Making Science and Chemistry Accessible to Students with Blindness or Low Vision (BLV)

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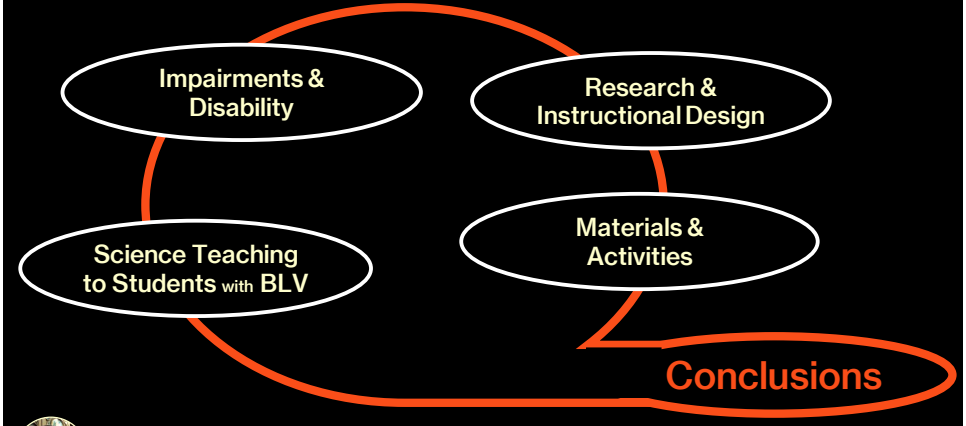
This study is a part of large scale research project funded by TÜBİTAK (The Scientific and Technological Research Council of Turkey) under the contract number 114K725.

Outline



ECRICE-2020 Webinar July 6, 2020

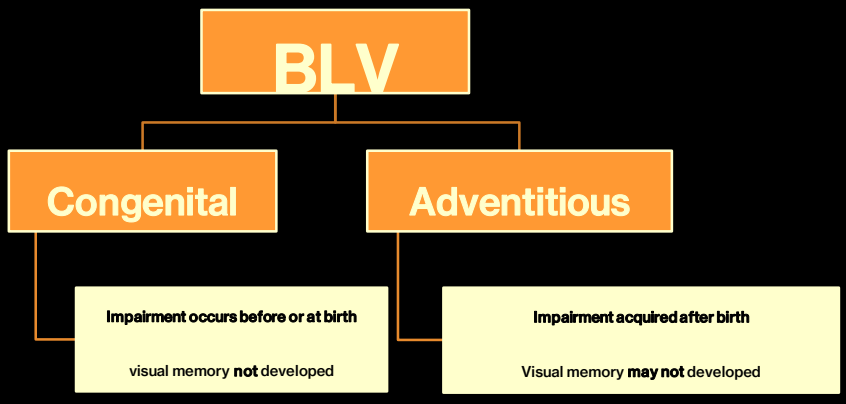
Impairments & Disability

- **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 disability 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



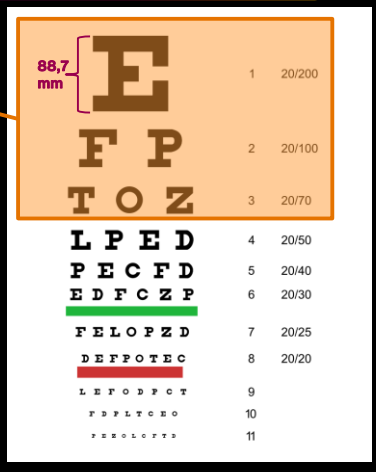
Terms used in VI

- **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.)

- **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).**

BLV vs Sighted Students

- Students with BLV are required to follow and achieve the same curriculum as sighted peers.
- The resources and instructional methods are mainly based on the use of vision but hardly accessible by the students with BLV.
- What is the solution?

What is the solution?

