Praxis of Practical Works in Science with Visually Impaired (VI) Students

Mustafa SÖZBİLİR

Atatürk University
Erzurum, Turkey
Email: sozbilir@atauni.edu.tr

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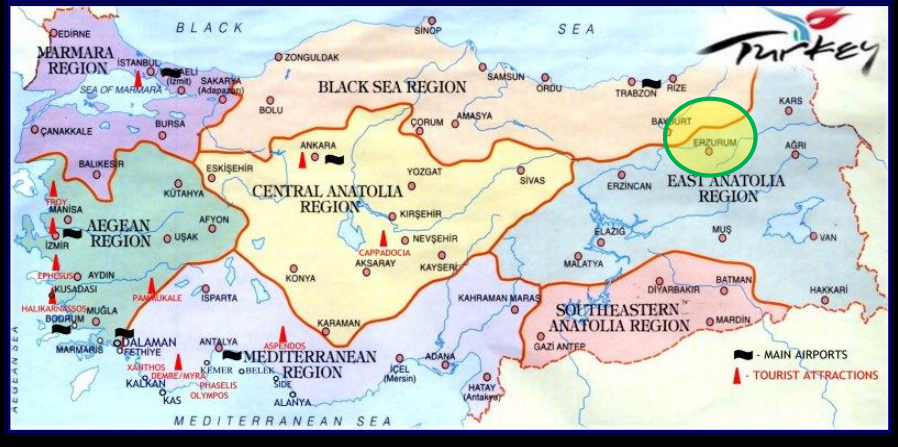
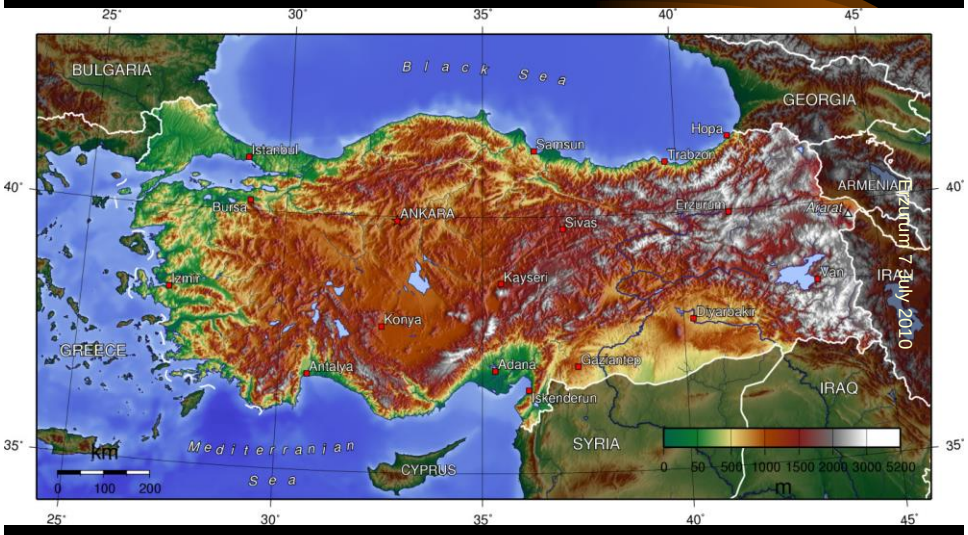
Turkey - Geographical Regions



