EFFECTIVENESS OF DIRECT INSTRUCTION MODEL IN ACQUISITION AND MAINTENANCE OF GEOMETRIC SHAPE CONCEPTS FOR STUDENTS WITH VISUAL IMPAIRMENT

Banu ALTUNAY ARSLANTEKİN
Ulviye ŞENER AKIN
[1] Special Education Program, Gazi University, Ankara, Türkiye
[2] Special Education Program, Gazi University (Ph.D. Cand.), Ankara, Türkiye
For correspondence: ulviye_2000@yahoo.com

ABSTRACT

The purpose of this study is to investigate the effectiveness of Direct Instruction model in acquisition and maintenance of geometric shape concepts for students with visual impairment. Three 1st grade students attending an urban primary public school for visually impaired students participated in this study. The design of the study is a multiple probe-across-patricipants design. Criterion-referenced tests were developed and conducted to assess the sphere concept in participating students. The results of the study showed that the Direct Instruction model is effective on the concept acquisition and maintenance in all the participants. Generalization data showed that the sphere concept was mastered by the participants.Social Validity data revealed that all students enjoyed the intervention. Results of the study were discussed and recommendations for further research were provided.
Keywords: Visual Impairment, Concept Acquisition, Direct Instruction Model.

Concepts play a significant role in reasoning, classifying, learning, memory, deduction, language comprehension and language production, explanation, inference, problem solving and generalization (Özmen-Güzel&Ünal, 2008; Thagard, 1992). Concepts are mental representations of objects, events, actions, qualities, or relationships and other item classifications; therefore, individuals often use concepts to communicate in their daily lives (Jonassen, 2006). Concept learning consists of generalization among different examplesnand discrimination between examples and nonexamples (Hayes &Conway, 2000; Park & Tennyson, 1986;Özmen-Güzel&Ünal, 2008).However, one of the major limitations of visual impairment is the concept range and variety (Hill &Blasch, 1980).A great number of students learn so many concepts through different activities. They observe , experience and understand the world with the help of these facilities (Markle, 1975). Concept development for an individual with visual impairment provides a good background for learning academic, social and psychomotor skills. Mobility oriented basic concepts such as body schema, body concept and body awareness including body image, body parts and figure, right-left side, directions, spatial and environmental concepts are critical for the individuals with visual impairment. Moreover, the acquisition of geometric shape concepts and measurement skills facilitates the examination of the environment. Therefore, knowledge of geometric shape concepts enables the visually impaired person to use objects as clues while moving around.

Geometry is both a learning area and a tool to comprehend and interpret the world we live in (National Council for Teachers of Maths, NCTM, 2000). Mastering in geometry assists individuals to generalize acquired concept knowledge, to think critically and to explain the information concretely (Battista, 2007; Clements, 1998). Additionally, some certain factors affect geometry learning process such as teaching method, teacher qualifications, student attitudes, student readiness, families, teachers and physical conditions (Messick& Reynolds, 1992). In this context, teaching programmes need improvement to avoid student failure (Sener&Belfiore, 2005). In the literature, there have been a number of studies related to Concept-Instruction (Gagne, 1965; Merrill and Tennyson, 1977; Bruner, 1961) and Direct Instruction model (Engelmann &Carnine, 1982). Direct Instruction model (Engelmann &Carnine, 1991) provides a presentation of concepts through concept instruction and schematic organizers. Kırcaali-İftar, Birkan and Uysal (1998) compared the structured language to the natural language presentation on colours and shapes for the mentally impaired through Gagne model. The presentation with natural language was found more effective. Furthermore, Özmen-Güzel and Ünal (2008) compared the effectiveness of Gagne model to Merrill and Tennyson model in teaching the mentally impaired the concepts of square and triangle. According to the results, two students succeeded in Gagne model and two in both of the models. The purpose of this study is to present the effectiveness of Direct Instruction Model in acquisition and maintenance of geometric shape concepts for the visually impaired students.