Solution is making science accessible via

modification, adaptation or **intervention**

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

Research in teaching science to students with BLV 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 BLV

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

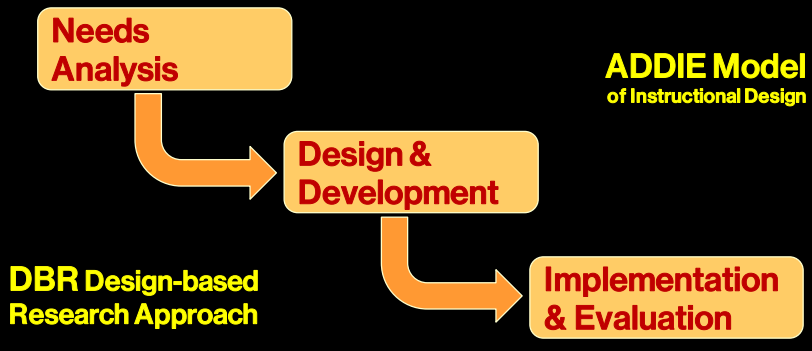
Research aims

- This study is aimed to provide a broad aspect to the questions:
  - What are the needs of students with BLV in learning concepts and skills relevant to science?
  - Can students with BLV be effectively 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?

Research questions

- What are the needs of students with BLV in learning science?
- How these needs could be met in designing instructional materials and activities?

Research & Instructional Design



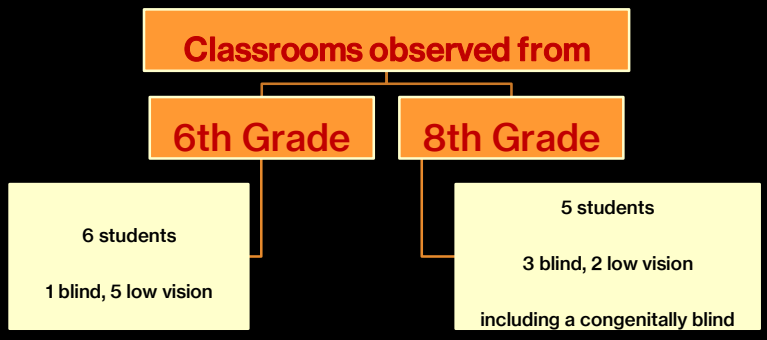
ADDIE Model
of Instructional Design

DBR Design-based Research Approach

Need analysis

- **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 based in Erzurum city center.

The students



The teachers

- 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 training for teacing students with BLV

Topics (lower secondary science)

- Three different topics in 6th grade science covered:
  - Reproduction, growth and development in plants and animals from life sciences,
  - Matter and heat from matter and change,
  - Conduction of electricity from physical phenomenon,

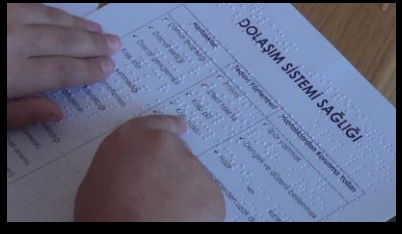
Findings

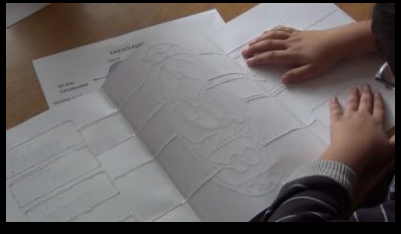
- Teaching based on;
  - Lecturing with not much adaptation of materials or instructional settings
  - Some adaptation made based on experience not knowledge based on research!
- One of the main problem was teacher's lack of knowledge in teaching science to students with BLV and lack of facilities.

Findings (cont)

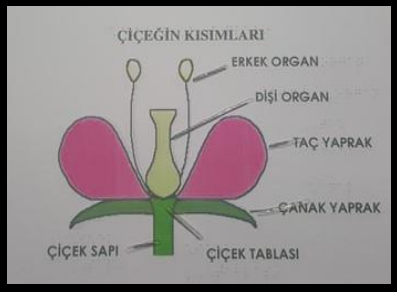
- Teacher did demonstrations but blind students were excluded.
- Print materials were not enough and not available in Braille.
- Students stayed passive. No active participations to practical works.
- Science was found as boring!
- The basic needs were materials and hands-on-activities designed carefully to meet the needs of students with BLV separately.

