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AWARENESS AS CORNERSTONE TO INCLUSIVE SUPPORT FOR LEARNERS WITH COLOUR VISION DEFICIENCY

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Abstract
There is a scarcity of research in South Africa on how to support learners with colour vision deficiency (CVD). Inspired by inclusive approaches to education, the purpose of our research was to explore and describe teachers' understanding and awareness of CVD and their experiences in teaching such learners, with the aim of enhancing effective support provision to learners with CVD. We implemented an explanatory sequential mixed methods design and collected/generated data in two phases. During the quantitative phase, we relied on a combination of convenient and purposive sampling to select 92 public school teachers in South Africa to complete a structured questionnaire. During the qualitative phase, data were generated through seven semi-structured interviews involving nine conveniently selected participants. Quantitative data were analysed by means of descriptive and inferential statistics, while we relied on inductive thematic analysis to analyse the qualitative data. The findings of our research indicate that the teacher-participants who had taught learners with CVD implemented supportive changes in their classroom teaching to accommodate these learners. We therefore concluded that teacher awareness of CVD may contribute to positive changes in support of learners with CVD. We therefore recommend that teachers should be made aware of the condition, for example through pre-service and in-service training initiatives, as this may guide them to offer inclusive support to learners with CVD.

Keywords: Colour vision deficiency (CVD), inclusive education, learner support, special needs, teacher awareness

Introduction

Colour vision deficiency (CVD), often referred to as colour blindness by the general public and also known as Daltonism (Maule & Featonby, 2016), refers to the inability, or decreased ability, to distinguish between certain colours (Collins, 2015; Woldeamanuel & Geta, 2018). CVD can be congenital (inherited) or acquired (Berisso, 2018), with acquired CVD being less common than the congenital form (Fentahun, 2014; Mitiku et al., 2020). Congenital CVD is one of the most common vision disorders amongst human beings and affects approximately 8% of males and 0,5% of females (Simunovic, 2010; Berisso, 2018).

CVD compromises a person's ability to effectively perform visualisation and colour-related tasks. It follows that people with CVD experience problems with colour perception in their daily lives and when executing tasks where colour is important (Machado et al., 2009). Various types of CVD are distinguished that may vary in severity and can influence daily living in different ways, ranging from minor challenges to experiencing high levels of frustration on a daily basis (Bailey, 2013).

Whichever the type, CVD can affect people across their lifespan in various ways. In early childhood, colour is often used as an important learning instrument due to children generally learning through visual stimulation involving imagery and colours (Bailey, 2013). As children with CVD are often challenged in the learning and school environment, they can be regarded as being at an educational disadvantage (Chan et al., 2014; Cumberland et al., 2004). Within the school setting, learners with CVD may, for example, experience challenges to describe objects around them accurately, follow instructions that include colour, read coloured printed material or interpret coloured pictures (Collins, 2015; Lin et al., 2019). This may lead to them experiencing difficulty to complete tasks in workbooks that involve colour, or read text in books and on a writing board that is written in colour (Chan et al., 2014; Lin et al., 2019).

In this regard, a study by Torrents et al. (2011) highlights the fact that educational media are seldom developed in a way that considers or accommodates learners with CVD. In addition to these basic challenges, the increased use of colour due to recent technological advances (CUDO, 2006) may pose further challenges to learners with CVD. Such learners may furthermore experience negative psychological effects due to feeling, for example, embarrassed, ashamed or anxious due to the challenges they face as a result of CVD and them not being able to perform as well as their peers (Klooster, 2016; Hui, 2021).

Despite the fact that there is no cure or treatment for CVD, a variety of strategies can be relied on to assist and support people with CVD with the challenges they typically face (Wu et al., 2019; Berisso, 2018). Central to providing support to this group of people is a general awareness of CVD and the challenges associated with the condition amongst the general public, teachers and other role-players involved in the education of learners with CVD. Even though CVD has not been historically regarded as a disability, learners with CVD are often at a disadvantage due to the associated challenges they face.

According to Collins (2015), simple adjustments can be made to support and better accommodate learners with CVD in the school context. At its core, Maule and Featonby (2016) highlight the importance of teacher understanding of CVD and the possible challenges that learners with CVD may experience an awareness of common mistakes that learners with CVD may make to avoid misdiagnosing these learners with other challenges or conditions, and a constant awareness of teaching and presentation styles as well as the topics in the curriculum that may potentially confuse learners with CVD (Maule & Featonby, 2016; Berisso, 2018). In addition to assisting these CVD, adjustments in class may support learners with CVD, whilst also providing additional information to other learners (Collins, 2015).