Direct Instruction Model was developed for the teaching of cognitive skills. The Model has been defined as a teacher-centered instruction model which focuses on curriculum design for the success of the student and which includes generalizable teaching presentations, assessments and strategies as well as written teaching processes (Engelmann and Carnine, 1991; Tuncer and Altunay, 2004). Direct Instruction Model, theoretically based on the studies of Engelmann and Carnine (1981), emphasizes the principle that the changes on students can be assessed and evaluated when a planned instruction is systematically offered to the students. In the Model, the most important feature of the instruction skills is that they do not show variations from practice to practice and

according to the personal characteristics of teachers. In Direct Instruction Model, the role of the teacher in the learning process was specified and the instruction skills were practically defined. It is suggested that every child can learn when the elements of the teaching process offered to the student are well-controlled. The importance of the elements such as supporting the curriculum in learning-teaching activities, choosing the examples to be presented for the teaching process, observing the improvement of the student, and systematically correcting the mistakes of the student have been pointed out (Tuncer&Altunay, 2004).

In Direct Instruction Model, factors influencing the learning process can be categorized as designing the teaching curricula, selecting the examples to be presented, and their sequencing, monitoring student progress and correcting student mistakes. When teachers consider the principles of Direct Instruction model, they can easily observe the changes in student behaviours (Engelmann &Carnine, 1991; Tuncer&Altunay, 2004). Three different types of Direct Instruction Model exist; non-comparative sequences, comparative single-dimension sequences and nouns. Non-comparative sequences are concepts that cannot be explained without showing the concept examples or their synonyms (Altunay, 2008; Tuncer&Altunay, 2004). In a non-comparative sequence presentation, a case has been labelled; while in comparative sequence, change from one condition to another has been labelled. Both types of arrangement of examples in teaching are similar. In the positive-first sequences, two negative examples follow the three positive examples and assessment starts with the positive example with miscellaneous questions. In the negative-first sequences, three positive examples follow the two negative examples and assessment starts with the negative examples. Teaching of such a sequence has been completed according to a "continuous cycle" where changes between examples occur quickly. In the comparative sequence, a reference example is available for students to be able to compare with the first example. Error correction processes of both sequences are similar.

The geometric shapes used for instruction in this study belong to the noun category. Nouns are multi-dimensional concepts, defined as labels for object classes such as, trucks, numbers, letters and geometric shapes. Some nouns entail sub-categories called higher-order nouns. Hierarchically, examples of the higher order nouns are furniture, vegetables and clothes.

The arrangement in teaching nouns starts with three positive examples and assessment begins with two positive examples. If the student has already labelled a geometric shape, newly learnt concept has been questioned randomly. For instance, while teaching the concept "circle" to the student who has already known the concept “square”, square and circle have been studied together. If the students are not able to label any geometric shape, the objects or pictures of the objects that have been previously labelled by them can be used. In noun presentations, negative examples cannot be labelled as "...not".

Several principles need to be considered in preparing the concept presentation. Engelmann and Carnine (1982) developed five principles for sequencing and ordering examples.(1)*The wording principle:* Presenting all the examples with the same statements. To make the sequence as clear as possible, same wording should be used on all items,(2)*The set-up principle*: Examples and non-examples selected for the initial teaching of concept should represent a great number of possible irrelevant features. It is suggested to use the same material for both material presentation and assessment. For example, while teaching the concept "on", only “order and box” can be used to focus on the changing position of the box (for relatedness).(3)*The difference principle*: In order to visualize the limits of a concept, we should demonstrate examples and non -examples that are similar to one another except in the critical feature and indicate that they are different. (4)*The sameness principle*: To show the range of variation of the concept, we should use the examples of the concept that differ from one another as much as possible. Yet, it still illustrates the concept and indicates that they are the same. (5)*The testing principle*: To test the acquisition, we had better present new, untaught examples and non- examples in a random order (Watkins & Slocum, 2004).

Concept teaching within the same concept group shows similarities (Kameenui& Simmons, 1990). For example, in the instruction of the concepts “cylinder” and "cat", since they belong to the same group, their instruction shows similarities. Presentations with a single set have the risk of generalisation. To eliminate, presentation with more sets and expanded teaching are necessary. Expanding teaching in Direct Instruction Model are divided into four: (a) manipulative tasks, (b) fooler games, (c) implied-conclusion tasks and (d) event-centered tasks.