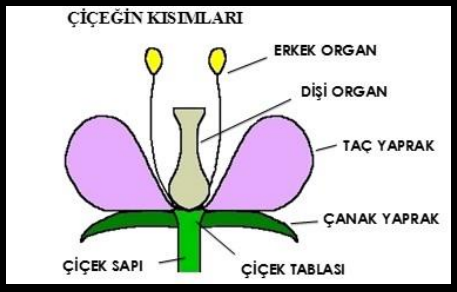
Sample tactile print documents





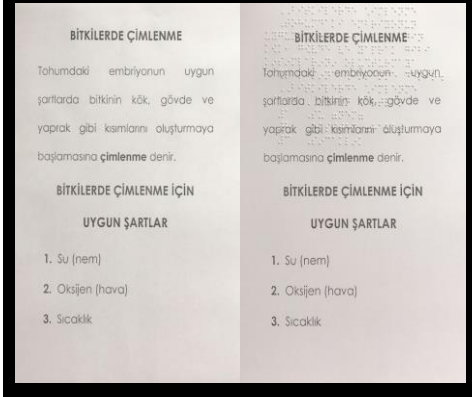
Sample tactile print documents (cont.)

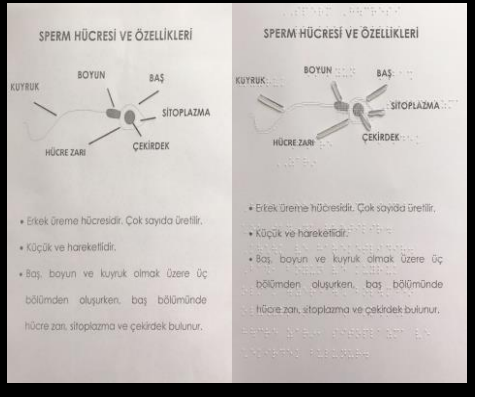




Two types of the same working paper. The one on the *left* is printed by braille and color in embosser for *blind* students, while the one on the *right* is printed a color printer for *low vision* students. Both materials printed in enlarged fonts.

Sample tactile print documents (cont)



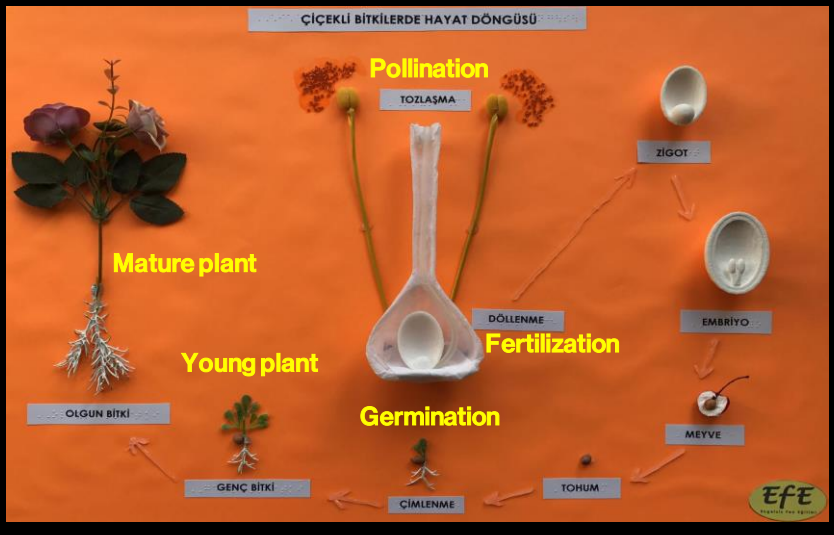


Two types of the same working paper. The one on the *left* is printed by braille and color in embosser for *blind* students, while the one on the *right* is printed for *low vision* students. Both materials printed in enlarged fonts.

Female and male reproductive system of a flower

Two tactile materials made with everyday objects and 3D printer

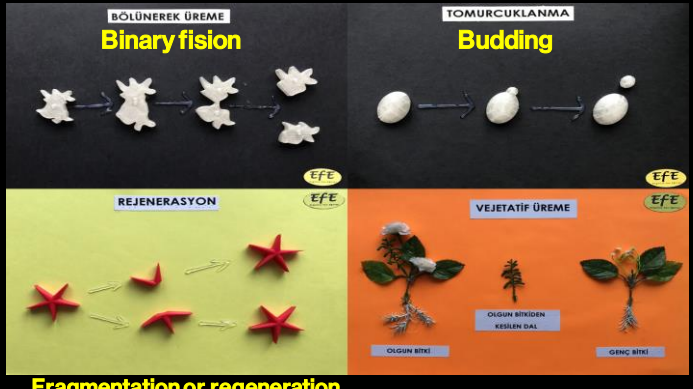
Flovering plants life cycle



Female and male reproductive system for human

Tactile materials made with everyday objects and 3D printer.

