think critically at higher levels of cognition. Dyer and Osborne (1996) found that problem-solving skills are needed and could be taught to agricultural education students. Goecker (1992) stated that agricultural education graduate students needed, but did not possess, very high levels of teaching and learning competencies to be effective and productive professionals. Timko, Linhardt, and Stewart (1991) showed that international graduate students have

particular challenges with respect to communication and social competencies. Henderson and Shibano (1990) found that international graduate students had the highest levels of knowledge acquisition in teacher education preparation, research methods and techniques, and program development.

Fewer studies have focused on the compilation of knowledge, skills, and abilities that influence student success (Garton, Spain, Lamberson, & Spiers, 1999). Drawbaugh (1972) noted that students must be made aware of their unique competencies and subsequently provided opportunity for growth as they progress in their education. Newcomb (1974) noted that there are numerous lists of competencies in agricultural education. For example, Shippy (1981) identified 246 competencies in 10 categories needed by agricultural education graduates. The categories identified by Shippy included "program planning, development, and evaluation; planning of instruction; execution of instruction; evaluation of instruction; student vocational organization; supervised occupational experience; management; guidance; school-community relations; and professional role and development" (p. 30). Other studies have focused on a compilation of competencies needed by agricultural teachers to be successful (Stewart, Lighari, & Gott, 1983; Cook, 1963).

Findlay (1992) found agricultural education teachers acquired high levels of competencies through formal education, on-the-job experience, and self-directed study. Lower levels of competency acquisition were achieved through teaching internships and laboratory experiences. Lindner, Dooley, and Murphy (2001) noted that low levels of doctoral student knowledge, skills, and abilities might result in frustration, demotivation, impeded learning, and ultimately failure for students. Further, faculty may similarly become frustrated in developing and delivering course material if they are challenged by students who do not possess the requisite competencies to master course material; or faculty may be able to use information about student competencies to improve curricula, teaching materials, and instructional delivery methods.

Identifying competencies associated with higher levels of performance or goal attainment is known as competency modeling (Stone, 1997). For competency models to be used to identify higher levels of performance, and because competencies can be influenced by a student's personality type, biological function, social style, and/or personal styles and values, competency models must be broad enough to allow for students to offset weaknesses on certain competencies with strengths on others (Parry, 1998). Competency models can be used as a student recruitment and selection tool; as a student assessment tool; as a tool to develop curricula and other teaching material; as a coaching, counseling, and mentoring tool; as a career development tool; and as a behavioral requirement benchmarking tool (Yeung, Woolcock & Sullivan, 1996).

Many models and methods for collecting the information necessary to establish a competency model are available. The knowledge category used in the research reported here was based on a census of Agricultural Education graduate course offerings at Texas A&M University and has been shown to be a valid and reliable model for collecting data on knowledge (Lindner et al. (2001). The skill and ability competencies were derived from the United States Department of Labor's Occupational Information Network (O*Net, 2000). Jackson and Schuler (2000) noted O*Net provides a national benchmark that offers a common language for all users of competency information. The skill category is based on Mumford and Peterson's (1995) taxonomy of skills and has been shown to be a valid and reliable model for collecting data on skills.

The ability category is based on Fleishman's ability requirements taxonomy and its associated measurement system and has been shown to be a valid and reliable method for collecting data on ability factors (Fleishman, Wetrogan, Uhlman, & Marshall-Mies, 1995). Fleishman's ability requirements taxonomy includes cognitive, psychomotor, physical, and sensory ability. Other institutions of higher education offering graduate degrees can use the Department of Labor skills and abilities as a

standard measurement to benchmark competencies. Using a standard inventory of graduate courses as a basis for measuring knowledge would be specific to each institution and content area.

As noted previously, various competencies needed by agricultural education graduates to be professionally successful in a given field have been identified in the literature. Further, doctoral students rely on a unique bundle of knowledge, skills, and abilities to be successful in the classroom and life. Little research, however, has focused on the compilation of unique competencies possessed by agricultural education doctoral students and which competencies are related to successful completion of a doctoral program of study. Lack of such information may subsequently inhibit a doctoral student's growth as he or she progress toward a degree.