Statement of the problem

Limited research has been conducted on the difficulties that people with CVD experience in everyday life (Collins, 2015). Such challenges are furthermore often under-reported due to a lack of awareness amongst the general population, including those experiencing this visual condition (Chan et al., 2014). Even though children with CVD may thus experience challenges in daily living activities, the learning and school environment as well as on psycho-social level, limited awareness amongst themselves and others will typically prevent them from receiving the necessary support to thrive and function optimally. Within the school context, these learners are seldom accommodated as can be expected when providing inclusive education to learners with special needs, meriting ongoing research in this field (Mpu & Adu, 2021). By broadening the current knowledge base on effective support for learners with CVD, existing theory can be strengthened while the inclusive practices of teachers in the profession can be enhanced.

Purpose of the study

The purpose of our research was to investigate teachers' awareness and understanding of CVD and the extent to which the condition is taken into account during lesson planning, teaching and classroom instruction. In addition to adding to the limited available research in this field of interest, our research can promote more effective support provision to learners with CVD.

Research questions

The following research questions were posed for the research:

- What is teachers' understanding of CVD and what this condition implies for learners?
- What are the needs of teachers for guidance on possible supportive strategies for learners with CVD?

Hypotheses

We predicted a possible relation between teachers' experiences of teaching learners with CVD (independent variable) and their support provision to such learners (dependant variable), as reflected in the following statement: *Teachers' experiences of teaching learners with CVD will have a positive effect on the support provided to learners with CVD in the classroom.*

We accordingly formulated the following hypotheses in undertaking our research:

- H_0: There is no significant relationship between teachers' experiences of teaching learners with CVD and the support they offer to such learners.
- H_1: There is a positive significant relationship between teachers' experiences of teaching learners with CVD and the support they offer to such learners.

Methods and materials

We implemented an explanatory sequential mixed methods design (Creswell & Creswell, 2022) and pragmatist epistemology (Creswell & Poth, 2017). The first quantitative phase of the study implemented a survey and entailed the completion of a structured questionnaire by selected teacher-respondents, with the purpose of obtaining baseline data on teachers' awareness and understanding of CVD, and how they have been supporting learners with CVD in the past. The questionnaire was completed in both electronic and hard-copy versions, determined by the preference of the respondent. During the second qualitative phase of the study, data was generated through semi-structured interviews with selected teacher-participants who had also participated in the first phase of the study. The second phase provided us with the opportunity to generate data that could enrich, explain and elaborate on the quantitative data collected during the first phase. In support of the qualitative interviews, we relied on field notes and a research journal to document our notes, reflections and process ideas.

The target population was teachers in the Ekurhuleni area in Gauteng, South Africa. In selecting suitable research sites, we conveniently selected public schools that were easily available and accessible, subsequently sampling 92 teacher-respondents from seven primary and secondary schools for the quantitative phase of the study. For the qualitative phase, we conveniently selected nine participants who had indicated their willingness to participate in a follow-up phase during their participation in the quantitative phase.

Quantitative data were analysed by means of descriptive and inferential statistics (Ali & Bhaskar, 2016). The Fisher's Exact Test was used to determine if there is a significant relation between teachers' experiences of teaching learners with CVD and their support provision to such learners. For the qualitative phase of our research, we completed inductive thematic analysis (Neuman, 2014), following the steps proposed by Braun and Clarke (2021).

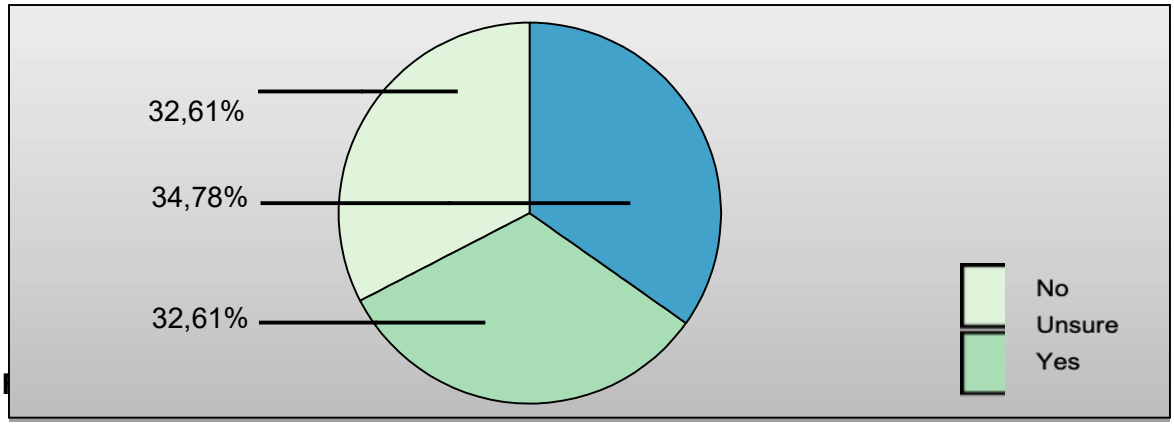
Throughout, we respected the ethical guidelines for conducting research with human beings. We obtained permission from the ethics committee of the supervising higher education institution as well as the national Department of Education and the principals and school governing bodies of the participating schools. All teacher-respondents provided written informed consent, had the right to withdraw and were protected from harm and deception. Trust, confidentiality and anonymity were respected throughout (Creswell & Poth, 2017).

