

## An instructional design to teach concepts regarding phases of matter to visually impaired students

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## Research Problem

In this study, the effectiveness of instructional design developed for students with visual impairments on concept learning was investigated.

In the context of this general problem, the following research questions were sought:

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### Research Problem

- ▶ What is students' conceptual learning difficulties related to the concepts of 'Phases of Matter and Heat' unit?
- ▶ What criteria should be considered while developing materials to teach 'Phases of Matter and Heat' unit to visually impaired students?
- ▶ What is the effect of the instructional design model developed on students' conceptual learning of concepts of 'Phases of Matter and Heat' unit?

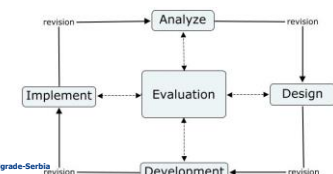
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### Research Methods: Design Based Research

Design-based research (DBR) was developed by educators as a response to the gap between basic and applied research practices.

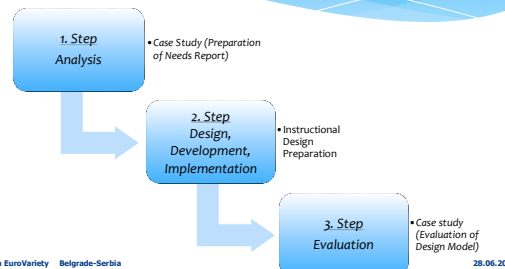
**ADDIE Design Model**

The ADDIE model is the generic process traditionally used by instructional designers and training developers. The five stages —Analysis, Design, Development, Implementation, and Evaluation— represent a dynamic, flexible guideline for building effective instruction design



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### Progression of ADDIE Design Model



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### Samples

The study group consisted of 8th grade students with visual impairments.

	Students	Visual acuity	Gender
Needs Analysis Stage Sample	S <sub>1</sub>	Blind	Male
	S <sub>2</sub>	Blind	Male
	S <sub>3</sub>	Blind	Male
	S <sub>4</sub>	Low vision	Male
	S <sub>5</sub>	Low vision	Female
Implementation Stage Sample	S <sub>1</sub>	Blind	Male
	S <sub>2</sub>	Low vision	Male
	S <sub>3</sub>	Low vision	Male
	S <sub>4</sub>	Low vision	Male
	S <sub>5</sub>	Low vision	Male
	S <sub>6</sub>	Low vision	Male

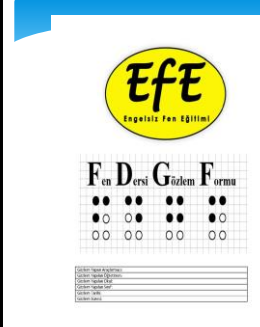
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### Data Collection Tools

Interviews and observations, which are frequently used data collection techniques in qualitative studies, are data collection tools of this study.

1. Science lesson observation form (SLOF)
2. Science activity observation form (SAOF)
3. Semi-structured teacher interview form
4. Academic achievement tests

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**EFE**  
Engelstilj Fen Eğitimi

**F en Dersi Gözlem Formu**

Science Lesson Observation Form (SLOF) was used observations to determine the visual impaired students' learning needs.

### Science Lesson Observation Form (SLOF)

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**EFE**  
Engelstilj Fen Eğitimi

**F en Etkinlik Gözlem Formu**

Science Activity Observation Form (SAOF) was used to assess the appropriateness, effectiveness and adequacy of the design model for the activities.

### Science Activity Observation Form (SAOF)

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### Semi-structured interviews

Two interviews were conducted within the scope of the study.

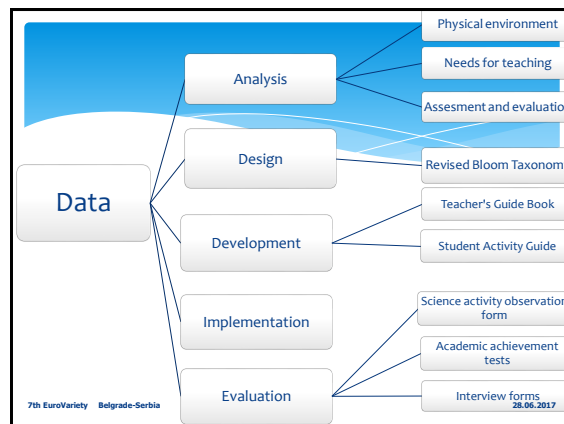
- Semi-structured Student Interview Form: Needs Analysis
- Semi-structured Student Interview Form: Assessment