Turkey-Physical

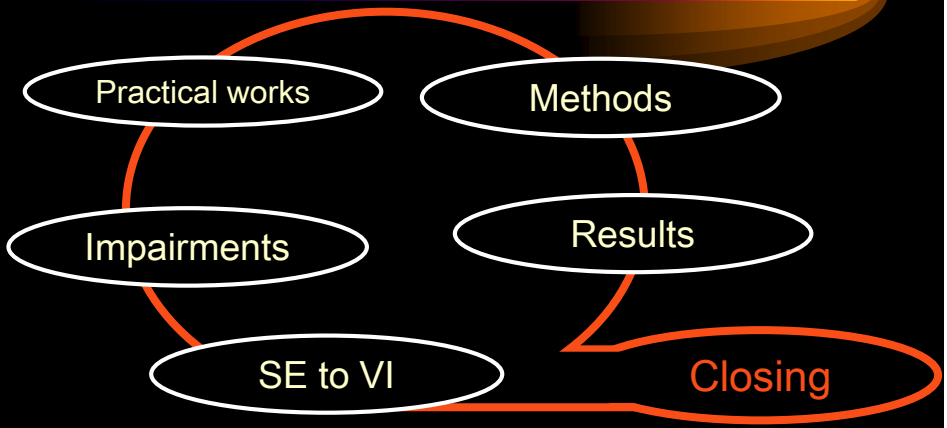


Scenes from Erzurum






Praxis of Practical Works in Science with VI Students



Why do we teach science?

- Reasons for science education are based on four arguments:
  - **Economic** (training more scientist and engineers to meet the needs of industry and science related fields)
  - **Democratic** (raising an informed citizens and knowledgeable consumers in the future)
  - **Skills** (science instills certain transferable skills that are important to students' understanding of science)
  - **Cultural** (the history and philosophy of science should play an integral role in science curriculum)

Ref: http://www.science-as-inquiry.org/why-do-we-teach-science.html

How to develop Skills?

Practical works help to develop **skills**.

What is **practical work**?

Practical Works?

- Hodson (2005) used the term '**practical work**' "for any classroom, laboratory or field activity that involves the use of scientific apparatus, chemicals, biological specimen or scientific models, either by students or their teachers"

- Practical work is considered "any science teaching and learning activity in which the students, working individually or in small groups, observe and/or manipulate the objects or materials they are studying" (Millar, 2010)

Practical works include

- teacher demonstrations,
- activities that students do themselves either through structured, guided or open inquiry,
- observing, collecting data, analyzing and interpreting their own data or given data and
- reporting them in various formats

Why use practical works in science teaching?

- It can motivate students towards the study of science,

However;

- Although it generates short-term engagement, they are relatively ineffective in generating motivation to study science at post compulsion or longer-term personal interest (Abrahams, 2009; Hodson, 2005)

If so ?

Why use practical works in science teaching?

- Beyond affective arguments (such as motivation, attitudes, interests towards science)

Practical works help to:

- skills development,
- conceptual understanding of basic science concepts,
- development of procedural knowledge for scientific method and nature of science (Millar, 2010)

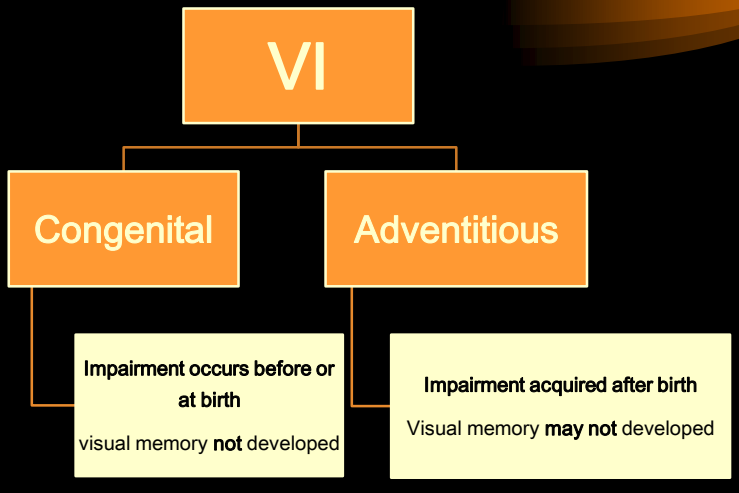
Impairments & Disability

- **Impairments** are problems in body function or alterations in body structures such as blindness (WHO, 2011)
- **Disability** is defined as the loss or limitation of opportunities to take part in society on an equal level with others due to social and environmental barriers (Northern Officer Group Report, 2002)
- WHO states that disabililty is not an attribute of the person, but inaccessible environments create disability by creating barriers to participation and inclusion.

