Raising Awareness of Language Learners with Color Vision Disabilities

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There are many learners with special needs in the classroom. Learners with disabilities are one example. A social model of disability suggests a paradigm shift from the notion of disability as impairment towards that of disability as inaccessibility. This paradigm shift begs the following question. Who are learners with special needs? Learners with special needs are defined as learners with inaccessibility to education; they include learners with gender, racial, ethnic, cultural, and language differences. The social model of disability enables teachers to play a major role in improving accessibility to the classroom for learners with special needs. This paper introduces the ARTS framework—assessing, redesigning, teaching, and supporting—in the context of language classes in order to raise awareness of learners with special needs through examining the example of learners with color vision disabilities.

今日の言語教育の現場には、多様なニーズを持つ学習者が存在する。障害を持つ学習者もその一例だ。障害の社会モデルは、「身体的欠損」から「アクセシビリティの不足」へと理論的なパラダイムの転換を提起した。つまり、障害の社会モデルの視点は、障害者を作りだす社会的要因はなにかという、障害観の転換を迫る問いを投げ掛ける。本論文では、障害の社会モデルの視点から、特別なニーズを抱える学習者をアクセシビリティの不足を抱える学習者と再定義することで、社会・文化的に様々な多様性を抱える学習者を対象に、教師がいかに包括的な学習環境を形成していくことができるのかについて検討した。本論文の目的は、色覚障害学習者の事例に焦点を当て、教育現場における実際の使用を想定した具体的な分析を行うことで、包摂的学習環境を構築するためのARTSステップ（評価、デザイン修正、教授、援助）を一つの解決方策として提案することである。

There are many learners with special needs, both visible and invisible, in the classroom. These include learners with racial, linguistic, cultural, socio-economic, ethnic, and physical differences. Learners with disabilities are one example. A social model of disability introduced in the UK theoretically separates disability from impairment.

According to Oliver, Sapey, and Thomas (2012), the social model of disability suggests a paradigm shift in the area of studies considering disabilities from the notion of disability as impairment towards the notion of disability as inaccessibility to social resources.

Education is arguably one of the most important social resources, particularly postsecondary education, which continues to become more and more necessary for career development. According to Statistics Japan (2015), 55% of high school graduates go to university but only 0.42% of students in postsecondary education have some form of impairment (Japan Student Service Organization, 2015). Considering a recent finding that 6% of the population has some type of impairment (Cabinet Office, 2014), the gap between 0.42% of postsecondary students and 6% of the population suggests that there are barriers in postsecondary education for learners with disabilities. Another finding is that only 28% of universities provide learners with impairment with support in language classes (Tonooka, 2015). Language classes, particularly English classes, tend to be mandatory for many majors, so there is a greater need in language classes for learners with special needs, including learners with disabilities.

Accordingly, in this paper my aim is to raise awareness of language learners with special needs by discussing the following questions:

1. Who are learners with special needs in language classes?
2. What are their needs?
3. How can language teachers fulfill these needs to improve the overall learning experience?

These questions are important not just for learners with disabilities, but also for those without disabilities. Focusing on learners with color vision disabilities as an example of learners with special needs, this paper provides teachers with an example of a pedagogical model applicable in class.

Theoretical Framework

In this paper, I will adopt a social model of disability, which assumes that disability is no longer caused by internal factors such as impairment or disease. Rather, disability is caused by external factors such as inaccessible buildings and pedagogies that do not accommodate learners with diverse needs. According to Oliver and Barnes (2012), the basic concept of a social model of disability was proposed by the Union of the Physically Impaired Against Segregation (UPIAS) in 1976. The primary element of the concept is a redefinition of disability that separates disability from impairment:

> Impairment: lacking part or all of a limb, or having a defective limb, organ or mechanism of the body.

