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BARRIERS PERCEIVED BY ADMINISTRATORS AND FACULTY REGARDING THE USE OF DISTANCE EDUCATION TECHNOLOGIES IN PRESERVICE PROGRAMS FOR SECONDARY AGRICULTURAL EDUCATION TEACHERS

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Abstract

A principal components analysis was used to develop an instrument that identified barrier factors toward distance education. The barrier factors of agricultural educators were compared between educators in the decision stage and educators in the implementation stage of distance education technology adoption. Respondents were grouped into decision stage or implementation stage of distance education technology adoption according to Rogers' (1995) innovation-decision process. Statistically significant differences existed for various technology types between groups' barrier factor scores. The following conclusions were formulated from this study: (a) respondents in the decision stage showed significantly more agreement toward inhibiting barriers than those in the implementation stage for all barrier factors, except expense; (b) significant differences in barrier factors were found between the participants in the decision stage and those in the implementation stage for all of the distance education technology types, except digital conferencing; (c) faculty time, faculty rewards, faculty workload, administrative support, cost barriers, course quality, student contact, and equipment concerns were considered barriers for a majority of the respondents, and (d) nine barrier factors were extracted and all were considered reliable, except the expense factor.

Introduction

There has been a rapid expansion of distance education (DE) at community colleges, universities and in the mainstream public (Berge, 1998; Gellman-Danley & Fetzner, 1998; Sherry, 1996). The Campus Computing Project (2002) reported that over half of the United States' public and private universities offered courses and degree programs via distance education in 2001. Moore (2003) claimed that, "Now, the first years of the new century, have seen a new, unparalleled willingness to consider the benefits of teaching outside of the classroom and beyond the campus" (preface).

As distance education continues to grow, it is important to look at how many faculty are embracing this educational phenomenon and actually teaching distance courses and using DE technologies. For the fall of 1998, the National Center for Education Statistics (2002) reported that no more than 9% of the instructional faculty and staff surveyed had taught a distance education class. Sax (as cited in Spodark, 2003) stated that 36% of the nationally sampled faculty placed or collected course assignments on the Internet and 22% used computers in undergraduate course instruction. The National Education Association's (NEA) survey (2000) estimated that only one in 10 NEA members had taught a distance learning course in the last five years. More universities offered distance education courses and programs, but there is no evidence in the literature that a majority of teaching faculty was teaching via distance education.

Various barriers to distance education have been studied to help determine why agricultural educators have not fully integrated distance education. Murphy and Terry (1998b) enlisted agricultural educators in a Delphi panel and found that the use of electronic communication, information, and

imaging technologies would improve teaching, but the lack of training time, commitment, support, and funding were all obstacles for the adoption of the technologies. Murphy and Terry (1998a) also surveyed all teaching faculty in the College of Agriculture at a land grant university and noted that substantial support would be needed in order for faculty to adopt electronic technologies for teaching purposes. The faculty members in their study did not feel that the time and effort needed to develop distance education courses was valued. Miller and Pilcher (2000) determined that students felt off-campus courses required more effort than did faculty; both students and faculty felt that interaction is very limited with off-campus courses, and off-campus students contribute less to class discussion than their on-campus counterparts. Murphy and Terry (1998a) recommended further clarification of obstacles was needed for faculty to adopt distance education technologies. Dooley and Murphy (2001) surveyed all teaching faculty in the college of agriculture at a land grant university and recommended that, "additional research be conducted to identify the barriers to adoption as perceived by both adopters and non-adopters" (p. 9) and that faculty member's attitudes and barriers need to be addressed in order to more fully integrate distance technologies into current learning and teaching processes.

While studies have summarized variables inhibiting faculty adoption of distance education (Berge 1998; Betts 1998; Gellman-Danley & Fetzner, 1998; Muilenburg & Berge, 2001; Olcott, 1996; Schifter, 2002), there are gaps in the literature that identified perceived barrier factors or tested for significant differences between those who use distance education technologies and those who have not used DE technologies. Additionally, no research was found that indicated which barriers inhibit teaching faculties' and administrators' involvement with distance education based on their relative stage of distance education technology adoption.

