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ABSTRACT

The usefulness of the Cognitive Engagement in Cooperative Learning (CECL) model for evaluating the learning outcomes associated with various cooperative learning activities is explored. The instructions that a set of learners is given, however broad or specific, is called a script. These scripts are associated with different learning outcomes according to the amount of engagement that learners have with the material to be learned. The CECL model allows the placement of a given script along a continuum for the purpose of predicting how well students will learn the new material. This investigation was a pilot attempt to use meta-analysis to validate the model. Thirteen studies from the last 15 years were chosen. The investigation shows that meta-analysis justifies the use of the model fairly well, but is very much affected by choice and interpretation of studies included in the analysis. (Contains 1 figure and 42 references.) (SLD)

A Meta-Analysis of Scripted Cooperative Learning

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Abstract

This paper investigates the utility of the Cognitive Engagement in Cooperative Learning (CECL) model for evaluating the learning outcomes associated with various cooperative learning activities. The instructions that a set of learners is given, however broad or specific, is called a *script.* These scripts are associated with different learning outcomes according to the amount of engagement that learners have with the material to be learned. This model allows the placement of a given script along a continuum, for the purpose of predicting how well students will learn the new material. This investigation was a pilot attempt to use meta-analytic techniques to validate the model. Broadly stated, this investigation showed that meta-analysis justifies the use of the model fairly well, but is very much affected by choice and interpretation of studies included in the analysis.

Background

Cooperative Learning in Contemporary Perspective

David Johnson, in an address to members of the International Society for Exploring Teaching Alternatives, asserted that education is in the midst of a paradigm shift (Rhern, 1992). The previous paradigm, Johnson believes, views the educational process as one of transferring knowledge from the teacher to the student, and since the student is merely a passive recipient, anyone with expertise can therefore teach. The new constructivist paradigm, Johnson believes, instead views the educational process as jointly constructed by teachers and students, in which the student is an active discoverer and transformer of knowledge and in which the teacher serves to develop students' competencies and talents. By reconceptualizing the educational process in this manner, students will be better suited for life in the twenty-first century, in which they will be expected to take more responsibility at earlier ages, to think and solve complex problems and to sort through information and produce knowledge rather than merely reproduce it. In the global society of tomorrow, the learning process will be fundamentally linked to social interaction that goes well beyond the traditional teacher-student information-transmission relationship. In such an educational environment, students and teachers will work cooperatively between and among themselves, instead of individualistically or competitively, as they would have under the previous paradigm.

Definition of Cooperative Learning

There are three ways that cooperative learning differs from traditional learning scenarios: (1) it involves two or more people learning material together; (2) participants play equal roles as peers (instructor's role is minimized); and (3) presumably, none of the learners are experts in the material to be learned (Hall, Rocklin, Dansereau, Skaggs, O'Donnell, Lambiotte & Young, 1988). Within this context fall many types of cooperative structures, such as dyads, rotated peer-teaching situations, reciprocal questioning groups, discussion groups or problem-solving groups. Those familiar with cooperative learning methods may use names for different structures such as cooperative integrated reading and comprehension (CIRC), co-op co-op, cooperative controversy, descubrimiento, jigsaw, learning together, numbered heads together, student team learning (STL), student teams-achievement divisions (STAD), teams-games-tournament (TGT), team assisted

individualization (TAI), and think-pair-share (Kagan, 1989/1990; Robinson, 1991; Slavin, 1991). Using structures such as these, cooperative groups may participate in various learning activities such as reviewing, summarizing, clarifying, explaining, questioning, debating, or reaching consensus.

The Value of Cooperative Learning

Cooperative learning has served as a valuable instructional tool for many years, and will very likely become even more foundational in light of the rising constructivist paradigm in education (Bredehoft, 1991; King, 1993; Rhern, 1992). Cooperative learning has been suggested as a valuable instructional alternative to traditional passive means of learning such as listening to and taking notes during a lecture (Bonwell & Eison, 1991; Johnson, Johnson & Smith, 1991; Whitman, 1988). In fact, Johnson points out that during the last 90 years, over 575 experimental studies (as well as hundreds of correlational studies) have compared the effectiveness of cooperative, competitive and individual approaches to learning (Johnson, Johnson & Smith, 1991; Rhern, 1992).

The evidence collected by Johnson (Johnson, Johnson & Smith, 1991; Rhern, 1992) and Slavin (Slavin, 1989-1990; 1991) shows many positive results from the use of cooperative methods in the classroom, and such methods are often to be preferred. For instance, Johnson and colleagues (1991) recommend using cooperative learning whenever the goals of learning are highly important, mastery and retention are important, the task is complex or conceptual, problem solving is desired, divergent thinking or creativity is desired, quality of performance is expected, and higher-level reasoning strategies and critical thinking are needed. In addition, there are many positive non-cognitive outcomes of cooperative learning in college students such as higher retention rates, more involvement in learning, increased self-confidence and self-esteem, higher motivation, more positive attitudes toward the subject area and faculty relationships, interpersonal cohesion, more balanced psychological adjustment and increased feelings of social support (Johnson, Johnson & Smith, 1991; Slavin, 1989-1990; 1991).