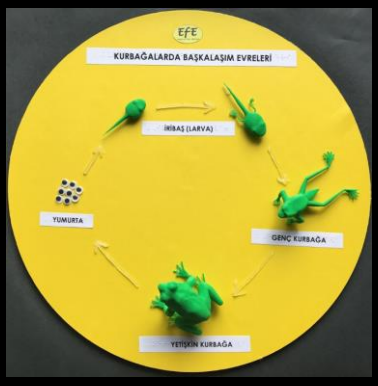
Vegetative reproduction



Fragmentation or regeneration

Tactile materials made with everyday objects and 3D printer

Life cycle of frog & butterfly



Tactile materials made with 3D printer

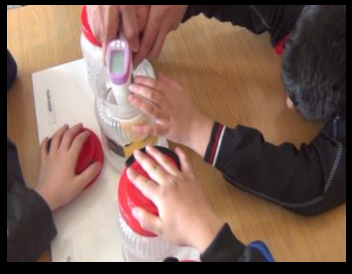
Activities for heat transfer

Heat transfer

Activities for heat transfer

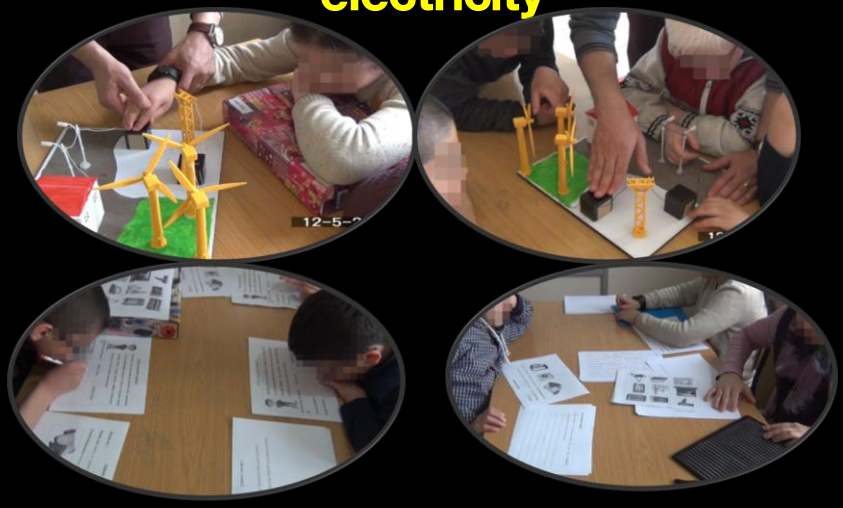
Heat transfer

Activities for heat transfer



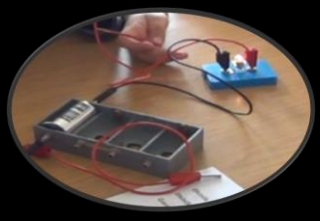
Insulation

Materials and activity for transfer of electricity



Materials and activity for resistance

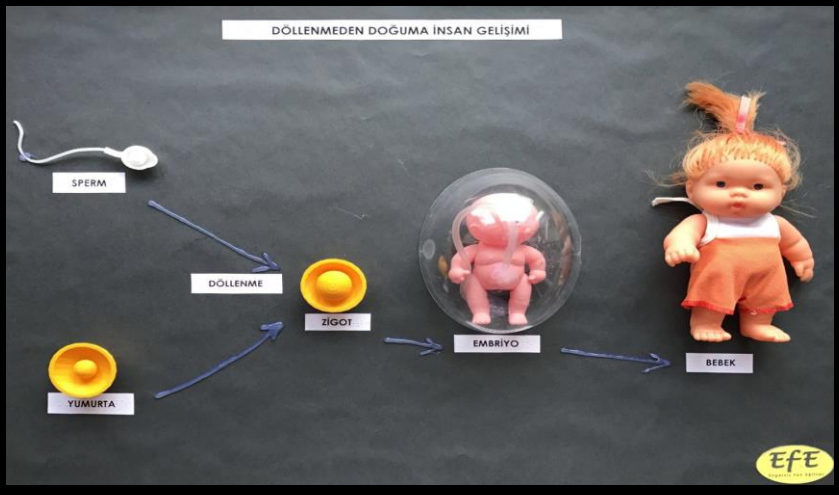
Materials and activity for resistance and bulb