Theoretical Framework

Many studies have been conducted that utilize Rogers' (1995) theory of diffusion of innovations (Anderson & Harris, 1997; Dooley & Murphy, 2000; Jacobsen, 1998; Knutel, 1998; and Ndahi, 1998) as the framework to study the adoption of distance education technologies. Rogers' model of the innovation-decision process was used as the theoretical framework for this study to search for differences between faculty in the different stages of the innovation-decision process. Rogers defines an innovation as, "… an idea, practice, or object perceived as new by an individual" (p. 11). He continued by adding,

> "It matters little, as far as human behavior is concerned, whether or not an idea, object, or practice is 'objectively' new in the sense of the time lapse since its first use or discovery. It is the perceived newness of the idea for the individual that determines his reaction to it. If the idea seems new to the individual, it is an innovation." (p. 11)

As fewer than 10% of faculty were teaching distance education courses (The National Center for Education Statistics, 2002; National Education Association, 2000) and the definition of distance education incorporates technology for delivery, (The American Association of University Professors, 2002) the use of distance education technologies to teach distance education courses can be viewed as an innovation.

For the purposes of this study, the innovation is the use of distance education technology to teach distance education courses and the diffusion is the extent that faculty and administrators of agricultural education teacher preparation programs have adopted this technology. The stages of Rogers' model that were examined in this study were the decision and implementation stages. Participants were grouped into either

the decision stage or implementation stage based on their current state of planning for or using DE technologies.

Purpose/ Objectives

Distance education is evolving and growing across the United States. Why does it appear that faculty are not adopting this form of education and its related technologies? Miller and Clouse (1994) stated the infrastructure must change to support faculty. Hanna (2003) confirmed and added, "The move toward distance education is inextricably linked with changing organization processes and procedures as well as developing new organizational models" (p. 67). Olcott (1996) posits that adoption of distance education by postsecondary institutions may be aided through utilization of a framework that combines attributes of organizational culture and innovation diffusion theories. He continued by identifying three inherent assumptions: (a) faculty are central to the adoption of distance education; (b) the institution and its subunits must accept distance education, or distance education programs must adopt the institution's principles and practices, or both must change to accept the practices of the other; and (c) faculty must see distance education's positive innovation attribute characteristics.

The purposes of this study were to determine if 35 barrier variables could be statistically reduced to reliable barrier factors and determine if a difference existed between deciders and implementers of technology adoption on those barrier factors. To achieve these purposes, this study had two major objectives:

1. To determine what faculty and program leaders of agricultural education teacher preparation programs perceived as the major barriers inhibiting the start and/or expansion of DE.
2. To determine if differences existed in how participants responded to barrier factors, as identified through factor analysis, for distance education when grouped by stage of adoption.

H_o: There was no significant difference (.05 alpha) between groups (defined by stage of distance education technology adoption) based on perceived barrier factor scores for distance education.

Methodology and Procedures

A survey instrument, developed specifically for this study, was used to identify and assess the perceived barriers and demographic information from both teaching faculty and program administrators in agricultural education teacher preparation programs.

Because of the complexity of this research, two different research methods were used. Descriptive research was used for gathering demographic information, assessing levels of technology adoption, and identifying perceived barriers. Comparisons of the two groups, as defined by level of distance education technology adoption, determined if significant differences existed. Since the independent variable, group affiliation, could not be manipulated, this type of research was a causal-comparative design (Gay, 1992), also referred to as ex post facto research because the causes have exerted their effect on the dependent variable and/or the personal characteristics were already present (Gall, Borg & Gall, 1996).

Description of the Population

The target population for this study was identified as program leaders and teaching faculty from all agricultural education teacher preparation programs across the United States during the 1999-2000 school year. Program leaders were defined as the individuals with direct leadership and responsibility for the agricultural education teacher preparation programs at each university. Teaching faculty were those individuals who taught agricultural education pedagogy courses for the agricultural education teacher preparation programs at each university. The entirety of

this population was surveyed instead of a sample, due to the relatively small population size and ease of accessibility.

Reliability and Validity of the Instrument

Internal consistency of the instrument's test scores were examined using Cronbach's alpha. The alpha coefficient for the pilot test data was $\alpha = .80$, indicating sufficient instrument reliability (Gall, Borg & Gall, 1996).

Construct validity verified that the instrument's scores actually reflected the conceptual domain that the scores claimed to measure. Evidence of construct validity was gathered by soliciting comments and suggestions from a panel of experts and from members of a pilot test group. The two groups provided input regarding the content and direction of the instrument, which added to the clarity and appropriate wording of questions.