In addition to the outcomes discussed by Johnson (Johnson, Johnson & Smith, 1991; Rhern, 1992) and Slavin (Slavin, 1989-1990; 1991), others have found that particular learning outcomes can be predicted as a function of the design or structure of the learning groups (Hall et al., 1988; Kagan 1989/1990; King & Rosenshine, 1993; Lambiotte, Dansereau, O'Donnell, Young, Skaggs, Hall & Rocklin, 1987; Larson, Dansereau, O'Donnell, Hythecker, Lambiotte & Rocklin, 1985; Lew, Mesch, Johnson & Johnson, 1986; O'Donnell & Dansereau, 1992; 1993; Sharan, 1980; Smith, Johnson & Johnson, 1981). When considering the use of a cooperative learning strategy, an instructor needs to consider the structure of the learning task and the learners' activities in light of the material to be learned (Dees 1991; Kagan 1989/1990; King 1991; Lambiotte et al., 1987). For instance, King (1991) found that the use of guided questioning within cooperative learning groups of fifth graders working with computer-assisted problems significantly enhanced learning compared to the group that did not use guided questioning.

Scripting for Performance

The term script has been adopted to describe the formal directions that a cooperative learning group or dyad would use to structure their activities (Lambiotte et al., 1987). A script outlines the learners' activities in detailed description, and should be contrasted to directions that are more open in nature or do not have specified learning outcomes, such as, "Discuss the following topic...", or, "Let's go around the circle and name our favorite ice cream flavors", or, "Tell about an experience that happened to you..." A script might include directions for a group to read a passage and cover a series of related questions, or engage in a debate using a specified format and certain positions, or any of an unlimited number of activities designed to engage the learner in the learning process with the specified material. Much recent research on cooperative

learning has explicitly used the term script, and there is also a good bit of research that has implicitly used scripts to structure the learning activities.

A series of studies conducted by O' Donnell, Dansereau and colleagues (Dansereau, 1985) over the last ten to fifteen years have described many ways that scripts have been manipulated to produce various learning outcomes (Dansereau, 1983; 1985; Hall, et al., 1988; Lambiotte et al., 1987; Larson, et al., 1985; McDonald, Larson, Dansereau & Spurlin 1985; O'Donnell & Dansereau, 1992; 1993; O'Donnell, Dansereau, Hall & Rocklin 1987; O'Donnell, Dansereau, Hythecker, Hall, Skaggs, Lambiotte & Young 1988; O'Donnell, Dansereau, Rocklin, Hythecker, Lambiotte, Larson & Young 1985; Spurlin, Dansereau, Larson & Brooks, 1984). For instance, Dansereau (1983; 1985), McDonald et al. (1985), O'Donnell et al. (1987), and Spurlin et al. (1984) examined the effects of a multiple summarization and corrective feedback script for learning expository text. O'Donnell, et al.(1988), on the other hand, compared prompting, preplanning, planning, and distributed planning scripts for use with learning a medical procedure. Further examples of script usage include scripts for learning text, lectures or procedures using strategies such as review, elaboration, multiple-step study strategies or reciprocal teaching (Hall et al., 1988; Lambiotte, et al., 1987; Larson, et al., 1985; O'Donnell, et al., 1985; O'Donnell & Adenwalia, 1989; O' Donnell & Dansereau, 1993). From a researcher's standpoint, the use of scripts in recent cooperative learning research has served to create satisfactory experimental control over learning activities, so that those activities may be repeated consistently and learning outcomes may be predicted with more reliability. From a teaching perspective, however, the use of reliable, tested scripts can help with course planning such that certain cooperative learning activities can be scripted to acheive desired learning outcomes.

Both Johnson (Rhern, 1992) and Slavin (1989-1990) indicate that cooperative learning is one of the most thoroughly researched instructional methods. Research on the use of scripts in cooperative learning, on the other hand, is a fairly recent development. Even though the research demonstrates consistent effects for the use of certain scripts on particular outcomes, the breadth of research still lacks theoretical unity.