Visual Impairment (VI)

- **Visual impairment (VI)**, also known as vision impairment or vision loss, is a decreased ability to see to a degree that causes problems not fixable by usual means, such as glasses (WHO, 2011).

Causes of VI



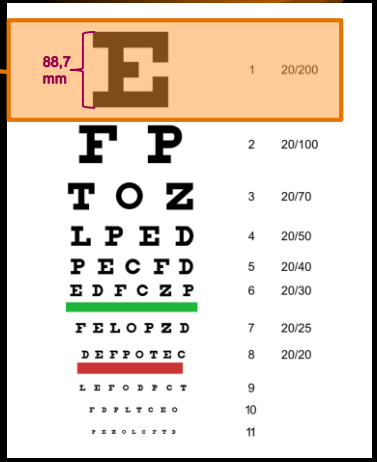
Terms used in VI

❖**Blind** refers to individuals with **no vision** or **only light perception**.

The word ‘blind’ is only a physical description of a person’s vision and should not be used for the person’s abilities, intelligence, personalities, or interest

Terms used in VI (cont.)

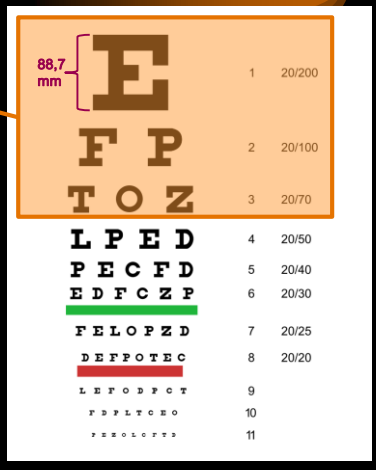
- **Legal blindness** is defined as
  - central visual acuity of 20/200 feet (or 6/60 in metric system) or less in better eye with best correction **or**
  - a central visual acuity of more than 20/200 if there is a visual field defect in which the peripheral field is contracted to such an extent that widest diameter of visual field subtends an angular distance of no greater than 20 degrees.
- Inability to read the top letter from 20 feet is considered legally blind.



https://en.wikipedia.org/wiki/Snellen_chart

Terms used in VI (cont.)

- **Low vision** is generally defined as
  - a central visual acuity of 20/70 to 20/200 in the better eye with correction **or**
  - a visual field of 20 to 40 degrees or less in better eye with correction.



Terms used in VI (cont.)

Definitions changes place to place due to the state benefits that provided to the visually impaired people.

Since the term **blind** has a negative connotation to some people, some prefer to use **visually impaired.**

VI vs Sighted Students

- Students with VI are required to complete the same curriculum and examinations as sighted students.
- However, resources and instructional methods are based on the vision is partly or not accessible at all by visually impaired students.
- What is the solution?

What is the solution?

Solution is

modification, adaptation or **intervention**

in the educational resources and methods according to the needs of individuals with VI

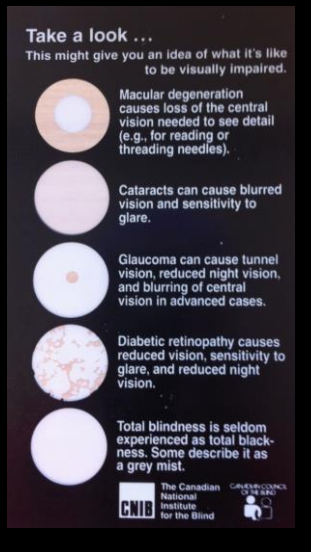
Adaptation but how?

- Because students with VI
  - differ in intellectual ability,
  - development rate,
  - social competence,
  - ….

Adaptation but how? (Cont.)

- Students with VI differ in their
  - impairments (low vision, blind etc),
  - the extent of their visual acuity,
  - ability in using the whatever vision they have.

Even if they have the same identical acuities and fields of vision this does not mean that they use the vision they have in the same way and capacity



Adaptation but how? (Cont.)