Data Analysis

Data related to demographic questions and the level of technology adoption were analyzed using descriptive statistics. Principal component analysis with varimax rotation was used to group 35 variables into nine factors. The regression factor scores were calculated and saved as new variables to compare means between the two groups. Independent samples *t*- tests were run on the factor scores, comparing factor scores for participants in the decision group (those who indicated they planned to use distance education technologies and those who did not plan to use distance education technologies) to factor scores for participants in the implementation group (participants who indicated they used distance education technologies and would continue and those who had used and would discontinue using distance education technologies). The alpha level of .05 was set a priori as the level of significance.

Results/ Findings

The target population for the study consisted of program leaders and faculty teaching pedagogy courses in agricultural education teacher preparation programs, *N*=193 (79 program leaders and 114 faculty). Returned questionnaires yielded a total response rate of 78%, with a useable response rate of 76.68%. The first step for controlling nonresponse error was attempting to get back as many responses as possible (Dillman, 1978; Miller & Smith, 1983). The first mailing resulted in 105 returned questionnaires. The 2-week follow up mailing to nonrespondents yielded an additional 36 completed questionnaires. The third and final reminder added 10 more useable questionnaires. To provide further evidence that results from this study can be applied to the 1999-2000 population of teaching faculty and program leaders in agricultural education teacher preparation programs, the early respondents were compared to the late respondents (Miller & Smith). Early and late respondents were compared using the regression factor scores for barriers. The independent sample *t* test indicated no significant differences between early and late responders at the .05 alpha level on a 2-tailed *t* test.

Program leaders and teaching faculty in agricultural education teacher preparation programs that responded to the questionnaire were predominately male (88.5%), an average of 48 years old, had an average of five years in administration, taught 16 years in higher education, and taught 5.5 years in secondary education. Forty-four percent of the respondents held the rank of professor and 68.9% indicated that they were tenured.

The average agricultural education preparation program had three faculty members, 16 student teachers, did not have a DE specialist in their department, and had taught an average of 2.4 courses via distance education technologies. Only two programs indicated their students were able to earn an agricultural education teaching certificate entirely at a distance.

The percentages for how respondents used and planned to use each distance education technology type are outlined in Table 1. Responses in the Use and Continue and Use and Discontinue columns were place in the implementation stage and responses in the Plan to Use and No Plan to Use were grouped as the deciders.

Table 1
Percentage of Agricultural Education Teacher Education Educators' Use or Planned Use of DE Technologies (N = 148)

Distance Education Technology	Use And Continue %	Use And Discontinue %	Total Implementation Stage %	Plan To Use %	No Plan To Use %	Total Decision Stage %
Audio Conferencing	33.1	6.8	39.9	12.8	46.6	59.4
Digital Conferencing	21.6	2.7	24.3	46.6	29.1	75.7
Internet	33.1	0.7	33.8	47.3	18.9	66.2
Telecourses	33.8	9.5	43.3	32.4	24.3	56.7
Video-conferencing	40.5	3.4	43.9	33.1	23.0	56.1

The barriers that the largest percentage of respondents indicated were either a moderate or major factor preventing their department from starting or expanding distance education offerings included the following: lack of adequate compensation for faculty's time, efforts, etc. (75.7%), lack of faculty rewards or incentives (70.3%), program development costs (68.3%), lack of ability to teach skills requiring "hands on" instruction (66.2%), concerns about faculty workload (64.9%), lack of administratively provided time/support to develop course and materials (64.2%), lack of personal contact (one on one) between instructor and student (59.4%), lack of face-to-face contact (58.1%), and concerns about course quality (58.1%).

Table 2 summarizes the frequency and percentage of the barriers that a majority of respondents indicated were either a moderate or major inhibitor toward using DE technologies. Two variables were not barriers that prohibited starting or expanding distance education offerings as indicated by over 60% of respondents. These included lack of fit with the institution's mission (69.6%) and concern for faculty leaving due to increased use of technology (61.5%).