The Cognitive Engagement in Cooperative Learning Model

The model presented here was created as a means of conceptually integrating the breadth and variety of research concerning cooperative learning scripts and corresponding learning outcomes. It is assumed in the CECL model that learning in cooperative groups is facilitated by two factors. The first factor is related to the depth of cognitive processing, or the "construction" of cognitive connections. The more new material is organized and elaborated upon, the better it will be encoded in a student's memory. Organization is the process of structuring information in such a way that maximum inferences can be made from knowing a minimum of the information. Creating outlines and matrices are types of organizational processes. Elaboration is the process of associating the new information with information that is already known. The pairing of new material with personal experience, or with similar ideas would be elaboration. The second factor that facilitates learning in cooperative groups is the "reconstruction" of information. Just as information is organized and elaborated upon for it to be encoded into memory, it also can be pulled out, reorganized and reelaborated upon, especially in light of new information. The more information is recalled and re-encoded, the more it is "reconstructed." Thus, the CECL model is based upon cognitive engagement-- defined here as the degree to which constructive processes (organization and elaboration) and reconstructive processes are scripted in a given cooperative learning activity.

Along the left-to-right continuum of the model (Figure 1), scripts can be placed according to the constructive and reconstructive processes that they promote in cooperative groups. At the far left end of the continuum are those scripts which do little to actively promote organiztion,

elaboration or reconstruction. The type of script placed at this end of the model might be the type that calls for a cooperative group to summarize a lecture or a reading. In summarization, little organization is done, and elaboration may consist of nothing more than repeating what was said in the learner's own words. Other scripts, however, may call for more constructions and reconstructions of information. At the far right end of the continuum are those scripts in which learners challenge each others' reasoning processes directly. This challenge may cause learners to rethink, reassess, or restructure their thinking about a particular issue or belief. A debate would characterize the type of cooperative script that is placed at this end of the continuum.

Method

Meta-analysis is a procedure for comparing mutliple studies using the siungle dimension of effect size (ES). The exact procedures used in this investigation parallel those outlined by Wolf (1986). To begin, studies from the last 15 years were chosen for inclusion by their relevance to the methods of cooperative learning described here. The criterion for used for inclusion were:

1) The instructions given to the learners were in the form of a broad "script"; In other words, cooperative groups were told what to do with their time together in a formal manner.
2) The learning was to take place in the form of declarative, conditional or procedural knowledge that could be measured using objective measuring techniques. Recall was the most prevalent form of performance measure. Measures of transfer, or successful completion of a procedure were not used.
3) The learning that occurred in these settings may have taken place in one session, or may be the cumulative result of many sessions using the same script over time.
4) Studies that involved measures in two different subject areas, or replications, were treated as if each one was a separate study. The weighting of results, discussed later, assured that this would not be a biasing procedure.
5) For a study to be included it had to have a control group that involved individualized, or traditional learning assignments.

For each of the studies, measures of effect size (ES) were derived, using either means and standard deviations, *t* statistics or *F* statistics. Wolf (1986) equation 8 and those on p. 35 were used. Effect sizes were recorded in the matrix in Table 1, according to the type of script used in each of the groups studied. Table 1 breaks the CECL model into four divisions, for practical utility in this meta-analysis. The divisions are: Simple Engagement- non-group, Simple Engagement-group (construction-organization, low elaboration), Moderate Engagement (construction- deep elaboration), and High Engagement (construction and reconstruction). In many cases, several scripts were compared, and so each script was considered according to its degree of potential in provoking cognitive engagement. Scripts were also weighted according to equation 27 (Wolf, 1986), since in most cases, the experimental and control groups were nearly equal and were close to or greater than 10. Thus, average effect size could be generated for each of the four categories using equation 26.

Results

As it turns out, the criteria for inclusion were a lot more limiting than at first suspected. Of the many types of cooperative learning groups that have been conducted, very few use a formal script that is easily broken down into a cognitive engagement perspective. For instance, in the structure called Student Teams Achievement Division (Slavin, 1988), learners are told not only to

quiz each other about the material, but to continue quizzing and discussing until everyone in the group understands the material thoroughly. Students are then held individually accountable on a subsequent test, and teams are rewarded when group members do well. The directions for the learners are not explicit in what strategies to use to learn the material. This exemplifies a majority of the research that has been conducted on cooperative learning; most examine the reward structure (like individual accountability) and speak of the social benefits (like increased motivation). Because of the difficulty of finding studies that fit the inclusion criteria, for this pilot investigation, only 13 studies were examined.

The analyses showed that across the four categories, the average effect size increased, lending credence to the CECL model. The largest difference occurred between the first two and last two categories, almost .3 of an effect size. However encouraging these results are, unfortunately chi-square tests for the homogeneity of variance across the four categories showed that in the second and forth groups, they were not homogeneous ($p=.165$ for simple engagement and $p=.16$ for deep engagement). Future analyses should therefore concentrate on including more similar studies.

Discussion

Although the evidence provides broad evidence for the utility and validity of the CECL model, this study has many limitations that should be considered. First of all, there were only 13 studies included in this investigation. As such, the effect sizes were greatly dependent on which studies were included, and how the scripts were interpreted to fit within the four categories. Of these 13 studies, each one was conducted very differently, so the amount of interpretation was high. For additional research using this method, reliability could be increased by reaching consensus among several researchers before inclusion in the meta-analysis.