> Disability: the disadvantage or restriction of activity caused by a contemporary social organisation which takes no or little account of people who have physical impairments and thus excludes them from participation in the mainstream of social activities. (Union of the Physically Impaired Against Segregation, 1997, p. 14)

A social model of disability suggests a paradigm shift from the notion of disability as personal tragedy—the barrier being the responsibility of the individual person—to the notion of disability as inaccessibility. Society is responsible for causing barriers to people with disabilities. This paradigm shift has major implications for postsecondary education by requiring accessible education for learners with diverse needs. For example, the Disability Resource Centre at the University of Cambridge (DRC) provides an example of how a social model of disability can be applied to university education in order to accommodate the diverse needs of students and colleagues with disabilities. These diverse needs include "well-designed buildings, assistive technology, alternative formats, sign language interpreters, and inclusive workplaces with respect to independent living, inclusive methods of assessment, positive and non-discriminatory attitudes, accessible environments" (Disability Resource Centre at University of Cambridge, 2014, p. 1). The DRC proposal can potentially be extended to other learners with special needs. These include learners with racial, gender, linguistic, cultural, religious, ethnic, and age differences, who also have diverse needs in education.

In this paper, I define learners with disabilities as one type of learner with special needs. According to the social model of disability, learners with special needs are learners who are experiencing inaccessibility to school activities caused by external factors. This definition of learners with special needs raises the aforementioned questions.

ARTS for Inclusive Language Classrooms

I propose a four-step procedure, called ARTS, in order to provide teachers with one way to make their classes more accessible. ARTS stands for the following:

1. **A**ssessing the disability or barrier
2. **R**edesigning teaching materials and pedagogy
3. **T**eaching students about accessibility
4. **S**upporting diversity of individual learning

The objective of ARTS is to encourage the teacher to see the classroom from the perspective of someone with a disability. This four-step procedure helps the teacher revise teaching materials and pedagogy in a way that incorporates learners with special needs.

Language Learners With Color Vision Disabilities

Within a social model of disability, color vision disabilities (CVDs) can be redefined as inaccessibility to social activities related to colors, caused by external factors, which impacts learners with CVDs.

Learners with CVDs are a particularly useful example of learners with special needs because an average language class of 20 males and 20 females will typically include at least one student with CVDs (Color Universal Design Organization, 2009, 2016). CVDs are also a borderline disability, because the barriers experienced by learners do not exclude them from the classroom outright, but can exclude them from certain activities. These features make learners with CVDs a typical example that can be applied to other learners with special needs. Assuming a hypothetical CVD student is an ESL speaker from Japan, the difficulty caused by external factors, such as English-only instruction at university for Japanese speakers, may be greater than the difficulty caused by internal factors, such as the fact that the ESL speaker cannot read or speak English. The following sections demonstrate the application of ARTS to a language classroom by focusing on the example of learners with CVDs.

Assessing Disability

Assessing disability in a class is a complex process because disability consists of multiple factors. Therefore, I propose a comparative culture dimensions framework for disability (CCDF; Figure 1), which is a modified version of Reimann's (2013) model, in order to help teachers assess the existing barriers in a class. By covering the five subcategories of CCDF, teachers can easily recognize and assess difficulties in the classroom.
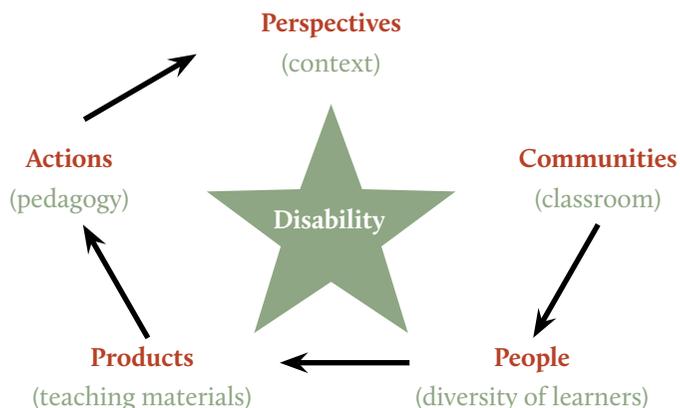
Figure 1. Comparative culture dimensions framework for disability (adapted from Reimann, 2013).