A significant body of research demonstrated that Direct Instruction Model has been effective in teaching concepts. Granzin and Carnine (1977) investigated the effect of diversifying the examples in concept presentation on concept learning. Carnine (1980a) conducted a study with 65 children aged 4-6 to identify how negative examples in concept presentation affect concept learning. Results indicate that the group which received training with the set showing the least dissimilarity between the negative and positive examples for the negative examples, showed considerably higher numbers of accurate behaviours. Besides, Carnine (1980b) analysed the effects of varying the discrete features in concept presentation examples on the pace of concept acquisiton. Gersten, White, Falco and Carnine (1982) examined the effects of differentiation while presenting the concepts statically or dynamically to children with or without disabilities in terms of concept acquisition rate. The results confirm that presenting the concepts through a continuous cycle to children with or without disability lead to

quicker acquisition of the concepts. Literature lacks studies on teaching geometric shape concepts considering the principles of the Direct Instruction Model to the students with visual impairment. This study will serve as an important source to investigate the effectiveness of the Direct Instruction model on geometric shape concept teaching and identifying instructional design variables that are effective on the concept learning of the visually impaired students.

METHOD

Participants and Setting

Three 1st grade primary public school students with visual impairment attending an urban public school participated in this study. The participants in this study had not attended Pre-Primary education. The students were also Braille-literate.Specifically, each student referred for this study;(a)was able to label two dimensional geometric shapes and cylinder as a three dimensional shape,(b)was able to speak four-or-five-word sentences, (c)was only visually impaired, (d)was able to label thesphere concept,(e)had not been exposed to Direct Instruction prior to this study, (f) was ranging in age from 7 to 8.The chronological ages of three participants are as follows: the first participant was 7 years old; the second participant was 7 years and 6 months old and the third participant was 8 years old. The third participant was a boy and the remaining participants were girls. The study was conducted in the reading room, under the guidance of the first researcher. In order to assess inter-observer agreement and treatment integrity, a video-camera was used to record all the sessions.

Experimental design

As Kazdin (1978) have indicated, the rationale of single-subject designs is to compare the performance of the participants under different conditions. In this study, a multiple probe-across-participants design was used to demonstrate the effectiveness of Direct Instruction model in acquisition and maintenance of geometric shape concepts to students with visual impairment.In the multiple-probe design, prior to the intervention (independent variable) being introduced, probe data were collected for any case (behaviour, setting or participant). In the first case, baseline data were collected in sequential three sessions. When the baseline data show stability, the intervention (independent variable) was introduced to the first case (Tawney ve Gast, 1984). When the criteria were met or the baseline data showed stability in the first case, baseline data were collected for the second case.For other cases, probe data were also collected. This process continued until all the cases received the intervention (Güzel, 1998). Additionally, multiple- probe procedures suggest cost effective data collection time (Murphy & Bryan,1980).The dependent variable of the study was the achievement level of meeting the goals of the sphere concept. Considering the principles of the Direct Instruction model, the independent variable was the teaching of the sphere concept.For each student, experimental procedures were applied for a week. The experimental process was conducted in two sessions per day. In order to collect data, criterion-reference tests were developed. The last objective attained by the participant was recorded on a graph during baseline and after the intervention and in the maintenance. Also maintenance data were collected to determine the effectiveness of the concept acquired by the participant.

*Baseline.*In order to collect the data,sphere-criterion referenced tests were conducted individuallyand participants' performance level for the sphere concept was determined in three sequential sessions. When the data of the intervention from the first participant showed stability, baseline data of the second participant were collectedin three sequential sessions and accordingly, and probe data of the third participant were collected in a single session. When the intervention data of the second participant showed stability, baseline data of the third participant were collected in three sequential sessions.

Intervention.After collecting steady baseline data, the first participant was instructed about the sphere concept considering the principles of Direct Instruction model and the sphere concept was taught individually. Criterion-references test was applied at the end of each intervention session.

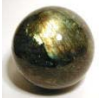
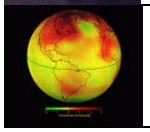
Maintenance and generalization.Maintenance data were collected at 15, 25 & 35 days post intervention. The Criterion-referenced test of the acquired concept was applied to determine the performance level of the participants. Generalization data were collected once during baseline and once after intervention. During generalization, each student was asked to apply different geometric shape concepts into various situations.

Instructional procedures

Prior to the instruction, instructional procedures of the sphere concept were designed considering the principles and sample order of Direct Instruction model. After presenting three positive nouns, assessment was given accordingly. During the presentation, the objects were shown and labelled by saying that "this is spherical". Assessment also started with two positive statements used in the presentation before. Considering the

assessment principles (the number of positive examples should outnumber that of negative, examples need to follow anunpredictable sequence). The concepts which the participants had already labelled and acquired recently were questioned randomly. The presentation and assessment lasted 5-6 minutes per student. Table 1 shows the presentation of the sphere concept including examples.