- Moreover, as they are different persons, they differ in terms of
  - personalities,
  - motivation,
  - cognitive abilities,
  - the degree to which they have learned to use their vision vary and affect their visual performance.

Adaptation but how? (Cont.)

- Some students take full advantage of their existing vision, other may not do the same.

- Therefore, **modification**, **adaptations** or **interventions** have to be done in a way that **all take full advantage of educational experiences** (Huebner, 2000)

Another Source of Difficulty !

- Teachers' knowledge, skills and the experiences
- School facilities and materials available

Designing an instructional setting for students with impairments is like solving a problem with multiple variables!

For an Effective Instructional Design

- Teacher should understand
  - students' needs,
  - be aware of their own capabilities, knowledge and skills,
  - the facilities available in the school.
  - understand the nature of visually impaired students as a whole (teaching is mostly done as groups).

Teaching Science to VI

- VI are under represented in STEM workforce due to discouragement to learn STEM fields.
- Misconceptions in
  - VI students themselves,
  - Parents
  - Teachers
  - Employers
  - Society ….

Research in teaching science to VI students is scarce

- Current research is focussed on
  - Instructional design and adaptation of available methods
  - Instructional material development
  - ICT integration
  - Studies on affective dimensions

Benefits of science education for students with impairments

- Expanding experiential background for students who have had limited experiences
- Covering skills and knowledge important for adult functioning
- Using concrete, hands-on learning activities
- Developing, through science activities, problem solving and reasoning skills (Mastropieri & Scruggs, 1992).

Benefits of science education for students with VI

- Science education will help to develop:
  - compensatory skills for observing, manipulating, and classifying phenomena and related matters (Supalo, 2012)
  - motivation towards STEM
  - encouragement VI students to take part in STEM workforce
  - Basic science knowledge development needed for everyday life
  - …

Purpose

- This study is aimed to provide a broad aspect to the questions
  - what are the needs of VI students in learning concepts and skills relevant to science?
  - can students with VI be efficiently taught basic science concepts, critical thinking and scientific process skills?
  - If so, which methods or adaptations of methods and materials have been seen to be the most effective in delivering science education?
- on the basis of evidences and experiences gained working with visually impaired students in the last three years of my research group

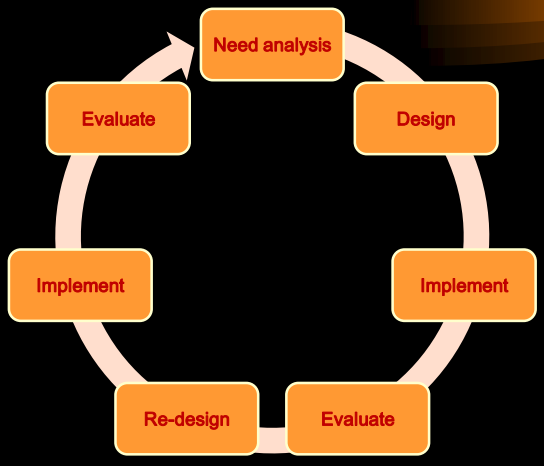
Research questions

- What are the needs of visually impaired students' in carrying out practical works?
- How these needs could be met in designing instructional materials and activities for practical works?

Research Design

- The whole project is designed as a design-based research (DBR).
  - DBR "blends empirical educational research with the theory-driven design of learning environments, is an important methodology for understanding how, when, and why educational innovations work in practice" (Design-Based Research Collective, 2003).