Assessing Communities

The first step of CCDF is assessing communities, which involves the teacher understanding the distribution and difficulty of learners with special needs in the classroom. In the case of CVDs, an average university language class of 20 males and 20 females will statistically have at least one student with CVDs (Color Universal Design Organization, 2009, 2016). Accordingly, unless the teacher experiences the same disability in the same way that the students do, assessing disability may be an extremely difficult task. Therefore, I propose the use of a free color vision simulator to assess disability in the classroom. The Chromatic Vision Simulator (Asada, 2015a) is one example. It allows the user to see colors in the same way as people with the three major types of CVD vision. In addition, it is a free application that provides high affordability and mobility for the user and is available for iPhones and Androids through App Stores and Google Play.

Using the Chromatic Vision Simulator allows teachers to walk in someone else's shoes. Figure 2 shows red blind vision (protanopia) and green blind vision (deuteranopia), as simulated by the Chromatic Vision Simulator. As we can see, the screen can be divided into two different simulations of color vision so that the users can compare CVD vision with normal color vision. The Chromatic Vision Simulator allows the teacher to assess barriers in the classroom from the perspective of learners with CVDs. As we can see in Figure 2, for example, blue or red letters may not stand out as clearly on the blackboard

as yellow and white letters in the eyes of learners with CVDs. Also, bigger and bolder letters are much easier to read than normal-sized letters for these learners. These are some examples of the barriers existing in the classroom that the teacher can easily find using the Chromatic Vision Simulator.
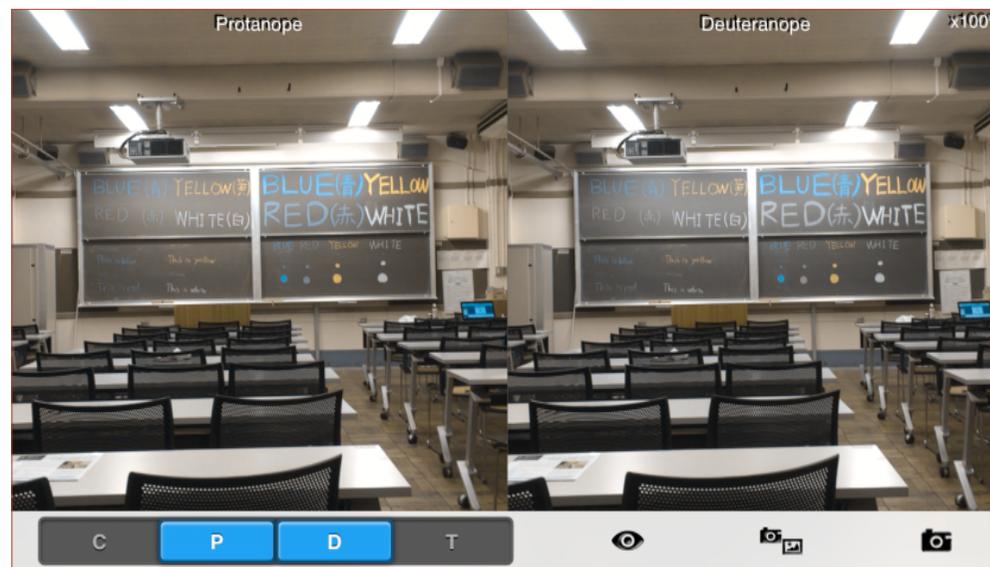
Figure 2. Simulated vision of protanopia (left) and deuteranopia (right) created by the author with the Chromatic Vision Simulator.

Assessing People

The next step of CCDF is assessing people, which involves the teacher recognizing that a diversity of needs exists in the classroom. For example, teachers may read and gather information about CVDs and understand that there are learners with three different types of CVD, such as green blind (deuteranopia), red blind (protanopia), and blue blind (tritanope) learners. Each type of CVD has unique color vision, but this does not mean that people with CVDs cannot see colors. Actually, 99% can see colors in ways that are different from people without CVDs (Color Universal Design Organization, 2009; McIntyre, 2002). The purpose of the second step of CCDF is to raise the awareness of teachers themselves regarding learner diversity in the language class.