Table 1.
Table 1 Shows the Presentation of the Sphere Concept Including the Examples.

Examples	*Presentation of the Teacher*
	*(1. positive example)* Spherical
	*(2. positive example)* Spherical
	*(3. positive example)* Spherical
	***Assessment*** *(1. Assessment Question)(One of the examples used in the presentation before)* What shape is it?
	*(2. Assessment Question)(One of the examples used in the presentation before)* What shape is it?
	*(3. Assessment Question)* What shape is it?
	*(4. Assessment Question)* What shape is it?
	*(5. Assessment Question)* What shape is it?
	*(6. Assessment Question)* What shape is it?
	*(7. Assessment Question)* What shape is it?
	*(8. Assessment Question)* What shape is it?
	*(9. Assessment Question)* What shape is it?

Data collection

In order to collect research data, criterion-referenced tests were designed including ten labelling questions and generalization questions. Criterion-reference tests were applied prior to the intervention to determine baseline for each participant. Extension questions were asked to determine whether students were able to generalise acquired knowledge to different situations.A Criterion-reference test was conducted in the maintenance phase. Maintenance data were collected at 15, 25 & 35days post intervention to determine whether the participants maintained acquired knowledge. During the criterion-referenced test, the researcher gave a sphere shaped object to the participant and said, “Examine it”. Physical assistance was provided when the student had difficulty with examining process. The researcher asked to the participant “Tell me its shape”.All sessions were videotaped.

Scoring procedures and data analysis

During the assessment with the Criterion-referenced test, %100 criterion principle was taken into consideration. When the participant responded all the ten questions in the test, it was accepted that the objective of the study was fulfilled. In this study, the performance of each participant was recorded in the phases of baseline, intervention and maintenance. Data were visualized in the graph.

Inter-observer agreement and treatment integrity

Agreement was assessed through the use of a second observer independently observing 35% of the recorded sessions across baseline, intervention, and maintenance equally distributed across the three students. Percentage of agreement was calculated by dividing the number of agreements plus disagreements, then multiplyingby 100 (Barlow &Hersen, 1984). Inter observer agreement ranged from 98%–100% (X =99%), and for generalization ranged from 98%–100% (X = 99%). Procedural integrity was monitored by a second observer during 25% of the all sessions. Integrity was assessed for teacher’s oral presentation, example sequencing and assessment principles. Procedural integrity was 100% across all session components.

Social validity

Social validity is referred to ascertain practice of a socially favourable study and to detect its socially momentous effects (Foster & Mash, 1999; Wolf, 1978). An important measure of a study’s success depends on its social acceptability or validity. Wolf (1978) suggests that assessing the goal significance, appropriateness of method and significance of consequences to identify the social validity of a practice is critical. As for social validity, a Likert-type questionnaire was developed and conducted on an individual basis. Results of the social validity questionnaires showed that all the students participated (n=3) liked the intervention very much. Within education, a single-subject research was used to determine main characteristics of behavior (e.g., theory) and to report interventions (independent variables) that practically changed in socially significant results (dependent variables) (Wolf, 1978).

RESULTS

Figure 1 shows the baseline, the intervention and the maintenance data for the three participants with visual impairment. The performance levels of three participants towards the geometric shape concept are graphed on Figure 1. As it was seen in the graph the first participant was unable to perform any objective. She could not label the sphere concept for three sessions. In the intervention sessions, sphere concept instruction was presented considering the principles of Direct Instruction model. The first participant labelled sphereconcept with 100% performance level in the assessment at the end of the intervention. While the baseline data were collected for the first participant, the probe data of the second and the third participant were collected. When the intervention data of the first participant showed stability, baseline data of the second participant were collected in three sequential sessions and one more probe data of the third participant were collected. Second participant were not able to perform any objective.After the intervention, the assessment data showed that second participant labelled the sphere concept with a 100% performance level. When the intervention data of the second participant showed stability, baseline data of the third participant were collected in three sequential sessions. Third participant were not able to perform any objective. After the intervention, the assessment data showed that third participant labelled concept sphere with a 100% performance level. In order to determine whether the participants maintained acquired knowledge or not, maintenance data were collected at 15, 25 & 35 days post intervention. In the light of maintenance data, it can be easily stated that the participants were able to label concept shapes after a while. After the instructional process, extension activities were practised. Extension activities (generalization) are highly important for the permanence of the concepts. Figure 2 shows the performance levels of the participants in the generalization phase.