Table 2
Barriers Preventing Departments from Starting or Expanding DE Offerings in Agricultural Education Teacher Preparation Programs (N = 148)

	Major Effect		Moderate Effect		Minor Effect		Not At All	
Barrier	*f*	%	*f*	%	*f*	%	*f*	%
Lack of adequate compensation for faculty's time, efforts, etc.	58	39.2	54	36.5	24	16.2	12	08.1
Lack of faculty rewards or incentives.	54	36.5	50	33.8	30	20.3	14	09.5
Program development costs.	50	33.8	51	34.5	37	25.0	10	06.8
Lack of ability to teach skills requiring "hands on" instruction.	42	28.4	56	37.8	37	25.0	13	08.8
Concerns about faculty workload.	47	31.8	49	33.1	35	23.6	15	10.1
Lack of administratively provided time/ support to develop course and materials.	46	31.1	49	33.1	39	26.4	14	09.5
Lack of administratively provided time/ support to learn technologies.	39	26.4	52	35.1	36	24.3	21	14.2
Lack of personal contact (one on one) between instructor and student.	40	27.0	48	32.4	43	29.1	15	10.1
Lack of face-to-face contact.	40	27.0	46	31.1	49	33.1	12	08.1
Concerns about course quality.	27	18.2	59	39.9	52	35.1	10	06.8
Equipment failures/costs of maintaining equipment.	34	23.0	46	31.1	45	30.4	22	14.9
Lack of faculty commitment to spend the time to master the use of technologies.	28	18.9	53	35.8	45	30.4	2	14.9
Lack of nonverbal communication between instructor and student.	31	20.9	47	31.8	54	36.5	15	10.1

Principal components analysis was used as the extraction method and data were rotated using varimax rotation with Kaiser Normalization for the 35 barrier variables. Tabachnick and Fidell (2001) stated that, "[Principal component analysis] PCA is the solution of choice for the researcher who is primarily interested in reducing a large number of variables down to a smaller number of components" (p. 612). All variables loaded on one of nine factors.

Stevens (1996) stated that rules indicating the appropriate sample size for component reliability vary from two subjects per variable to 20 subjects per variable. Tabachnick and Fidell (2001) indicated that four to five observations were needed for every variable. Hair, Anderson, Tatham and Black (1998) indicated a preference for a sample size of 100 or larger. The sample size of the study was 148 with the 35 barrier variables, yielding an

observation to variable ratio of 4.2:1. The value of the Kaiser-Meyer-Olkin Measure of Sampling Adequacy (KMO) was .812. Tabachnick and Fidell (2001) claim that KMO values of .6 and above are required for good factor analysis.

The four methods used to determine the number of factors retained from the 35 barrier variables included: (a) eigen values equal to or greater than one (Tabachnick & Fidell, 2001), (b) a scree plot of eigen values plotted against factors to visualize changes in the slope (Tabachnick & Fidell), (c) the combination of factors that accounted for at least 70% of the variance (Stevens, 1996), and (d) factor loadings greater than ± .3 (Hair, Anderson, Tatham & Black 1998). The eigen values and percentage of explained variances are summarized in Table 3.

The nine factors extracted and named in this study follow: (1) Faculty Attitudes and Resistance to Distance Education, (2) Lack of Personal Contact, (3) Lack of Faculty Time/Support, (4) Technology Issues, (5) Lack of Student Services, (6) Institutional Culture, (7) Legal Concerns, (8) Regulatory Restrictions, and (9) Expense.

Table 3
Statistics for Nine Extracted Barrier Factors

Factors		Eigen values	% of Variance	Cumulative %
Factor 1	Faculty Attitudes and Resistance to DE	9.07	25.92	25.92
Factor 2	Lack of Personal Contact	3.11	8.89	34.81
Factor 3	Lack of Faculty Time/Support	2.91	8.31	43.12
Factor 4	Technology Issues	2.37	6.76	49.88
Factor 5	Lack of Student Services	2.06	5.90	55.78
Factor 6	Institutional Culture	1.75	4.98	60.76
Factor 7	Legal Concerns	1.31	3.75	64.51
Factor 8	Regulatory Restrictions	1.14	3.25	67.76
Factor 9	Expense	1.04	2.96	70.72

The purpose of the second research question was to determine if significant differences at the .05 alpha level existed between respondents' scores on each of the nine barrier factors when grouped by level of adoption from Rogers' (1995) innovation-decision process.