Assessing Products

The third step of CCDF is assessing products. Using available technologies, such as the Chromatic Vision Simulator, may be useful to assess barriers involved in teaching materials. For example, red chalk on blackboard can be confusing in the eyes of learners with CVDs. On the other hand, by using the Chromatic Vision Simulator teachers can also recognize that contrast between colors is vital for people with CVDs to see colors. For example, yellow and white may be the best combination of colors used on the blackboard. There are also other teaching materials to consider, such as textbooks, charts, posters, and labels.

Assessing teaching materials is a particularly important procedure for language teachers because many university language textbooks contain colorful and color-coordinated images. Figure 3 shows how different colors in language textbooks appear in the eyes of learners with a protanopia. For example, one of the questions in the textbook (Figure 3) asks the following question, "Where is the red book?" As we can see in Figure 3, choosing a red book from the picture is extremely difficult for a learner with protanopia vision because red appears darker than it does for someone with normal color vision. Therefore, this textbook is creating a barrier for learners with CVDs.

Assessing Actions

The fourth step of CCDF is assessing actions. In the classroom, pedagogy is one of elements responsible for creating barriers between learners with special needs and other learners. Pedagogy can also be assessed by the Chromatic Vision Simulator. For example, bigger and bolder letters are clearer in the eyes of learners with CVDs because those learners may have weak perception of specific colors depending on the type of CVD.

Furthermore, writing the names of colors is also helpful for learners with various CVDs to read colors because this gives them an alternative way to understand the meaning communicated by the colors. Color has meanings, and color vision disabilities exist in the gap between perception of colors and understanding the meaning of colors. For example, red is often used for the purpose of emphasizing words and phrases that require serious attention. If a student with protanopia cannot read red writing on the blackboard, a color vision disability arises. Some language teachers use various colors in order to emphasize grammatical points. Thus, teachers should decide how much color they want to use. If only white and yellow are always used, there may be fewer problems for learners with CVDs. Therefore, it is particularly important for language teachers who tend to use a variety of colors to keep in mind that providing alternative ways for learners with CVDs to understand the meaning of materials is necessary in order to enhance accessibility in the class.
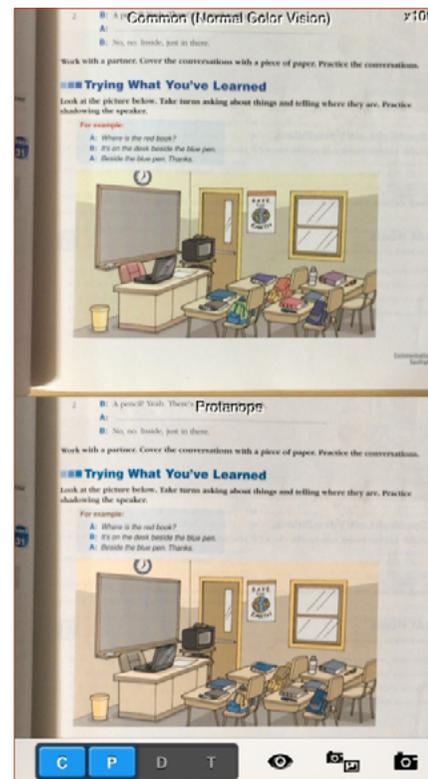

Figure 3. Simulated normal (top) and protanopia (bottom) color vision. Produced by the author through the Color Vision Simulator (adapted from Graham-Marr, Mora, Reynolds, & McNeese, 2009, p. 41).

Assessing Perspectives

The fifth step of CCDF is assessing perspectives, which involves examining the context and meaning of particular differences that teachers teach in the language classes. Perspective itself is vague, but can be broken down into four elements: perceptions, beliefs, values, and attitudes (Reimann, 2014, p. 20). Regarding perceptions, the teacher has the choice to make learners with CVDs visible or invisible. Next, concerning beliefs, teachers

tend to believe that the color the teacher sees is true and the same for everyone. Accordingly, values involve decisions about right or wrong. For example, teachers who unconsciously believe that the book on the table is red (see Figure 3) may incorrectly judge that a student who cannot answer the question does not understand the question. However, this judgment may be based on a faulty assumption. Consequently, the teacher may negatively evaluate learners with CVDs. Lastly, with regard to attitudes, language teachers might assess whether their attitude toward learners with CVDs is inclusive or exclusive. By observing all four elements, the language teacher can assess whether the class provides students with various needs with an inclusive or exclusive teaching environment.

