

## Hearing stakeholder voices in the design of a non-electronic sepedi graphic symbol-based AAC resource

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### ABSTRACT

The design of non-English Augmentative and Alternative Communication (AAC) resources is an urgent necessity. Human centered design (HCD) may be a useful framework for involving stakeholders in establishing design requirements for a non-electronic Sepedi graphic symbol-based AAC resource. This framework foregrounds the voice of stakeholders in the design process to counter the hegemony of Western Anglo-centric methodologies and approaches. This study aimed to obtain initial input on the need for and design requirements of a non-electronic Sepedi GS-based AAC resource from the stakeholders. A qualitative descriptive design was used. The perspectives of 21 stakeholders including special school teachers, speech-language therapists, parents of participants in need of AAC, Sepedi linguists and adults using AAC were obtained via focus groups and interviews. Recordings were transcribed and analyzed using qualitative content analysis. Participants highlighted a need for a culturally and linguistically appropriate AAC resource. They furthermore indicated that the resource should promote communication access, social inclusion and the development of various communication and language skills. The school and the home environment were identified as primary contexts of use. Specific suggestions regarding the vocabulary, the graphic symbols, the lay-out and organization of the vocabulary as well as the physical properties of the resource were obtained. The participants highlighted a need for a team to design and develop the resource. The study showed that diverse stakeholders could contribute meaningfully to the design process of an AAC resource for young individuals from a Sepedi language background.

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Disparities in health and rehabilitation services within and across countries have been raised as a global concern (United Nations, 2024). Indigenous populations specifically have been excluded from such services, or offered services that are ill-aligned to their languages, beliefs, values and culture (Keikelame & Schwartz, 2019; Pillay & Kathard, 2018). The field of augmentative and alternative communication (AAC) is no exception. While the field aims to promote communication access for those who have communication barriers as well as promote their inclusion and participation in society, concerns have been raised that the needs of indigenous and otherwise culturally and linguistically marginalized people have been little heeded in the field as a whole (Amery et al., 2022; Collin Stone, 2019; McCord & Soto, 2004; Tönsing & Soto, 2020). A lack of AAC resources appropriate to non-Western contexts, for example, is a persistent challenge (Amery et al., 2022; Mindel & John, 2022). This is also true in the South African context, where a lack of indigenous and culturally competent AAC service providers and a lack of culturally and linguistically appropriate AAC resources for the African population have been noted (Tönsing, Van Niekerk, et al., 2018). For example, to date there are no rigorously designed AAC resources giving access to the Sepedi language, one of the official South African languages spoken as

a home language by about 10% of the population, amounting to about 6.2 million people in 2022 (Statistics South Africa, 2023).

Graphic symbol-based (GS-based) resources are often provided to individuals who require AAC but are not (yet) literate. A variety of electronic and non-electronic aided AAC resources exist. A non-electronic GS-based AAC resource typically consists of preselected words and/or phrases (the vocabulary) represented by graphic symbols (typically accompanied by the written words) that are organized across one or more paper-based pages on a communication board, folder or book (Judge et al., 2020). In contexts such as South Africa, where the digital divide is a reality and where populations groups disadvantaged by Apartheid and colonialism still have significantly poorer access to mobile technology and the internet (Bornman; 2016; Chisango & Marongwe, 2021), non-electronic resources are often more accessible, affordable and sustainable to use. Young individuals using these types of resources select the graphic symbols displayed to communicate their thoughts, ideas, and needs. When the aim of the AAC resource is to support language development through various stages, the resource needs to give access to a large and growing vocabulary as well as morphology and grammatical features (Von Tetzchner & Grove, 2003). These

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features also allow communication partners to model the use of the resource, an intervention strategy with a strong empirical base (Allen et al., 2017; Biggs et al., 2018; Sennott et al., 2016).

Because communication and language are cultural and identity-promoting processes, AAC resources that are incongruent with the language and culture of the individuals who are intended to use them are likely to be abandoned (Moorcroft et al., 2019). Indeed, imposing culturally and linguistically foreign methods of communicating on indigenous and marginalized people during communication intervention has been linked to a form of oppression - this may be interpreted as attempting to alter the user's identity to coerce indigenous people into accepting Western-based ideas, methods, values, and processes that do not resonate with their own culture (Pillay & Kathard, 2018). Practitioners and researchers in the field of AAC should be exceptionally mindful of such uncritical and unreflective approaches when working with indigenous populations with severe communication disabilities - these populations face disempowerment not only by way of their indigenous status, but also by way of disability (Pillay & Kathard, 2018). While the term "indigenous" is complex and can be controversial (Weaver, 2001), we apply it broadly to people groups who regard themselves as the native people of a particular area, race, ethnicity, or tribe. Many indigenous people have faced colonization by settlers who displaced or oppressed them, relegating their customs, beliefs, knowledge systems and community structures to the margins of society (Keikelame & Schwartz, 2019).