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

Human development



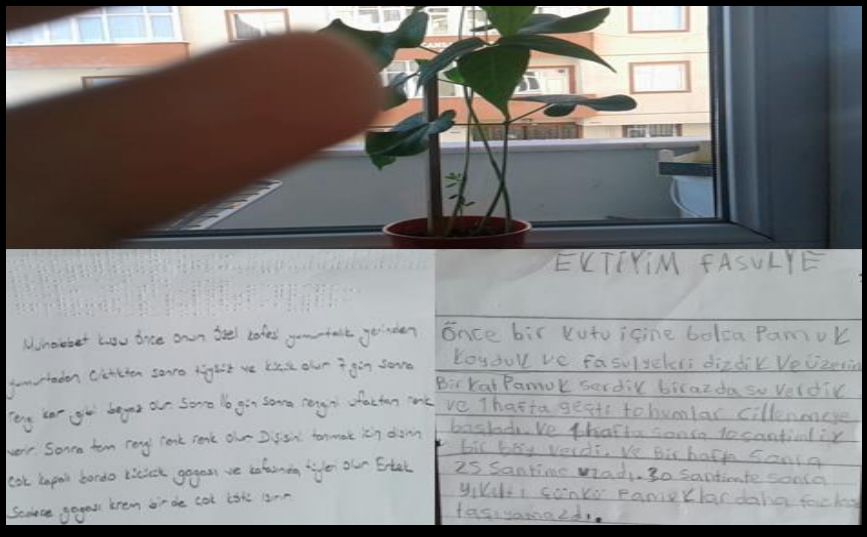
Combination of everyday materials or 3D printed materials. All the materials include features for *low vision* and *blind* students

Designing tactile materials for students with BLV

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

Classroom activities

Classroom activities



Results (Positive aspects)

- Motivation & interest towards science was increased
- Positive attitudes developed
- Students developed practical works skills
- Learning & understanding was 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 activities are for understanding the science not just for play!

Take home messages

- Teachers should understand
  - students' needs,
  - be aware of their own capabilities, knowledge and skills,
  - the facilities available in the school.
  - understand the nature of learning for students with BLV as a whole
  - students with BLV are easily distracted by unnecessary details, therefore the materials has to be simple and focussed
  - how to establish close collaboration with students, parents and experts

Some publications in English

EUROPEAN JOURNAL OF SPECIAL NEEDS EDUCATION
https://doi.org/10.1080/08856257.2020.1732110

Routledge
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ARTICLE

Check for updates

Improve learning with hands-on classroom activities: science instruction for students with visual impairments

Aydın Kizilaslan [a], S. Levent Zorluoglu [b] and Mustafa Sozbilir [c]

[a]Department of Special Education, Agri Ibrahim Cecen University, Agri, Turkey; [b]Department of Mathematics & Science Education, SDU University, Isparta, Turkey; [c]Department of Mathematics & Science Education, Ataturk University, Erzurum, Turkey

ABSTRACT
The preponderance of visually oriented and visually complex con-

KEYWORDS
Hands-on science; students

Journal Paper:

Kizilaslan, A., Zorluoglu, S.L., & Sözbilir, M. (2020). Improve learning with hands-on classroom activities: science instruction for students with visual impairments. *European Journal of Special Needs Education*, Advance online publication. https://doi.org/10.1080/08856257.2020.1732110.

Some publications in English

SCIENCE ACTIVITIES
2019, VOL. 56, NO. 4, 130–138
https://doi.org/10.1080/00368121.2020.1724860

Routledge
Taylor & Francis Group

Check for updates

A hands-on classroom activity to teach science concepts for students with visual impairment

Aydın Kızılaslan[a], S. Levent Zorluoglu[b], and Mustafa Sözbilir[c]

[a]Department of Special Education, Agri İbrahim Cecen University, Agri, Turkey; [b]Department of Mathematics & Science Education, SDU University, Isparta, Turkey; [c]Department of Mathematics & Science Education, Ataturk University, Erzurum, Turkey