Redesigning Language Teaching Materials and Pedagogy

Once the teacher has assessed the nature of disabilities in the language classroom, the second step of ARTS is to redesign teaching materials and pedagogy, two of which are discussed here. First, I propose the use of a free simulator, the Toyo Ink Uding Simulator (Takeda et al., 2010). The Toyo Ink Uding Simulator is a free application (available for iPhone, Android, and computers) that allows users to see confusing colors with onscreen warnings, as well as to make posters and websites accessible by clicking a button.

Figure 4 shows an example of a redesigned web page. The second picture, labelled "simulating," shows the screen after clicking the warning button. Certain colors that are used in the picture appear in black and warn the user of confusing colors. When "modify" is clicked, the application automatically changes the confusing colors into accessible colors. The user also can select three major types of CVDs to modify the picture. By using this application, the teacher can easily make posters and other teaching materials with color-coded information more color vision-friendly. Language teaching often involves color-coordinated teaching materials, so using a simulator makes preparation easier.
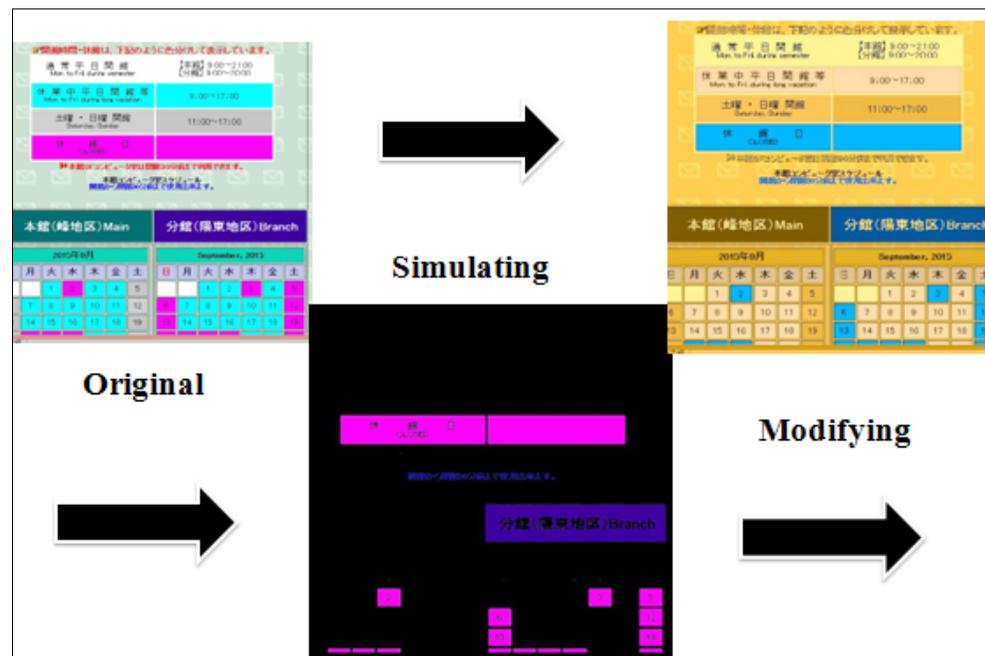

Figure 4. A redesign procedure using Toyo Ink Uding Simulator, produced by the author (adapted from Utsunomiya University, 2015).

Second, adapting a concept of color universal design may also help teachers redesign other types of teaching materials as well as pedagogy. Color universal design provides teachers with necessary theoretical understanding of learners with CVDs. The Color Universal Design Organization lists two key points that can be applied to the classroom:

1. Choose color schemes that can be easily identified by people with all types of color vision, in consideration of the actual lighting conditions and environment.

2. Use not only different colors but also a combination of different shapes, positions, line types and coloring patterns, to ensure that information is conveyed to all users including those who cannot distinguish differences in color (Color Universal Design Organization, 2016).