Purpose

The purpose of this study was to describe and explore perceived knowledge, skills, and abilities of current and past Texas A&M University Agricultural Education doctoral students as they progressed toward a doctoral degree. This study further, attempts to develop a taxonomy from which to consider student competency assessment in agricultural education (Lindner & Dooley, 2001). The objectives of the study were:

1. To describe and explore perceived knowledge competencies and examine the relationship between knowledge and progress toward a degree.
2. To describe and explore perceived skill competencies and examine the relationship between skill and progress toward a degree.
3. To describe and explore perceived ability competencies and examine the relationship between ability and progress toward a degree.

Methods

The research design used for this study was descriptive in nature. The target population was Texas A&M University's Department of Agricultural Education doctoral students and recent doctoral graduates. The population consisted of 68 doctoral students and recent graduates in the population. The population consisted of "beginning" students (*N*=18) who had completed application for admission and were within their first semester of course work; "middle" students (*N*=32) who were actively and continuously enrolled beyond their first semester of coursework, had a degree plan on file, satisfactorily completed the general exam, or had a research proposal approved; and "end" students (*N*=18) who had completed and defended their dissertation or graduated within the past three years. The population was not delineated by full or part-time enrollment status. In this paper, success is defined as obtainment of a doctoral degree.

A census of the defined population was conducted. The questionnaire was designed to measure participants' perceptions of competencies. The participants were asked to indicate their current level of competence using a five-point Likert-type scale. The points on the scale are: 1 = Very Low; 2 = Low; 3 = Average; 4 = High; and 5 = Very High. A limitation of this study is that competencies are self-reported perceptions.

Data for this study were collected using a mixed mailed/Internet questionnaire. Dillman's (2000) general procedures for mailed/Internet questionnaires were followed. A response rate of 85% (*n*=58) was obtained for the study. Ninety-four percent of beginning students, 94% of middle students, and 75% of end students participated in the study. To control for non-response error, late respondents were compared to early respondents on the scaled items. No significant differences were found; therefore, the results of the study are generalizable to the target population (Lindner, Murphy, & Briers, 2001).

The instrument was pilot tested with 17 master's level graduate students at Texas A&M University. Instrument reliability was

estimated by calculating a Cronbach's alpha coefficient. Reliability for the scales on knowledge (.93), skills (.95), and abilities (.92) were calculated. Reliability estimates for corresponding subcategories are presented in Tables 1, 2, and 3. A panel of 12 experts at Texas A&M University and Texas Tech University established instrument content and face validity. The alpha level for statistical significance was set a priori at .05.

Findings

This section presents a summary of findings by objective.

Objective 1

The first objective of this study was to describe doctoral students by their perceived knowledge competencies and to examine the relationship between knowledge and progress towards degree. Participants were asked what level of knowledge they possessed on 22 items. Knowledge items were classified into four subcategories. Mean scores of subcategories were computed. Teaching Strategies Knowledge was defined as theories, techniques, and processes that enhance the teacher-learner process for adults and youth. Foundations Knowledge was defined as methods, theories, principles, and practices that provide a foundation for and guide the field of agricultural education. Applications Knowledge was defined as current trends, practices, and applications that facilitate change and technology transfer. International Knowledge was defined as theories, principles, and practices related to agricultural development in cross-national settings.

Table 1 shows participants' levels of Overall Knowledge (M=3.13), Teaching Strategies Knowledge (M=3.29), Foundations Knowledge (M=3.21), Applications Knowledge (M=3.16), and International Knowledge (M=2.41). When subjected to an *F-Test*, Overall, $F(2,56)=10.68$, Foundations, $F(2,56)=13.13$, Applications, $F(2,56)=11.21$, and International knowledge, $F(2,56)=3.59$ were significantly related to progress towards degree. As doctoral students progressed toward a degree, their Overall, Foundations, Applications, and International knowledge increased. Teaching Strategies Knowledge, however, was not significantly related to progress toward degree, $F(2,56)=2.68$.