Decolonial and emancipatory methodologies (e.g., participatory codesign, participatory action research) have the potential to recognize, respect, and foreground indigenous voices in healthcare research and practice, challenging the hegemony of knowledge produced in the global North and the promotion of universal ideas about health, communication, and human nature (Barnes, 2018). Keikelame and Swartz (2019) advocate for participatory approaches to research whereby indigenous people should be researchers and not only the researched - particularly in the Global South which suffers the long-term impacts of colonialization. The authors further argue that for research to be emancipatory and impactful to quality of life, it needs to consider indigenous people's culture, world views as well as the language spoken by the population. In participatory research, the researched should collaborate throughout all research stages, including the identification of the research problem, planning (e.g., the proposal, choice of design and methodology) as well as execution (data collection, analysis and interpretation) of the project. In the process, researchers need to be mindful of power differentials and actively work toward equal power sharing - acknowledging that the researcher and researched make different but equally valuable contributions to the process and ensuring that the project is of benefit to the researched. Specifically, in applied research, where a change in practice or a form of intervention is envisaged, different types of knowledge are needed to ensure that this intervention is not only effective, but appropriate to the population and context within it should be applied.

One participatory approach to AAC resource design and development that counters colonial practices is human centered design (HCD). HCD entails the collaboration of researchers, designers and end users, to learn from them and to ensure that the designed product matches their needs, behaviors and preferences (Steen, 2011). In line with decolonial approaches, HCD foregrounds power sharing between designers and end users as well as other stakeholders in the design process (Steen, 2011). It promotes the active involvement of stakeholders throughout various phases of the design project. Stakeholders should not only test the designed product, but be involved in the needs analysis, in the conceptualization of the design requirements, in iterative cycles of prototyping and testing, as well as the final evaluation of the product. Designers need to remain sensitive to power differentials and actively work to overcome them, for example, by sharing knowledge with stakeholders to increase their power (Steen, 2015).

Although HCD has reportedly been used in AAC resource design, its application has been inconsistently described (Tönsing, Bartram, et al., 2024). To our knowledge, HCD has not yet been purposefully applied as a decolonizing methodology to ensure that the voices of stakeholders belonging to indigenous and marginalized groups are heard. Recognizing its potential to address power imbalances and actively engage stakeholders as collaborators, we selected HCD -specifically participatory design - as the method for designing a non-electronic Sepedi GS-based AAC resource for young individuals (aged 4-12 years) who belong to the expressive language group, defined by Von Tetzchner (2015) as children who experience a large gap between their comprehension and production of speech.

The design project proceeded in three phases; Phase 1 focused on a needs analysis and determination of design requirements; Phase 2 involved iterative cycles of design and feedback; and Phase 3 consisted of a summative evaluation. This paper describes the first phase of the project. The aim of this phase was to determine the need for and design requirements of a non-electronic Sepedi GS-based AAC resource.

## Method

### Participants

Prior to recruitment, the study was approved by the first and second author's institutional ethics committee (HUM004/0322). Permission to recruit participants was additionally received from the Limpopo Department of Education. Using a combination of convenience and referral sampling, the first author recruited a total of 21 participants. Six speech-language therapists (SLTs) were recruited/they had at least one year of experience in providing AAC services, and had provided AAC services to a child in need of AAC from a Sepedi language background. Five special school teachers were recruited who used Sepedi as a Language of Learning and Teaching (LoLT) in their classrooms and who taught individuals with special needs between the ages of 6-12. Six parents of young individuals requiring AAC from a Sepedi background were also

recruited. Two Sepedi linguists were recruited who had three or more years' working experience as a linguist. Two young adults with congenital cerebral palsy who had experience in using GS-based communication (but currently use text-based AAC) were recruited. All participants were over 18 years of age, had a good knowledge of spoken Sepedi, and had access to the internet through a personal device such as a mobile phone or laptop in order to receive communication and materials related to the study. AAC experience and data collection particulars per participant group are outlined in Table 1.

### Setting

The study was conducted in multiple settings. The first setting was online. The SLTs' focus group was conducted online, as they were geographically spread out and could not attend a face-to-face group. The second setting was a quiet conference venue at a hotel located centrally in the urban town of Polokwane, Limpopo, South Africa, where the 'parents and teachers' focus groups were held face-to-face. This central venue was within travelling distance of the parents and teachers. Limpopo is the fifth largest province in South Africa and the northernmost province of the country. Sepedi is one of the common languages spoken in Limpopo with an estimated 56% of the province's population (amounting to 6.5 million people) indicating that Sepedi is the language most frequently spoken in the home (Statistics South Africa, 2023).