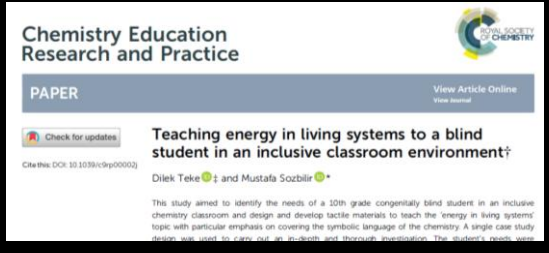
ABSTRACT
Students with visual impairments have the same span of cognitive abilities as their peers, but science instruction typically relies very heavily on vision. The preponderance of visually oriented and visually complex science concepts poses significant challenges to learning among students

KEYWORDS
Students with visual impairment; science; activity material; thermal insulation

Journal Paper:

Kizilaslan, A., Zorluoglu, S.L., & Sözbilir, M. (2019). A hands-on classroom activity to teach science concepts for students with visual impairment. *Science Activities*, *56*(4), 130-138. https://doi.org/10.1080/00368121.2020.1724860.

Some publications in English



Chemistry Education Research and Practice

ROYAL SOCIETY OF CHEMISTRY

PAPER

View Article Online

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Cite this: DOI: 10.1039/c9rp00002j

Teaching energy in living systems to a blind student in an inclusive classroom environment†

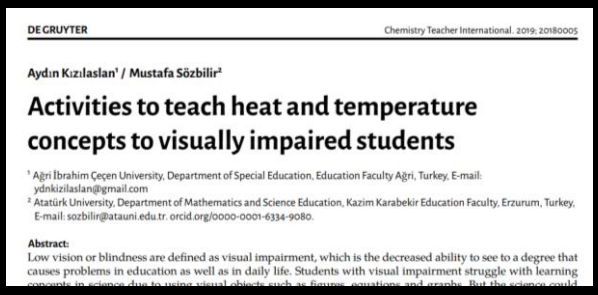
Dilek Teke‡ and Mustafa Sozbilir*

This study aimed to identify the needs of a 10th grade congenitally blind student in an inclusive chemistry classroom and design and develop tactile materials to teach the 'energy in living systems' topic with particular emphasis on covering the symbolic language of the chemistry. A single case study design was used to carry out an in-depth and thorough investigation. The student's needs were

Journal Paper:

Teke, D., & Sozbilir, M. (2019). Teaching energy in living systems to a blind student in an inclusive classroom environment. *Chemistry Education Research and Practice*, *20*(4), 890-901. doi.10.1039/C9RP00002J

Some publications in English



DE GRUYTER Chemistry Teacher International. 2019; 20180005

Aydın Kızılaslan[1] / Mustafa Sözbilir[2]

Activities to teach heat and temperature concepts to visually impaired students

[1] Ağrı İbrahim Çeçen University, Department of Special Education, Education Faculty Ağrı, Turkey, E-mail: ydnkizilaslan@gmail.com
[2] Atatürk University, Department of Mathematics and Science Education, Kazim Karabekir Education Faculty, Erzurum, Turkey, E-mail: sozbilir@atauni.edu.tr. orcid.org/0000-0001-6334-9080.

Abstract:
Low vision or blindness are defined as visual impairment, which is the decreased ability to see to a degree that causes problems in education as well as in daily life. Students with visual impairment struggle with learning

Journal Paper:

Kızılaslan, A., & Sözbilir, M. (2019). Activities to teach heat and temperature concepts to visually impaired students. *Chemistry Teacher International*, Advance online publication. doi.10.1515/cti-2018-0005.

Some publications in English

JOURNAL OF CHEMICAL EDUCATION Article

Cite This: J. Chem. Educ. 2019, 96, 1383−1388 pubs.acs.org/jchemeduc

Making Science Accessible to Students with Visual Impairments: Insulation-Materials Investigation

Aydin Kizilaslan,* Mustafa Sozbilir, and Seraceddin Levent Zorluoglu

Department of Special Education, Agri Ibrahim Cecen University, 04000 Agri, Turkey
Department of Mathematics and Science Education, Ataturk University, 25030 Erzurum, Turkey
Department of Mathematics and Science Education, Suleyman Demirel University, 32260 Isparta, Turkey