Figure 1

*Figure 1.*shows the baseline, intervention and maintenance data of the participants.

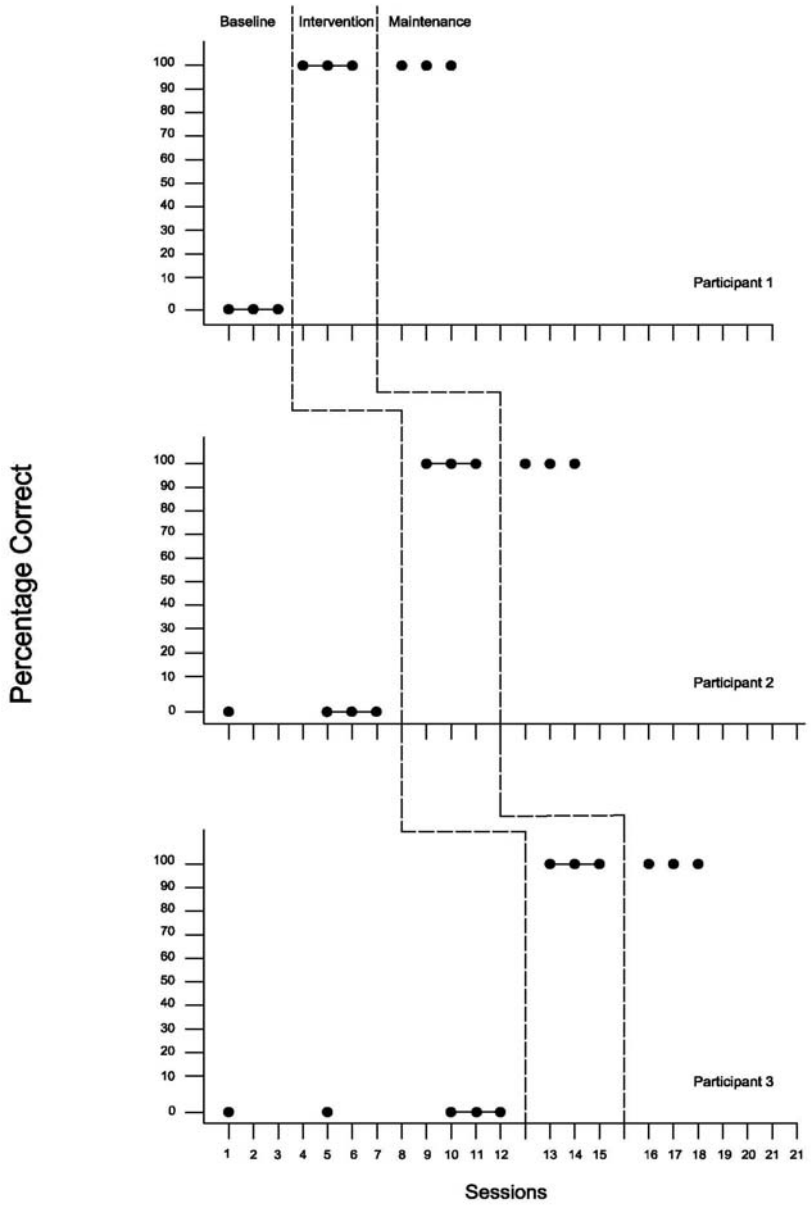
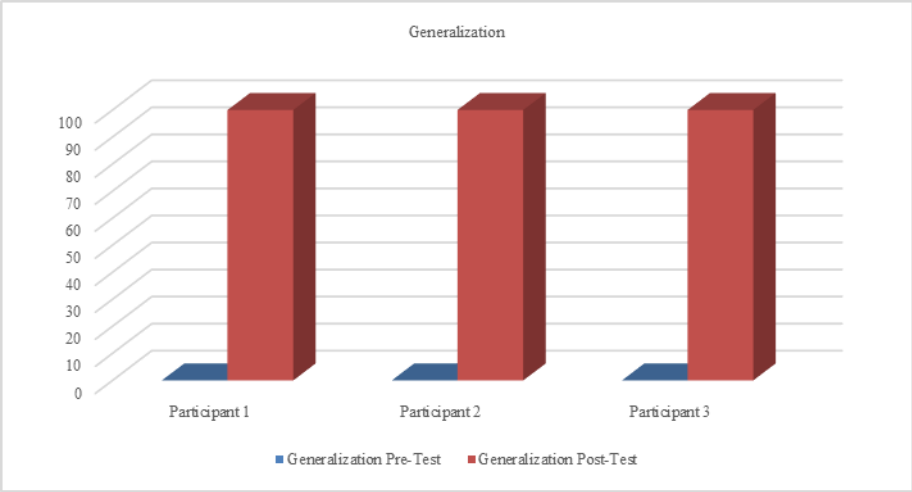