Independent *t* tests were used to determine if significant differences existed between respondents' barrier factor scores when grouped by decision group and implementation group for each distance technology listed in Table 1. Regression factor scores were compared between the decision and implementation groups for each technology type. Equal variance was assumed and associated scores were reported unless indicated by "a" (equal variances not assumed as determined by Levene's test for equality of variances).

Results from significance tests at the alpha level .05 are reported in Table 4 for the group's *t* tests. Significant differences were found between both groups for at least one barrier factor on all but one technology type, digital conferencing.

Table 4
Significant Results for Independent T-Test on Barrier Factors Between Decision Group and Implementation Group

Technology Type	Factor Name	Group	*N*	*t*	*df*	Sig. (2-tailed)
Audio conferencing	Expense	Decision	88	-2.721	145	.007
		Implementation	59			
Audio conferencing	Technology issues	Decision	88	2.130	145	.034
		Implementation	59			
Internet or on-line course	Institutional culture	Decision	98	2.184[a]	136[a]	.031[a]
		Implementation	50			
Telecourses	Lack of personal contact	Decision	84	1.989	146	.049
		Implementation	64			
Video-conferencing	Faculty attitudes and resistance to distance education	Decision	83	2.575	146	.011
		Implementation	65			
Video-conferencing	Technology issues	Decision	83	2.122	146	.036
		Implementation	65			

[a] Equal variances not assumed

Conclusions

Based on the findings of this study, the following conclusions were formulated:

1. A majority of participants indicated that the barriers listed in Table 2 were either a moderate or major inhibitor to starting or expanding distance education offerings. This finding was similar to the conclusions from Miller and Pilcher, 2000; Born and Miller, 1999; and Murphy and Terry, 1998b. All of these barrier variables, except for three, loaded onto two barrier factors, Lack of Personal Contact and Lack of Faculty Time/Support.
2. Significant differences in barrier factors were found between the participants in the decision stage and those in the implementation stage for all of the distance education technology types, except one. The two groups related to digital conferencing did not show a significant difference on any of the barrier factors.
3. Respondents in the decision stage showed significantly more agreement to barrier factors as inhibitive than those in the implementation stage in all significant results except one. The Expense barrier factor was seen as more of a barrier by the implementation group than the decision group for those using audio conferencing.
4. Barrier Factors 1 through Factor 6, (Faculty Attitudes and Resistance to Distance Education, Lack of Personal Contact, Lack of Faculty Time/Support, Technology Issues, Lack of Student Services, and Institutional Culture) were reliable

factors, as they had an adequate number of variables load with high loading scores, ≥ .40 (Tabachnick & Fidell, 2001). Factors 7 and 8 had only two barrier variables load, but they loaded with high loading scores (≥ .73) and were considered reliable factors. However, caution is advised for interpreting Factor 9 (Expense) as reliable; this factor had only one variable load, but was left as a factor as it had a unique interpretation (Tabachnick & Fidell, 2001). Practical reliability for the barrier factors can be demonstrated by comparing these barrier factors to similar factors found by Muilenburg and Berge (2001).

Recommendations for Practice

As Olcott (1996) indicated, faculty are central to the adoption of distance education, there must be mutual acceptance of DE between university structures and DE programs, and faculty must see distance education's positive innovation attributes. In order to advance the rate of DE adoption through movement of faculty from the decision group to the implementation group, proponents of DE programming for agricultural education teacher preparation programs should focus efforts on the following differences in barrier factors: (Although each specific barrier is only mentioned once within a particular technology type, the concepts and ideas for change are presented with the intention that faculty will adapt and refine to accommodate their specific distance education technology.)

For faculty involved in audio conferencing, interested stakeholders should concentrate on removing barriers related to Technology Issues. To remove technology barriers, program leaders should develop a technology plan to keep the technology current and functioning properly for both instructors and students. Resources should be dedicated to the plan at both the program and university levels. The technology plan should indicate the responsible parties for keeping technology updated, troubleshooting and correcting problems, and providing accessible assistance and feedback for both instructors and students.