Table 1
Doctoral Student Perceived Level of Knowledge by Progress Toward Degree

Progress Toward Degree	Alpha Coefficient[a]	*N*	*M*[b]	*SD*	*F*
Overall Knowledge	**.93**	**58**	**3.13**	**0.68**	
Beginning		17	2.64	0.55	10.68*
Middle		24	3.15	0.57	
End		17	3.57	0.64	
Teaching Strategies Knowledge	**.84**	**58**	**3.29**	**0.79**	
Beginning		17	2.98	0.85	2.68
Middle		24	3.29	0.68	
End		17	3.59	0.80	
Foundations Knowledge	**.83**	**58**	**3.21**	**0.71**	
Beginning		17	2.67	0.60	13.13*
Middle		24	3.23	0.57	
End		17	3.72	0.64	
Applications Knowledge	**.84**	**58**	**3.16**	**0.75**	
Beginning		17	2.61	0.49	11.21*
Middle		24	3.21	0.68	
End		17	3.65	0.75	
International Knowledge	**.91**	**58**	**2.41**	**1.11**	
Beginning		17	1.98	0.83	3.59*
Middle		24	2.58	1.17	
End		17	2.94	1.10	

Note. [a]Overall and subscale reliability was estimated by calculating a Cronbach's alpha coefficient. [b]1=very low, 2=low, 3=average, 4=high, 5=very high. *$p<.05$.

Objective 2

The second objective of this study was to describe doctoral students by their perceived skill competencies and to examine the relationship between skill and progress toward a degree. Participants were asked what level of skill they possessed on 43 items. Skill items were classified into seven subcategories. Mean scores of sub categories were computed. Content Skills, such as reading comprehension and mathematics provide a foundation for the acquisition of more specific skills. Process Skills, such as critical thinking and active learning, contribute to increased acquisition of additional competencies. Social Skills, such as persuasion and social perceptiveness, are developed capacities that help individuals achieve objectives. Complex Problem-Solving Skills, such as information gathering and idea evaluation, are necessary to solve real-world problems. Technical Skills, such as technology design and operations analysis, are needed to use information technologies effectively. Systems Skills, such as visioning and decision-making, are needed for people to work with others. Resource Management Skills such, as time management, are needed to effectively and efficiently allocate resources.

Table 2 shows participants' levels of Overall Skill (M=3.71), Social Skills (M=4.00), Content Skills (M=3.93), Process Skills (M=3.91), Complex Problem-Solving Skills (M=3.89), Systems Skills (M=3.65), Resource Management Skills (M=3.64), and Technical Skills (3.17). When subjected to an F-Test, Overall, $F(2,56)=11.38$, Social, $F(2,56)=3.26$, Content, $F(2,56)=6.98$, Process, $F(2,56)=13.35$, Complex Problem-Solving, $F(2,56)=11.47$, $F(2,56)$=Systems,

$F(2,56)=8.33$, and Resource Management skills, $F(2,56)=7.77$ were significantly related to progress toward degree. As doctoral students progressed toward a degree, their Overall, Social, Content, Process, Complex Problem-Solving, Systems, and Resource Management skills increased. Technical Skills, however, was not significantly related to progress towards degree, $F(2,56)=3.01$.