Figure 2

Figure 2 shows the generalization data of the participants.



DISCUSSION

The purpose of the present study was to show the effectiveness of direct instruction model in acquisition and maintenance of geometric shape concepts to students with visual impairment. Results indicated that the Direct Instruction model was more effective than the traditional model in teaching concepts. Results also demonstrated that Direct Instruction model was highly effective with these students. In addition, the evidence from this study suggested that Direct Instruction model required less instruction time with all three participants. In this study real- life materials were used for labelling the sphere concept (ball). In a study by Fielding, Kameenui and Gersten (1983) stated that using authentic materials like a 'ball' in Direct Instruction model facilitates student success. This also supports the results of the current study.In general, the results indicated that the Direct Instruction model was effective on the sphere concept acquisition and maintenance for all students. Previous studies showed that students' ability to focus on the attribution of examples and their overall attention increase when the language used in concept instructions is clear and straightforward (Engelmann & Carnine, 1991; Tuncer & Altunay, 2004;Özmen & Unal, 2008).

In Direct Instruction Model, the instructions are prepared based on the association typesenchance the teaching practices of the teacher. The teacher knows how to withdraw the clues and how to present the examples. In the Model, the most important feature of the instruction skills is that they do not vary from practice to practice and according to the personal styles of teachers. In Direct Instruction Model, the role of the teacher in the learning process of the individual was defined and the instruction skills were exactly explained (Altunay, 2008). Furthermore, it is observed that the students are highly motivated and learn permanently as a result of the instructions which progress cumulatively. Also, it is highlighted that including the expanded teaching and worksheet items in Direct Instruction Model helps students to master their acquired knowledge. Therefore, the teachers need to know how to conduct the subject, how to review and evaluate, and how to apply the process of correcting mistakes in teaching.

In conclusion, evidence from this study supported the Direct Instruction model in teaching academic concepts to students with visual impairment. It is important to use evidence-based practices in education in order to result in effective outcomes from the curricula created for the education of the individuals with special needs. The interventions that positively affect the performance of the student need to be applied in classes. That is why it is critical to build a bridge between the teaching process in class and the research that suggests the efficiency of the practice (Carnine, 1997; Cook &Schirmer, 2006). Yet, evidence-based practices are the instruction techniques which fills the gap between research and practice.

In future research, the researchers have demonstrated the success of this model within a primary school setting for students with visual impairment. This study targeted only three students in a 1st grade classroom in Turkey, further research with different grade level, subject level, and countries programs are warranted to note generalized effects. Therefore, this study suggests that the effectiveness of Direct Instruction model in teaching different concepts should be compared with students from different age groups and different special needs, too. The above-mentioned results of the current study and the following constraints should prompt future research in other academic areas within the Turkish education system. But more importantly, this study provides a

systematic research model to evaluate research-based academic model in an applied setting. Instituting such an applied research model must be expanded within the Turkish public education system to further assist those students in need of academic support, both for qualifying for special education services and for general education services. To break the cycle of students' learning failure, the awareness in Turkey regarding the special education and specific learning disabilities should improve with the support of the governments' education programs (Sener& Belfiore, 2005). The result of such an applied research agenda for Turkish public education will only benefit allinvolved, promoting educational success for all students.

A primary purpose of the present study was to provide further evidence on the effectiveness of concept instruction considering the Direct Instruction model. The potential significance of such evidence for teacher educators lies mostly in the good options it might suggest for effective concept instruction. Concept Instruction considering the principles of the Direct Instructional model might as well require well-designed protocols.With the growing demand for accountability and the functional significance of assessing the effectiveness and generality of interventions, further studies related to the Direct Instruction model will be beneficial.

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