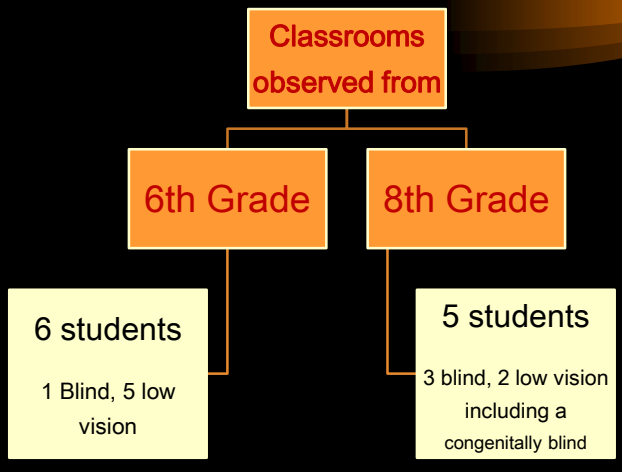
DBR Stages



Need Analysis

- This was done by **observations** made in classrooms during science teaching, **interviews** carried out with students and their science teacher, as well as **curriculum analysis**.
- Unstructured observations were conducted in classrooms from a special middle school for visually impaired students in Erzurum city center during 2014-15.

The Participants



The Participants

- Worked with two different teachers
  - Need analysis stage: a female teacher with more than 10 years of experience in science teaching but only less than 3 years of experience working with VI students.
  - Implication stage: a male teacher, temporary replacement teacher, with no teaching experience.
  - None of the teachers has any kind of traning for teacing VI students

Topics

- Observations made from three different topics in science:
  - reproduction, growth and development in plants and animals from life sciences unit
  - matter and heat from matter and change unit
  - conduction of electricity from physical phenomenon unit

Findings (cont)

- Teaching based on
  - Lecturing with not much adaptation of materials or instructional setting
  - Some adaptation made based on experience not knowledge!
- The main reason is teacher's lack of knowledge in teaching science to VI students, and lack of facilities.

Findings (cont)

- Teacher does demonstrations but blind students are excluded.
- Print materials were not enough and not available in Braille.
- Students stay passive. No practical Works at all.
- Science was found as boring by the students!

Findings (cont)

- The basic needs are materials and hands-on-activities designed carefully to meet the needs of low vision & blind students separately.

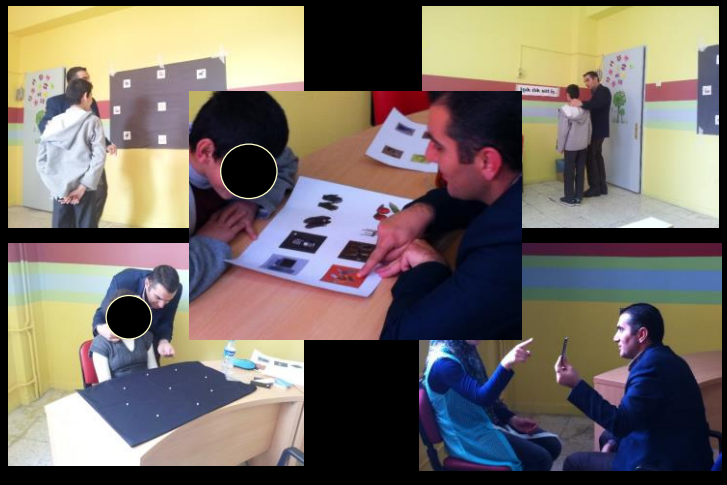
Individual Needs

- Students individual needs were identified by functional vision evaluation instrument called GIGDA (Gazi İşlevsel Görme Değerlendirme Aracı-Gazi Functional Vision Evaluation Instrument) developed by professionals in Gazi University in Ankara.

Individual Needs - GIGDA

- Functional vision evaluation included:
  - eye condition,
  - focusing objects from different angles, following an objects,
  - seeing objects in close distance (seeing 1cm objects less than 60 cm distance),
  - identification of the colors,
  - acuity in contrast,
  - reading,
  - writing
  - seeing from a distance (seeing 10x10 object from 1 m distance).