Table 2
Doctoral Student Perceived Level of Skill by Progress Toward Degree

Progress Toward Degree	Alpha Coefficient[a]	*N*	*M*[b]	*SD*	*F*
Overall Skill	**.95**	**58**	**3.71**	**0.48**	
Beginning		17	3.37	0.39	11.38*
Middle		24	3.71	0.30	
End		17	4.04	0.54	
Social Skills	**.75**	**58**	**4.00**	**0.49**	
Beginning		17	3.81	0.44	3.26*
Middle		24	3.98	0.41	
End		17	4.23	0.57	
Content Skills	**.73**	**58**	**3.93**	**0.56**	
Beginning		17	3.58	0.48	6.98*
Middle		24	3.97	0.47	
End		17	4.22	0.57	
Process Skills	**.81**	**58**	**3.91**	**0.62**	
Beginning		17	3.40	0.44	13.35*
Middle		24	4.00	0.52	
End		17	4.30	0.58	
Complex Problem-Solving Skills	**.90**	**58**	**3.89**	**0.60**	
Beginning		17	3.43	0.48	11.47*
Middle		24	3.95	0.52	
End		17	4.27	0.56	
Systems Skills	**.84**	**58**	**3.65**	**0.57**	
Beginning		17	3.33	0.48	8.33*
Middle		24	3.60	0.43	
End		17	4.04	0.63	
Resource Management Skills	**.56**	**58**	**3.64**	**0.55**	
Beginning		17	3.29	0.45	7.77*
Middle		24	3.67	0.43	
End		17	3.96	0.59	
Technical Skills	**.92**	**58**	**3.17**	**0.77**	
Beginning		17	2.92	0.83	3.01
Middle		24	3.10	0.51	
End		17	3.52	0.92	

Note. [a]Overall and subscale reliability was estimated by calculating a Cronbach's alpha coefficient. [b]1=very low, 2=low, 3=average, 4=high, 5=very high. *$p<.05$.

Objective 3

The third objective of this study was to describe doctoral students by their perceived ability competencies and to examine the relationship between ability and progress towards degree. Participants were asked what level of ability they possessed on 23 items. Ability items were classified into seven subcategories. Mean scores for sub categories were computed. Verbal Abilities, such as oral comprehension and written expression, are needed to communicate effectively. Idea Generation and Reasoning Abilities, such as inductive and deductive reasoning, are needed to formulate logical conclusions. Spatial Abilities, such as visualization, are needed to understand components of a system. Auditory and Speech Abilities, such as speech clarity and auditory attention, are needed to focus attention and deliver information. Attentiveness Abilities, such as time-sharing, are needed to handle multiple tasks or concentrate on single tasks. Quantitative Abilities, such as number facility and arithmetic reasoning, are needed to use mathematical methods to solve problems. Perception Abilities, such as speed and flexibility of closure, are needed to identify and make sense of complexly related material.

Table 3 shows participants' levels of Overall Ability (M=3.77), Verbal Abilities (M=4.13), Idea Generation and Reasoning Abilities (M=3.87), Spatial Abilities (M=3.79), Auditory and Speech Abilities (M=3.77), Attentiveness Abilities (M=3.70), Quantitative Abilities (M=3.48), and Perception Abilities (M=3.40). When subjected to an F-Test, Overall, $F(2,56)=10.53$), Verbal, $F(2,56)=9.25$, Idea Generation and Reasoning, $F(2,56)=13.14$, Auditory and Speech, $F(2,56)=13.03$, Attentiveness, $F(2,56)=3.39$, and Perception abilities were significantly related to progress toward degree. As doctoral students progressed toward a degree, their Overall, Verbal, Idea Generation and Reasoning, Auditory and Speech, Attentiveness, and Perception abilities increased. Spatial Abilities, $F(2,56)=2.59$, and Quantitative Abilities $F(256)=.44$, were not significantly related to progress toward degree.