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### Academic Achievement Tests

Two (pre-test and post-test) different tests have been developed to measure the students' academic achievement

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## Analysis

**Physical environment**

- Classroom design
- Location of classroom furniture, auxiliary teaching materials and materials
- Color and pattern contrasts in classroom furniture, on the floor and on the walls for students with low vision,

**Teaching**

- Enlarged texts suitable for the inadequacy of the student
- Verbal communication in the teaching process
- Efficient use of time

**Assessment and evaluation**

- The exam papers for students with low vision (Century Gothic, double line spacing, minimum 18 points)
- Multiple-choice questions read by the teacher to blind students

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## Development

Guidelines were developed and designed at the development stage.

- Teacher's Guide Book
- Student Activity Guide Book

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## Implementation

- \* The design model was implemented in 16 hours for four weeks
- \* All lessons are recorded with video camera

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## Evaluation

In this stage, the applied design model is evaluated

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graph TD
    A[Data collection tools to evaluation of instructional design] --> B[Teaching, learning, functionality and usability]
    A --> C[Pre-test and Post-tests]
    A --> D[Teacher and student views]
    
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## Evaluation

Activity Analysis: Activities were analyzed by the Science Activity Observation Form (SAOF).

- Activities were analyzed in terms of teaching, learning, functionality and usability dimensions

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### Teaching, Learning, Functionality and Usability Dimensions

Dimensions of Evaluation	Activity 1		Activity 2		Activity 3		Activity 4	
	Yes	Partially	Yes	Partially	Yes	Partially	Yes	Partially
<b>Teaching Dimension</b>								
Are the questions asked before the activity appropriate to test the preliminary knowledge?	X		X		X		X	
Can activity questions raise awareness of effectiveness?	X		X		X		X	
Is the time given for the presentation of materials sufficient?	X		X		X		X	
Is the activity consistent with the intended purpose of the subject?	X		X		X		X	
<b>Learning Dimension</b>								
Does the activity give the opportunity to use different senses?	X		X		X		X	
Is the activity adapted from everyday phenomenon?	X		X		X		X	
Can the activity attract the attention of the students?	X		X		X		X	
Does the activity fit the cognitive characteristics of students?	X		X		X		X	
<b>Functionality Dimension</b>								
Are the materials used in the activity eligible for reuse?		X		X		X		X
Is the activity appropriate for the student's independent use?	X		X		X		X	
Can the event be adjusted to individual differences?	X		X		X		X	
<b>Usability Dimension</b>								
Is the scheduled time for the activity sufficient?	X		X		X		X	
Are the materials used in the activity economical?	X		X		X		X	
Are the materials used in the activity easily accessible?	X		X		X		X	
Is the activity appropriate for the safety of the student?	X		X		X		X	

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### Scope of the pre and post tests

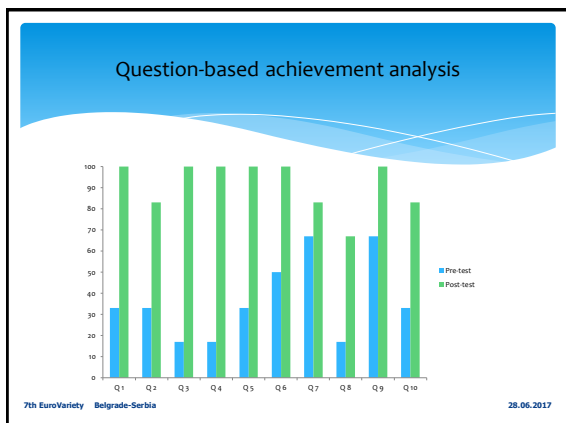
Questions	The content of the questions
Q 1	Heat and temperature
Q 2	Heat mass relation
Q 3	Melting and melting point
Q 4	Freezing and freezing point
Q 5	Heat capacity
Q 6	Heat and temperature
Q 7	Condensation
Q 8	Space between particles
Q 9	Boiling
Q 10	Space between particles