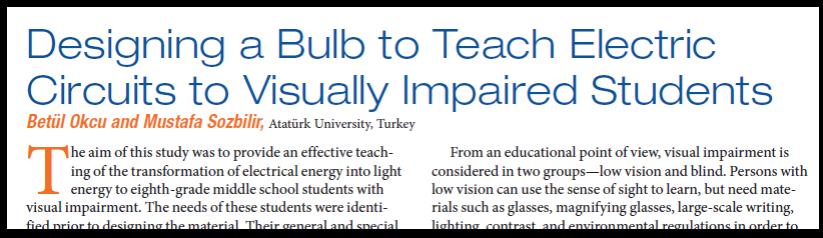
Supporting Information

ABSTRACT: Science education could be made more accessible to students with visual impairments through collaboration and specific adaptation in both the science classrooms and laboratories. For example, by providing simple adaptations or doing some essential modifications, students can gain experience with measuring, balancing, and weighing a variety of materials. Unfortunately, many concepts in science have been found inaccessible to students with visual impairment because of the use of figures, equations, and graphs. An activity was designed to teach the insulation properties of different

Journal Paper:

Kizilaslan, A., Sozbilir, M., & Zorluoglu, S.L. (2019). Making science accessible to students with visual impairments: insulation-materials investigation. *Journal of Chemical Education*, *96* (7), 1383-1388. doi:10.1021/acs.jchemed.8b00772.

Some publications in English



Designing a Bulb to Teach Electric Circuits to Visually Impaired Students

Betül Okcu and Mustafa Sozbilir, Atatürk University, Turkey

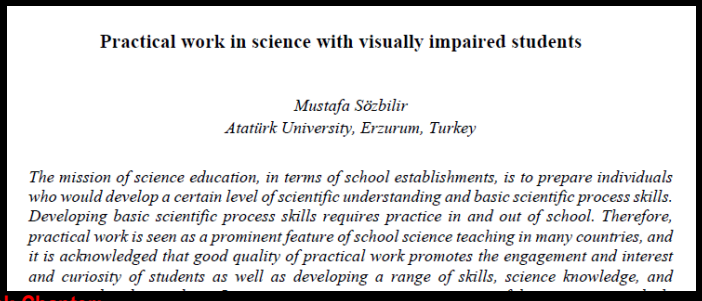
The aim of this study was to provide an effective teaching of the transformation of electrical energy into light energy to eighth-grade middle school students with visual impairment. The needs of these students were identified prior to designing the material. Their general and special

From an educational point of view, visual impairment is considered in two groups—low vision and blind. Persons with low vision can use the sense of sight to learn, but need materials such as glasses, magnifying glasses, large-scale writing, lighting, contrast, and environmental regulations in order to

Journal Paper:

Okcu, B., & Sozbilir, M. (2019). Designing a bulb to teach electric circuits to visually impaired students. *The Physics Teacher*, *57* (2), 99-101. doi.10.1119/1.5088470

Some publications in English



Practical work in science with visually impaired students

Mustafa Sözbilir
Atatürk University, Erzurum, Turkey

The mission of science education, in terms of school establishments, is to prepare individuals who would develop a certain level of scientific understanding and basic scientific process skills. Developing basic scientific process skills requires practice in and out of school. Therefore, practical work is seen as a prominent feature of school science teaching in many countries, and it is acknowledged that good quality of practical work promotes the engagement and interest and curiosity of students as well as developing a range of skills, science knowledge, and

Book Chapter:

Sözbilir, M. (2016). Practical work in science with visually impaired students. In I. Eilks, S. Markic, & B. Ralle (Eds.), *Science education research and practical work* (pp. 169-179), Aachen: Shaker Verlag.

Acces to other publications

- For full list of the publications and the materials you may visit http://efe.atauni.edu.tr
- More papers to come in the future ...

Thank You

- Thank you for the kind invitation by the ECRICE Organising Committee and your participation.
- This work is funded by the Scientific and Technological Research Council of Turkey by the Grant #114K725.
- I would like to thank the teachers and students who voluntarily participated in this study.

Project Team

This work could not be done without the help of my colleagues and my students. I thank all of them.

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World Health Organization (2011). *World report on disability*. Geneva: World Health Organization. Retrieved from http://www.who.int/disabilities/world_report/2011/report.pdf on May 14, 2016.

Q & A

- Questions?

- Contact: sozbilir@atauni.edu.tr