Results of the study

In this section we report on both the quantitative and qualitative results we obtained related to teachers' understanding of and support provision for learners with CVD.

Quantitative results on teachers' understanding and experiences of CVD

As part of the questionnaire, the respondents relied on short responses to elaborate on their understanding of the condition of CVD. The most common response indicated by the teacher-respondents captured the belief that a person with CVD cannot see certain colours or shades of colours, with a fairly great proportion of the respondents (46,15%) providing this response. Some less common responses related to the ideas of people with CVD lacking photoreceptors in the eyes that perceive different colours, people seeing colour less saturated, people being colour blind, or people being affected by depth perception and Irlen syndrome. When respondents were asked whether or not they had taught learners with CVD in the past, the responses of *No*, *Unsure* and *Yes* were almost equally distributed, as captured in Figure 1.



The respondents who indicated that they had taught learners with CVD in the past were also asked about the number of learners with CVD they had taught. Responses ranged from one to 20, with an average of three learners with CVD having been taught by each of the respondents in the past. Closely related, the respondents were asked how they had become aware of the learners with CVD whom they had taught in the past. In response, 39,02% of the respondents indicated that they were informed by the learner, 36,8% that they had noticed it

through observation, 21,95% that they were informed by the parent and 2,44% that another teacher informed them.

Quantitative results on inclusive support and accommodation of learners with CVD

The following questions included in the questionnaire relate to the support and accommodation of learners with CVD by teachers in the school context, with the results presented in Figure 2:

- Q68: I received sufficient training to address the needs of learners with colour vision deficiency in the classroom effectively.
- Q69: In my view, learners with colour vision deficiency are at a disadvantage in the classroom.
- Q70: Learners with colour vision deficiency are supported in the school where I teach.

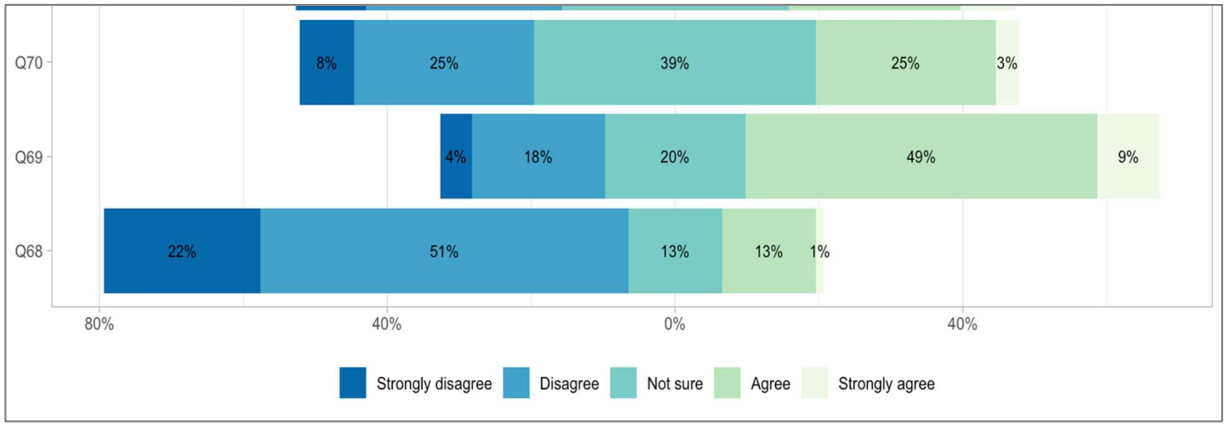


Figure 2: *Accommodation of learners with CVD*

With regard to the accommodation of learners with CVD, 73% of the respondents thus indicated that they had not received sufficient training to address the needs of learners with CVD in class effectively. More than half of the respondents (58%) were of the view that learners with CVD were at a disadvantage in the classroom. Although 28% of the respondents noted that learners with CVD were supported in the school where they taught, more of the respondents (33%) indicated that learners with CVD were not supported in their schools.