Table 3
Doctoral Student Perceived Level of Ability by Progress Toward Degree

Progress Toward Degree	Alpha Coefficient[a]	*N*	*M*[b]	*SD*	*F*
Overall Ability	**.92**	**58**	**3.77**	**0.52**	
Beginning		17	3.45	0.35	10.53*
Middle		24	3.73	0.51	
End		17	4.15	0.45	
Verbal Abilities	**.83**	**58**	**4.13**	**0.71**	
Beginning		17	3.65	0.72	9.25*
Middle		24	4.17	0.64	
End		17	4.57	0.48	
Idea Generation and Reasoning Abilities	**.83**	**58**	**3.87**	**0.55**	
Beginning		17	3.50	0.38	13.14*
Middle		24	3.83	0.51	
End		17	4.31	0.47	
Spatial Abilities	**.62**	**58**	**3.79**	**0.73**	
Beginning		17	3.62	0.67	2.59
Middle		24	3.69	0.66	
End		17	4.12	0.80	
Auditory and Speech Abilities	**.54**	**58**	**3.77**	**0.62**	
Beginning		17	3.39	0.54	13.03*
Middle		24	3.68	0.52	
End		17	4.27	0.47	
Attentiveness Abilities	**.40**	**58**	**3.70**	**0.58**	3.39*
Beginning		17	3.49	0.39	
Middle		24	3.65	0.66	
End		17	3.98	0.56	
Quantitative Abilities	**.84**	**58**	**3.48**	**0.97**	
Beginning		17	3.29	0.87	0.44
Middle		24	3.56	0.85	
End		17	3.56	1.24	
Perception Abilities	**.84**	**58**	**3.40**	**0.78**	
Beginning		17	3.10	0.59	4.41*
Middle		24	3.32	0.90	
End		17	3.82	0.59	

Note. [a]Overall and subscale reliability was estimated by calculating a Cronbach's alpha coefficient. [b]1=very low, 2=low, 3=average, 4=high, 5=very high. *$p<.05$.

Conclusions and Implications

Based on the study objectives, the following conclusions were drawn and implications made.

The results presented here address the need, as described by Garton, et al. (1999) and Newcomb (1974), for information about what competencies are related to student success. As doctoral students progressed toward a degree, they acquired and strengthened unique bundles of competencies. Doctoral students perceived growth in Overall Knowledge in general and

Foundations Knowledge, Applications Knowledge, and International Knowledge in particular. Participants perceived the most growth in International Knowledge, a category in which students had the overall lowest levels of competence.

Of the four knowledge categories used in this study, doctoral students had highest levels of perceived competency in Teaching Strategies. Students, however, did not show growth in the acquisition and development in theories, techniques, and processes that enhance the teacher-learner process for adults and youth as they progressed toward a degree.

These findings, unlike those of Goecker (1992), showed that these particular doctoral students entered a degree program with well-developed teaching and learning competencies. Findlay's (1992) findings would suggest that such competencies should have been acquired through previous degree programs, experiences, and self-directed study.

More research, however, is needed to explore the relationship between graduate student knowledge and success and whether perceived levels of knowledge meet minimally acceptable standards for doctoral students. For example, doctoral students must ultimately become experts in theory and design of research (Foundations Knowledge). Lower levels of knowledge related to the theory of research may result in frustration, demotivation, impeded learning, and ultimately failure for students. Faculty may similarly become frustrated in the development and delivery of course material if they are challenged by students who do not possess the requisite knowledge to master course material; or faculty may be able to use this information to improve curricula, teaching materials, and instructional delivery methods.

Because students perceived that they had the lowest level of competence in International Knowledge, even though this was the area in which they showed the greatest growth, an implication exists that low levels of knowledge related to theory of agricultural development in cross-national settings may cause negative consequences for students engaged in international agricultural development.

Doctoral students perceived growth in Overall Skill in general and in Social Skills, Content Skills, Process Skills, Complex Problem-Solving Skills, Systems Skills, and Resource Management Skills. Participants perceived the most growth in Process Skills and Complex Problem-Solving Skills. Of the seven skill categories used in this study, doctoral students had lowest levels of competency in Technical Skills. Further, students did not perceive growth in the acquisition and development in technology design and operations analysis needed to use information technologies effectively as they progressed toward a degree. As departments of agricultural education strive to meet the growing demand for distance education, an implication may exist that doctoral graduates will need high levels of Technical Skills with respect to technology design and operations analysis.