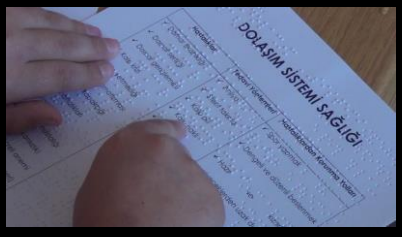
GIGDA Application

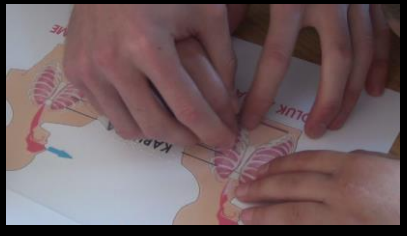


Design needs for text came out of GIGDA

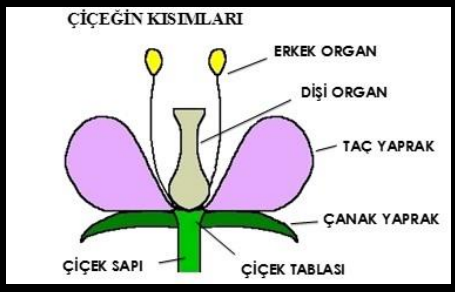
- The minimum size for text has to be at least 20 point (1 point = 1/72 inch)
- Best font is the Century Gothic.
- Braille materials should be printed with normal text (for this braille and color in embosser is used)
- Pictures should be tactile

Sample tactile print documents




Sample print documents (cont)



Two types of the same working paper. The one on the *left* is printed by braille and color in embosser for *blind* students, while the one on the *right* is printed a color printer for *low vision* students. Both materials printed in enlarged fonts.

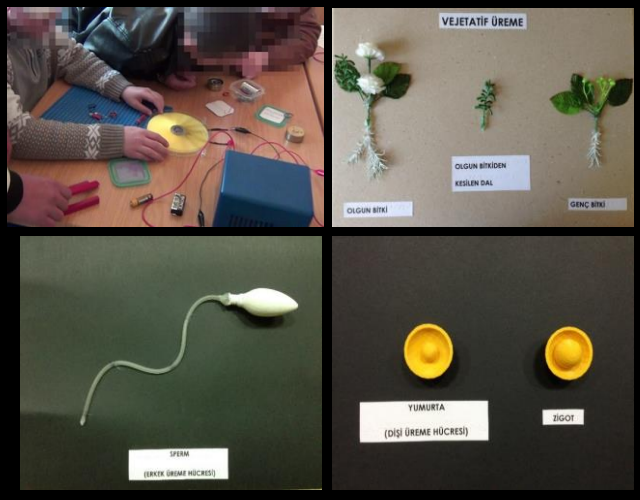
Sample tactile documents (cont)

Two tactile materials made with everyday objects and 3D printer for female and male reproductive system of a flower.

Designing tactile materials for practical works

- ❖Adapt current materials for sighted students
- ❖Develop with everyday materials.
  - Above options are cheap and easily available but not durable always.
- ❖Use emerging 3D printing technology.
  - Expensive, not available for everybody but versatile & durable

Sample Tactile Materials



Different types of the adaptation of everyday materials or 3D printed materials. All the materials include features for *low vision* and *blind* students

Sample Videos (Before & After)

- Life Sciences Unit
- Matter & Change Unit
- Physical Phenomenon Unit

Results (Positive aspects)

- Project is still undergoing.
- First hand experiences:
  - Motivation, interest increases
  - Positive attitudes developed
  - Students develop practical works skills
  - Learning & understanding needs to be tested but there is improvement.

Results (Drawbacks)

- Time management is difficult due to too much time devoted to the understanding the materials and activities,
- Lack of scientific process skills to carry out the activities
- Analysing the results
- Writing reports
- Overcoming the understanding that practical Works are for understanding the science not just for play!

Closing

- Each VI student has different needs. VI students needs should be identified individually
- Close collaboration of working together students, teachers, parents and experts are required.

Closing (cont)

- Practical works are not just for play, but for understanding the science
- As VI students are easily distracted by unnecessary details, materials has to be simple and focussed.

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Mustafa SÖZBİLİR
Atatürk University, Erzurum, Turkey
Email: sozbilir@atauni.edu.tr