Quantitative results on hypotheses testing

We relied on inferential statistics and utilised the Fisher's Exact Test in an attempt to demonstrate a relationship between the results discussed in the previous two sections, related to (i) teachers' experiences of teaching learners with CVD and (ii) the support they offered to these learners. The Fisher's Exact Test enabled us to determine whether the observed association between the two categorical variables is likely due to a real relationship or just the result of random chance. As we predicted a possible relation between teachers' experiences of teaching learners with CVD (independent variable) and their support provision to such learners (dependant variable), we used the Fisher's Exact Test to determine the relationship between the following questions included in the questionnaire:

- Q64: Have you ever taught learners with colour vision deficiency?

- Q70: Learners with colour vision deficiency are supported in the school where I teach.

In the case of the resultant p-value being less than 5%, we would reject the null hypothesis and conclude that the two variables have a significant dependent relationship with each other. In the case of the p-value being greater than 5%, we would not reject the null hypothesis and conclude that the two variables are independent and not related to each other. Based on the Fisher's Exact Test p-value of 0.002, which is less than 0.05, we thus deducted that there is a significant association between the two variables. This implies that teachers who had experience in teaching learners with CVD were more likely to report that support for these learners was provided in their schools. Conversely, those who reported support for learners with CVD in their schools were more likely to have had experience in teaching such learners.

Qualitative results related to the challenge of not being aware of learners with CVD

A general lack of awareness seemingly existed amongst teachers related to the identification of learners with CVD or what the condition implies. One of the participants, for example, indicated that he could not remember teaching children with CVD but then noted the following: *Maybe they were there but never mentioned that they are colour-blind and then I never knew that I taught learners with colour-blindness*. Another participant elaborated as follows:

> *They must be aware of the fact that we have a number of children that normally have that problem … at the moment I don't know what is the tendency, what is percentages you know … So if you make them aware that this problem uhm appears more often than what we thought then they will be more alert*.

In this regard, the participants noted that learners with CVD might experience challenges due to teachers not being informed about the learners' condition. One of the participants stated, *If they never have the courage to go and tell the teacher or their educator that I can't see this colour or the teacher isn't accommodating of them then it can also be very difficult to see what the teacher is talking about if she is using the colour that they can't identify*.

Several participants however shared experiences regarding the challenges associated with the reporting of CVD and making teachers aware of a learner with CVD. A participant, for instance, mentioned an example of not being aware of a learner's challenges with differentiating colours until a late stage, saying, *By the time we actually figured it out, she was in Grade 11*. Another participant similarly noted that it may be hard for learners to inform their teachers if they have CVD, stating that, *I think one of the biggest challenges is … basically being bold enough to come out and say … I cannot see this colour … I think that's a very big step where they have to have a lot of courage*. Closely aligned, another participant related such difficult for learners to make teachers aware of their CVD to the possible reactions of their peers in class. The participant explained this view as follows:

> *It would be very difficult for them to just come forward and say that they have colour-blindness. So, the teachers are aware so that they can work around that and accommodate them when necessary if possible. I feel in all high schools uhm teenagers tend to be quite cool. So as soon as learners find out about that they would tease them*.

Qualitative results on the importance of being informed about learners' CVD

Several participants emphasised the importance of increased awareness of CVD amongst both teachers and learners, including peers. In this regard, a participant said the following:

> *Maybe if the school can make everybody the students more aware of colour-blindness so that students can, don't feel as shy and as intimidated to say hey, I cannot see this colour … the school to be more aware of colour-blindness to maybe have like someone to come in and to speak about colour-blindness and … how to accommodate someone who has colour-blindness just to make people more aware of it. And also, for the students to feel more safe … a safer environment for them to come out and say … I cannot see this colour or, hey, please don't use this colour because I cannot see it. So just to be more to make the students and the teachers even more aware of colour-blindness … that would be the first step for the school to take to improve*.