For those doctoral students entering Extension as a profession, the results presented here suggest that doctoral students acquire the necessary resource management skills to be effective employees (Place, & Jacob, 2001). The results presented here, like those of Dyer and Osborne (1996), suggest that students perceived they could acquire and develop problem-solving skills.

Minimally acceptable skill standards for success in a doctoral program are not known and the problems and opportunities discussed previously also apply here. For example, will international students, who have been shown to have lower levels of social skills than domestic students (Timko, et al. (1991), be disadvantaged in completing a doctoral program? Or, will international students rely on different competencies to perform an observable behavior in order to be successful? If higher levels of social skills are necessary to complete a doctoral program, then international students are at a distinct disadvantage for completion. More research is needed to explore the relationship between graduate student success and skill.

Doctoral students showed perceived growth in Overall Abilities in general and in Verbal Abilities, Idea Generation and Reasoning Abilities, Auditory and Speech Abilities, Attentiveness Abilities, and Perception Abilities. Participants perceived

the most growth in oral comprehension and written expression needed to communicate effectively. Doctoral students did not perceive growth in the acquisition and development of visualization needed to understand components of a system (Spatial Abilities) and number facility and arithmetic reasoning needed to use mathematical methods to solve problems (Quantitative Abilities) as they progressed toward a degree. Again, the problems and opportunities discussed in the first two conclusions apply here and little is known about acceptable ability standards for success in a doctoral program.

For example, students need well-developed abilities, such as perceptual abilities, to think critically at higher levels of cognition (McCormick, & Whittington, 2000). Participants in this study perceived growth in perceptual abilities as they progressed toward a degree. Perceptual Abilities, however, was the lowest rated ability category. Whether students with higher Perceptual Abilities are more likely to be successful in a doctoral program is not known. More research is needed to explore the relationship between ability and success.

As noted earlier, a limitation of self-administered rating scales, such as the one used for this study, is that they measure perceptions of the person making the judgment. Additional research is needed to verify the validity of such judgments. Further, replication of this study with other student populations is needed to evaluate the extent to which the results presented here would be similar and recommendations applicable. One procedure for gathering these data would be to conduct authentic assessments of student competencies through testing, faculty assessment, peer assessment, or other forms of external assessment.

Longitudinal research is needed to verify these results as new students join the program, and as beginning and middle of program students achieve or fail to achieve success. Doctoral students can use the results presented in this study to help identify and understand their unique bundle of knowledge, skill, and abilities that will help them achieve success, and can use these results to develop opportunities for competency acquisition and growth (Drawbaugh, 1972). Faculty members can use the results presented in this study now in limited and expanded capacities to take advantage of a student's unique bundle of knowledge, skill, and abilities. Faculty can create individual learning plans for students by authenticating these results. For example, a student with low writing skills may need more writing assignments to improve his or her written skills. We have used this approach to help students use strengths on certain competencies to overcome weaknesses in others.

The findings of this study may contribute to the body of literature related to the compilation of knowledge, skills, and abilities that influence student success. Research findings, like those presented here, should be scrutinized against strategic objectives to insure that departments of agricultural education are fulfilling their missions. For example, "Teaching is the *raison d'être*" of the Department of Agricultural Education at Texas A&M University (Shinn, 2001, p. 4). Doctoral students' competency level of theories, techniques, and processes that enhance the teacher-learner process for adults and youth should be compared against a department's strategic objectives with respect to Teaching Strategies Knowledge to insure that desired levels are acquired. Findings show doctoral students have higher perceived levels of Teaching Strategies Knowledge than any other knowledge category. Competencies that do not show growth, such as Technical Skills, should be evaluated against a department's strategic objective to insure that desired student growth is occurring. This study provides a model for benchmarking competencies and provides baseline data understanding graduate student competence. The methods and procedures used in this study provide a taxonomy from which to consider student competency assessment in agricultural education.

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