In general, however, the results were encouraging, because they support the CECL model. Given more investigation and further validation, CECL model could be very useful in helping instructors consider how to use cooperative groups to the greatest learning benefit.

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Figure 1- CCCL Model and Meta Analysis Results

Study	Simple Engagement- Indiv								Simple Engagement- Group								Moderate Engagement								Deep Engagement-Constr/Reconstr							
		ES	n=	cont	w	w*es	d-D	w*(d-D)		ES	n=	cont	w	w*es	d-D	w*(d-D)		ES	n=	cont	w	w*es	d-D	w*(d-D)		ES	n=	cont	w	w*es	d-D	w*(d-D)
King 92	Self Q	0.63	19	18	8.813	5.552	0.409	1.4778																								
	summ	1.33	19	18	7.575	10.07	1.109	9.3247																								
King 89	Self Q	0.7	8	8	3.769	2.638	0.479	0.8666	Review	-0.31	8	8	3.953	-1.225	-0.557	1.228									Self/Peer Q	0.91	8	8	3.625	3.299	0.341	0.422
King 93									Unguided Q	0.185	6	5	2.738	0.507	-0.062	0.011	Guided Q	0.926	6	5	2.484	2.3	0.39	0.383									
King 91									Unguided Q	0.104	8	8	3.995	0.415	-0.143	0.082	Guided Q	1.31	7	8	3.088	4.045	0.78	1.863									
Dees 91									"encouraged"																							
									algebra	0.497	37	39	18.43	9.16	0.25	1.149																
									geom	0.431	31	32	15.39	6.634	0.184	0.519																
Smith 81																										Controv						
																										coal	0.42	9	9	4.403	1.849	-0.15	0.098
																										BWCA	1.002	9	9	3.998	4.006	0.433	0.75
McDonald 65									discuss								recall/correct															
									ecol	0.409	60	60	29.39	12.02	0.162	0.788	ecol	0.74	60	60	28.08	20.78	0.21	1.2									
										0.04	27	30	14.25	0.57	-0.207	0.612		0.75	30	30	14.01	10.51	0.22	0.658									
									geol	-0.069	60	60	29.98	-2.069	-0.316	3	geol	0.597	60	60	28.72	17.15	0.06	0.117									
										-0.095	27	30	14.23	-1.352	-0.342	1.668		0.82	30	30	13.84	11.35	0.29	1.137									
O'Donnell 87									discuss	0.649	32	31	14.96	9.71	0.402	2.414	recall/correct	0.568	30	31	14.66	8.326	0.03	0.018									
*Spurlin 84	Listen	-0.117	18	18	8.985	-1.05	-0.34	1.0234	recall	0.941	18	18	8.103	7.625	0.694	3.899	recall/correct	0.576	18	18	8.642	4.978	0.04	0.016									
	Active Liste	0.087	18	18	8.991	0.782	-0.13	0.1603																								
O'Donn 93	Listen	0.103	36	19	13.73	1.414	-0.12	0.1896	Recall	0.483	36	19	13.36	6.453	0.236	0.742																
Lambiotte 87	Listen	-0.158	26	20	11.46	-1.81	-0.38	1.6424									MicroTeach	-0.36	25	20	11.07	-3.99	-0.89	8.834	Peer Teach	1.12	26	20	9.941	11.13	0.551	3.02
O'Donn 88									Prompting	0.123	18	26	10.98	1.35	-0.124	0.17	PrePlanning	0.007	27	26	13.25	0.093	-0.53	3.67	Distr Plan	0.538	27	26	12.79	6.88	-0.03	0.012
O'Donn 85																																
murder	ind	0.012	9	13	5.5	0.066	-0.21	0.2391	Sing Elab Dya	-0.303	13	14	6.673	-2.022	-0.55	2.021	Mult Elab Ind	0.127	12	8	4.99	0.634	-0.41	0.824	Mult Elab Dya	-1.01	10	10	4.435	-4.48	-1.58	11.05
elab		-0.235	9	13	5.462	-1.28	-0.46	1.1334		0	13	14	6.75	0	-0.247	0.413											0.506	13	13	6.298	3.187	-0.06	0.025
	Sum(w*ES)	16.382		df=	8				Sum(w*ES)	47.776		df=	14				Sum(w*ES)	76.171		df=	10				Sum(w*ES)	25.876		df=	6			
	Sum w	74.291		p=	0.04				Sum w	193.19		p=	0.165				Sum w	142.83		p=	0.043				Sum w	45.487		p=	0.16			
	Avg ES	0.2205		Chi Sq	16.06				Avg ES	0.2473		Chi Sq	18.7				Avg ES	0.5333		Chi Sq	18.72				Avg ES	0.5689		Chi Sq	15.38			

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