This need for awareness was similarly emphasised by another participant, who stated, *The extra support that would be most important is awareness … either having like someone coming in with a slideshow making the teachers more aware. Then the teachers can maybe take that information and make the students more*. This need for teacher awareness was confirmed by several other participants, e.g. in the following ways:

- *I think training or maybe just like awareness, because I think they tend to forget about, like colour-blindness, or they think it's not that not that bad, or it's not a serious problem like ADHD … Because we can see colour, we don't usually think, oh okay what if I couldn't see this is red … I think like awareness and training … will be nice*.
- *I don't think people are aware of it … If you educate people especially educators, because not everyone is aware of it. I am because I had one learner and I had barriers to learning as one of my major subjects, so I know about the different barriers. But not everyone does. So, I think educate the educators on this*.

Contributions such as these point to the participants' view that awareness of a learner's CVD is important for the learner, teacher as well as peers. Furthermore, these contributions highlight the participants' view that teachers could be more aware of and be informed about CVD through training opportunities or self-driven initiatives. It was however interesting to note that the participants' awareness seemingly followed their participation in the research process, as captured in the following reflection: *She explained that several of them had taught learners with CVD and shared their experiences with each other after the completion of the questionnaire … It seems as if the completion of the questionnaire itself generated conversation and brought awareness of CVD* (Research journal).

A number of participants reported that, once they had become aware of CVD and the associated challenges, they became more inclusive of learners with the condition in their teaching. To this end, a participant noted the following: *I think out of my experience with the girl, I I'm forcing myself to use … more basic colours than highlighters. So I'll focus on the black, the blue and then the red. More primary colours …. I must say my way of teaching has changed because of that girl*. Another participant indicated that, although she did not stop using colour, she made other changes, as captured in the following contribution: *I'm more aware of colour-blindness after this boy. I do ask the learners if they can see the specific colours. I do make a point of asking, Can you all see this?* Contributions such as these emphasise the importance of teachers and others being informed in the case of a learner experiencing CVD, in order for all role-players to provide effective inclusive support to such a learner.

Discussion

We utilised the Fisher's Exact Test to demonstrate how teachers' experiences of teaching learners with CVD (independent variable) might affect the support they offered to these learners (dependent variable). Based on the Fisher's Test p-value of 0.002, the alternative hypothesis can be accepted, resulting in the conclusion that a significant positive relationship exists between these two variables. The qualitative results confirm this conclusion, as the teachers who became aware of and had taught learners with CVD reportedly made positive changes in support of these learners. To be more specific, the teachers who shared experiences on teaching learners with CVD indicated that they changed their teaching practices in response and in support of these learners.

The findings of our research underscore the need for increased awareness of CVD and the associated challenges that learners may face amongst teachers as well as other important role-players. To this end, we propose some form of teacher training, not only as part of pre-service training programmes but also for practising teachers in the profession. Such teacher training may not merely provide teachers with knowledge on how to support learners with CVD but can also guide them on how to identify learners experiencing challenges with colour differentiation and when to refer such learners for a possible formal diagnosis. In addition, if guided, teachers may share their newly gained knowledge and skills with other role-players and all learners in the classroom, thereby contributing to more inclusive school environments.

Teacher awareness and a better understanding of CVD will thus not only provide teachers with valuable information but also serve as a source of support to learners with CVD in the school context, with the identification of such a learner already accounting for a form of support. To elaborate, teachers who are aware of learners with CVD in their classrooms will be able to make adjustments in support of these learners in terms of their own teaching practices and the use of colour in tasks and supportive resources. A teacher guidance intervention or informative workshops can serve as possible platforms to convey such information and provide teachers with continued training opportunities. To this end, follow-up research on possible teacher training opportunities and the potential value of such initiatives is recommended.

Conclusions

The findings of our study indicate that an increased awareness of CVD and of learners with the condition amongst teachers may result in supportive change within the school setting. The teachers in our study explained how they, once becoming aware of learners with CVD in their classrooms, were able to make changes in their teaching practices in support of these learners by, for example, reducing the use of colour and using only colours that learners with CVD can distinguish. Considering this, it can be concluded that teachers who are aware of learners with CVD in their classrooms will be able to provide them with inclusive support, enabling the learners to perform to the best of their potential.

Based on the findings and conclusions of our study, we recommend that all teachers should be made aware of CVD. One possible way towards doing this entails the development of a teacher guidance intervention that can be implemented with teachers in the profession and also form part of teacher training programmes of pre-service teachers. Other training opportunities for in-service teachers such as professional development programmes required by the South African Council for Educators (SACE) may also include this type of information and assist teachers who are currently in the profession to support learners with CVD in their classes as part of the drive for inclusive education. In-service training can, for example, be offered

during workshops as part of teacher discussions where teachers share their personal experiences with peers, or it can be distributed in the form of written material.

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