The first point of the universal color design concept enables teachers to redesign the color coordinated charts and graphs of their power point slides, handouts, and posters by choosing colors from color universal design. The organization *Karaa Yunibaasaru Dezain Suisho Haishoku Setto Seisaku Iinkai* (2013) created a free guidebook including a schematic arrangement of the colors in color universal design and has made it available through the website of the Color Universal Design Organization (2016). The guidebook introduces 20 universal design colors that contain nine high-chromatic colors, seven high-value and low-chromatic colors, and four achromatic colors. Each color follows the Munsell color system (*Karaa Yunibaasaru Dezain Suisho Haishoku Setto Seisaku Iinkai*, 2013; X-Rite, 2016) so that users can easily select colors they want from the guidebook.

The second point of the color universal design concept enables teachers to redesign their teaching materials as well as pedagogy by using different shapes, positions, and line types. The purpose is to help learners with CVDs understand the meanings of colors by reading shapes, positions, and line types rather than only reading colors. Theoretically, CVDs appear in the gap between perception and meaning. Because language teachers teach color terms in different languages, the gap between color perception and meaning may appear in language classes more often than it does in other classes. Following is a list of self-check key questions for language teachers to apply to their classrooms:

1. Am I using white or yellow to increase contrast?
2. Am I including meanings and names of colors?
3. Am I writing large and bold letters?
4. Am I providing alternative sources of information?

These four questions can help language teachers to make their classrooms more inclusive through redesigning the teaching materials and pedagogy.

Teaching the Students About Accessibility

The third step of ARTS is teaching the students about accessibility by incorporating perspectives that include learners with different needs. I propose the example of teaching CVDs as a global issue in the language class. Perception of color is different between people with and without CVDs. However, it is scientifically impossible to prove that the color red, for instance, appears the same in the eyes of everyone. Taylor (1995) asserted, "Languages differ very considerably, both with regard to the number of color terms they possess, and with regard to the denotational range of these terms" (p. 3). It is not possible to determine that CVDs are abnormal and regular vision is normal without making a value judgment. The example of teaching CVDs as a global issue in the language class aims at deconstructing the notion of color vision by raising a basic question: Why are learners with CVDs considered impaired or disabled?

For example, teachers could present a poster of two pictures, which are the same picture but painted by people from two different cultural groups, such as Canada and Japan, along with the picture of the global distribution of CVDs (Figure 5). This poster has the following features. First, it shows the distribution of CVDs in the world. Second, it shows the different use of colors in paintings such as the color of the sun. Third, the different use of colors for the same object reflects cultural differences. This third feature is demonstrated by using the two different paintings. In Figure 5, the image to the left of the map was painted by a native speaker of English in Canada. The image to the right was painted by a native speaker of Japanese in Japan. Thus, the question "Why?" is included in the space between the two differently colored suns. These three features suggest to students that differences in the way colors are perceived reflect a diversity of notions of color. Language teachers can develop an inclusive attitude among students towards CVDs by showing various uses of colors in the same object because differences in color perception become differences in external social factors. Furthermore, by teaching social and cultural differences in the notion of color terms, language teachers may raise the well-known Sapir-Whorf hypothesis: Do language differences influence perception (Carroll, 1993)?