Leaders should concentrate on removing the barriers involved in lack of Personal Contact for faculty involved in telecourses. Adding personal contact to telecourses could be accomplished by integrating opportunities for students to correspond with instructors and peers by using the Internet (through e-mail, discussion boards, and/or on-line chat sessions), phone, or fax. Instructors need to provide motivators for students to connect with each other and the instructor throughout their lessons and provide opportunities for communication through different media. The perceived lack of personal contact between students and instructor is also often associated with lower course quality. Increasing and maintaining high course quality, increasing and maintaining instructor responsiveness, and increasing opportunities for students to interact among themselves, with the instructor and with outside expertise are objectives that would begin removing the personal contact barriers.

For faculty involved with video conferencing, change agents should attempt to remove the barriers involved with Faculty Attitudes and Resistance to Distance Education and Technology Issues. Removing barriers associated with faculty resistance would include getting faculty more comfortable using video conferencing technology, developing structures to allow efficient use of faculty time, providing training and follow-up support, and exhibiting the advantages of video conferencing to increase awareness and interest.

Leaders should attempt to remove the barriers of Institutional Culture for faculty involved with on-line courses. Removing the barriers of Institutional Culture will require incorporating the need and purpose for distance education into the institution's mission and identifying student populations that distance education would best serve. The variables that loaded on the Institutional Culture factor were: lack of fit with institution's mission, lack of perceived need (e.g., limited student market), and lack of support from institution administrators. Educational opportunities should be created

for both faculty and administrators in the decision group that focus on how distance education can align with institutional missions, identify possible student markets and define the characteristics of students who tend to take courses via distance education. The question that many deciders need answered is, "How does distance education align with the institutional mission and how do distance students fit into the institutional culture?" The answer may have unique features for different universities, and DE implementers need to help answer this question for their respective universities.

Agricultural education teacher preparation program leaders need to begin looking at the types of distance education technology their departments are using or planning to incorporate and develop strategies for removing barriers that were shown as significantly different between faculty in the decision group and those in the implementation group.

In addition to the recommendations for removing barriers, it is recommended to focus on removing barriers surrounding the Lack of Faculty Time/Support factor. Although that factor was not a significantly different factor between the groups, it was indicated as either a moderate or major inhibitor by a majority of participants. Removing the barriers surrounding lack of faculty time and support requires the support of the university and the program leaders. Distance education needs to be incorporated into tenure policies and practices, resources need to be reallocated to provide financial incentives and continued support, university practices may need to be altered to provide accessible student services for distance students, and faculty need to be adequately supported for their time. Faculty need to see evidence of administrators' support through changes in policies and practices that align distance education with the rewards systems, policies and practices of the institution in order to feel secure and confident experimenting with distance education technologies.

In addition to the faculty support and incentive barriers previously mentioned, cost, course quality, student contact, and equipment concerns were also considered barriers for a majority of the faculty. The profession must also address these barriers to move distance education technologies toward the mainstream of faculty teaching delivery systems.

Recommendations for Research

The following areas are recommended for future research:

1. Future research is needed to further validate the barrier factors found in this study. New studies may choose to not include barrier Factor 9 (Expense), as the reliability of the variable is questionable. It may also prove beneficial to include additional barrier variables related to expense for future factor analytic studies in an attempt to further explore the factor.
2. A combination of quantitative and qualitative research is needed at university and departmental levels. First, quantitative research is needed to identify significantly different barrier factors between the decision stage of adoption and the implementation stage of adoption for specific DE technologies in use at university, college and department levels. Second, qualitative research is needed to identify how to help members of the decision group overcome their barriers, and move them into the implementation group.
3. Additional research is needed to follow-up with department leaders and identify what barriers they have toward providing the type of faculty support that participants have indicated are barriers associated with using distance education. Specifically, future inquires need to address how departments can do the following: (a) adequately compensate faculty's time, efforts, etc., (b) provide adequate rewards/incentives, (c) alleviate or reduce faculty workload concerns, and (d) provide time/support for faculty to learn technologies and

develop courses and curriculum materials.

4. Research at the university level is needed to identify the institution's stage of innovation according to Rogers' (1995) five stage model of the innovation-decision process in an organization. Identifying significant barrier factors between groups of faculty in various stages of the innovation process in an organization could help a university implement an innovation such as distance education technologies. Future research should focus on identifying if faculty will embrace or possibly reject Rogers' notions about the five innovation attributes as they relate to distance education. Identifying any attribute that faculty do not feel is present or feel is too complex in distance education technologies, may help change agents to focus educational efforts more effectively.

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