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### Analysis of the pre and post test

Questions	Pre-test						Correct Response (%)	Post-test						Correct Response (%)		
	Student Answers							Student Answers								
	0 <sub>1</sub>	0 <sub>2</sub>	0 <sub>3</sub>	0 <sub>4</sub>	0 <sub>5</sub>	0 <sub>6</sub>		0 <sub>1</sub>	0 <sub>2</sub>	0 <sub>3</sub>	0 <sub>4</sub>	0 <sub>5</sub>	0 <sub>6</sub>			
Q1	-	+	-	-	+	-	33	+	+	+	+	+	+	100		
Q2	-	-	-	-	+	+	33	+	+	+	-	+	+	83		
Q3	+	-	-	-	-	-	17	+	+	+	+	+	+	100		
Q4	-	-	-	-	-	+	17	+	+	+	+	+	+	100		
Q5	-	+	-	-	+	-	33	+	+	+	+	+	+	100		
Q6	+	+	+	-	-	-	50	+	+	+	+	+	+	100		
Q7	+	-	+	+	-	+	67	+	+	+	-	+	+	83		
Q8	-	-	-	+	+	-	17	-	+	-	+	+	+	67		
Q9	-	-	+	+	+	+	67	+	+	+	+	+	+	100		
Q10	-	+	-	-	-	+	33	+	+	-	+	+	+	83		
Response (%)	Belgrade-Serbia						30	30	40	50						
Response (%)	Belgrade-Serbia						90	100	80	80	100	100	100	83		

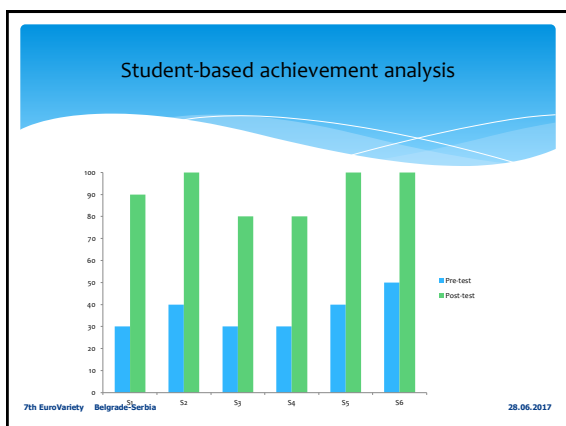
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### Question-based achievement analysis

- \* While the percentages of the students able to answer the first and sixth questions related the concepts of heat and temperature in the pre-test were 33% and 50%, at the post-test all the students could answer the questions that include these concepts.
- \* Respectively while 67% and 17% of students were able to answer the seventh and eight questions related condensation and space between particles questions in the pre-test, in the post-test percentages of the students able to answer these questions are 83% and 67%.

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### Student-based achievement analysis

Student-based achievement analysis of the students show that S<sub>1</sub> coded student had 30% success in the pre-test and 90% in the post-test. On the other hand the student coded as S<sub>2</sub> student had 40% success rate in the pre- test and 100% in the post-test. As a result S<sub>2</sub>, S<sub>5</sub> and S<sub>6</sub> were able to answer all questions in the post-test.

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## Interview Analysis

Concepts	Concept Learning Level						Correct Response (%)
	Students						
	S <sub>1</sub>	S <sub>2</sub>	S <sub>3</sub>	S <sub>4</sub>	S <sub>5</sub>	S <sub>6</sub>	
Heat	+	+	+	+	+	+	100
Temperature	+	-	+	+	+	+	83
Freezing	+	+	+	+	+	+	100
Heat capacity	+	+	+	+	+	+	100
Correct Response	-	+	+	+	+	+	83
Bolling	+	+	+	+	+	+	100
Freezing	+	+	+	+	+	+	100
Bolling	+	+	-	+	+	+	83
Condensation	+	+	+	-	+	+	83
Matter	+	+	-	+	+	+	83
Correct Response	90	90	90	90	100	100	

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## Result and Discussion

- The scientific knowledge can be facilitated by the activities based on different senses
- Students can learn basic concepts of science by activity based learning method
- Every material to be used in the activity should be introduced to the students and precautions must be taken against the injuries
- After the activities, students should be allowed to brainstorm the activity.

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Thank you for your attention

Questions?

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