Language classes are where learners develop multiple perspectives on particular objects and notions through the lens of the target language. Each language has a unique notion of colors. Therefore, language teachers can play a major role in enhancing mutual understanding of differences in color vision between learners with CVDs and those without CVDs in the classroom. In summary, teaching CVDs as a global issue allows learners to critically analyze the notion of disability.
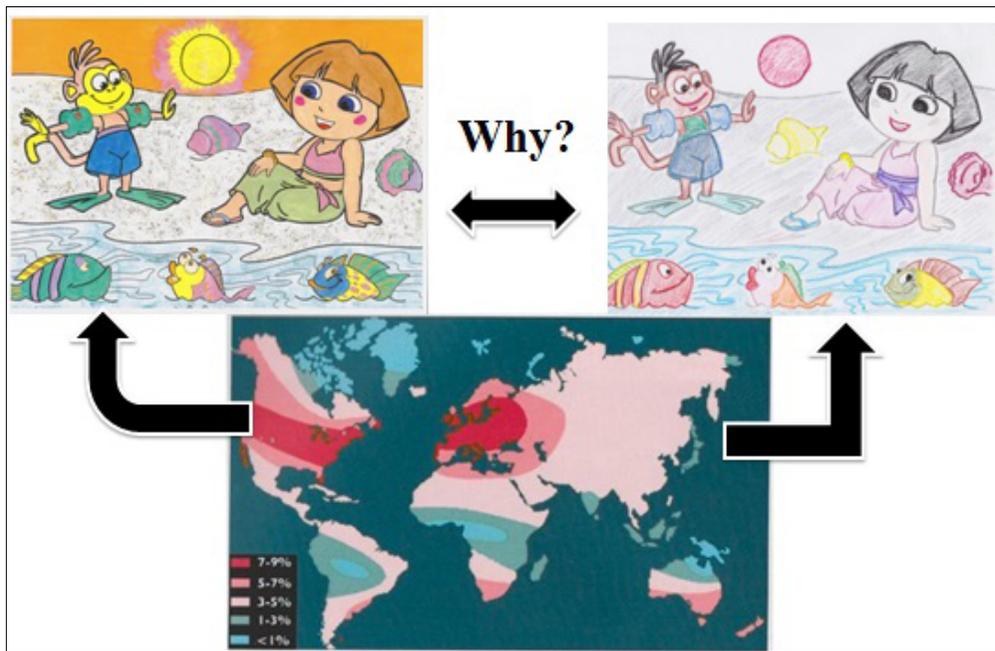
Figure 5. A model of CVDs as a global issue topic (adapted from McIntyre, 2002, p. 68).

way of using an assistive application may support learners with CVDs to develop self-reliance in learning.

Figure 6. An image created using Chromatic Glass (Asada, 2015b).

Supporting Diversity of Individual Learning

The fourth step of ARTS is supporting individual learning, which involves encouraging learners with special needs to adjust to the classroom and even to improve their functioning skills. It is important to ensure that there is enough support available for language learners with various needs. However, support can also be provided by the learners themselves. I propose the use of assistive technology for language teachers to support diversity in individual learning thus encouraging self-reliance.

For instance, a software program called Chromatic Glass (Asada, 2015b) can support this aim. Chromatic Glass is a free application that allows users to read the names of the color of an object. (It is available for iPhone and Android through the App Store and Google Play.) It provides high mobility, and users can take a picture of any object using a mobile phone. Figure 6 shows an example from usage of the Chromatic Glass application. The user takes a picture of the object and can read color names in the bar. By using this assistive technology, learners with CVDs can read confusing colors. As a result, this

Conclusion

Although the ARTS framework is just an example of a way to improve accessibility of learners with special needs to the classroom, the procedure is a useful way to make language classes more accessible. By assessing disabilities, the language teacher may have a better understanding of the fact that the school environment, pedagogy, and ordinary teaching materials may cause disability. Redesigning language teaching materials illustrates the process by which a color vision simulator may increase accessibility for learners. In addition, applying universal design perspectives may increase accessibility among learners as part of redesigned pedagogy. Furthermore, incorporating inclusive perspectives by discussing disability as a global issue in the language class may encourage an inclusive perspective in the classroom. Lastly, using assistive technology may increase accessibility among language learners by supporting individual learning.

Inclusive language classes reflect the diverse needs of individual learners. It may not always be simple, but accessible education should benefit every person in society. Even in

the case of disability, it is not only the medical profession but also teachers who can play a major role in improving accessibility in the classroom. The ARTS procedure is the first step towards a significant shift in perspectives in order to consider developing accessibility for learners with special needs in language classes. This paper focused on the example of learners with CVDs, but the example can also be applied to other sorts of learners, such as learners in wheelchairs. Wheelchairs are usually available at university health centers. Teachers can use a wheelchair themselves in order to assess their classrooms. It is not practical to expect language teachers to suddenly accept learners with any difference. However, it is the aim of this paper to raise awareness of learners with special needs in language classes. That is, the more language teachers realize that they can improve accessibility to their classes, the more learners with special needs can participate in higher education.

Bio Data

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