The third setting was at a university in the Gauteng province where the paired-depth interview with the two linguists was held face-to-face on a Saturday morning. Gauteng is the smallest but most urban and most populous province, situated in the north of the country but south of the Limpopo province. About 13% of the 15 million inhabitants use Sepedi most frequently in the household (Statistics South Africa, 2023). The fourth and fifth settings were the locations where the interviews with adults using AAC were held face-to-face. These settings were convenient to each participant - a restaurant close to the first participant's residence and at an adult skills development center where the second participant spent most of her time respectively. The restaurant was situated in the North West province (west of Gauteng and southwest of Limpopo) where 2% of the 3.8 million inhabitants use Sepedi most frequently in the household. The adult skill center, run by a nonprofit organization, was situated in a township in Gauteng and offered skills training to about 20 adults with a variety of disabilities.

### Materials

In order to facilitate the stakeholder engagement, the first author, in consultation with the second and third author, developed a range of materials. Firstly, she developed a PowerPoint presentation aimed at sharing knowledge with the participants about AAC and specifically GS-based resources. The presentation included (a) a description of GS-based resources and how they have been used in the field of AAC (purpose of use and target user group); (b) challenges in the design of such resources; (c) examples of the way such resources have been designed for other languages, including choices made regarding vocabulary, graphic symbols, lay-out and organization, and physical properties; and (d) resources that are already in place for Sepedi.

The outline of topics, the content covered and the literature consulted are described in Table 2.

We drew particularly on the work by Boenisch and Sachse (2020) who describe the design and development of the Cologne Communication Boards and Binders. Participants were also alerted to the existence of a Sepedi core vocabulary (Mothapo et al., 2021) as well as a validation of the list by stakeholders and their further vocabulary suggestions (Tönsing, Mothapo, et al., 2024). The presentation was customized slightly for each of the participant groups. Presentations were reviewed by an SLT and a teacher (Sepedi speaking) with AAC experience.

Secondly, a persona was developed in the format of a case study in order to provide participants with a realistic picture of a potential end-user of the Sepedi resource. In developing the persona, care was taken to describe various relevant domains as per the Comprehensive Assistive Technology (CAT) model (Hersh & Johnson, 2008). This model, based on a combination of the Human Activity Assistive Technology (HAAT) model and the International Classification of Functioning, Disability and Health (World Health Organization, 2011), describes multiple components to be considered when designing and implementing assistive technology, including the person (e.g., body functions and structures, psychosocial and personal characteristics), the activity, as well as various environmental factors such as the physical and social context. Care was taken to ensure that the profile of the persona represented a child with specific capabilities and weaknesses who would benefit from using an AAC resource in Sepedi.

Thirdly, the first author created focus groups scripts as well as interview scripts to guide the discussions. The focus group scripts were used for the SLTs, the special school

**Table 1.** AAC experience and data collection particulars per participant group.

Participant group	Number of participants	AAC experience or training	Type of engagement	Time used for in-person presentation	Time of focus group/ interview
SLTs	Six	Varying between 1-5 years	Online focus group	—(viewed online in their own time)	2.5 hours
Teachers	Five	AAC training varying between two weeks- 2 years	In-person focus group	1 hour	1.5 hours
Parents	Six	Their children used some form of AAC	In-person focus group	1 hour	1 hour
Linguists (with focus areas general linguistics and syntax respectively)	Two	None	In-person paired depth interview	1 hour	3 hours
Adults using AAC	Two	Had used multiple AAC tools, including GS-based tools	In-person individual interviews	1 hour	2 and 2.5 hours respectively

**Table 2.** Outline of topics, the content covered and the literature consulted.

Topic	Content covered	Literature consulted
Introductions	<ul style="list-style-type: none"> <li>• Introduction of the researcher and participants</li> </ul>	
Introduction to terms used	<ul style="list-style-type: none"> <li>• Definition of communication, AAC and graphic symbols</li> </ul>	Beukelman and Light (2020)
Summary of literature on what graphic symbol-based AAC resources are	<ul style="list-style-type: none"> <li>• What are graphic symbols</li> <li>• How have they been used</li> <li>• Example of the use of graphic symbols</li> <li>• Purpose of such resources</li> <li>• Who can use them</li> </ul>	Beukelman and Light, (2020); Judge et al. (2020); Lynch et al. (2018); Smith (2006)
Challenges in designing and implementing such resources and how other AAC resources such as these have been developed before	<ul style="list-style-type: none"> <li>• Challenges with graphic symbols</li> <li>• Design requirements and constraints and how they have been addressed in AAC resources for other languages: <ul style="list-style-type: none"> <li>• Core and fringe vocabulary</li> <li>• Application exercise: Making sentences with core and fringe vocabulary</li> <li>• Vocabulary arrangement</li> <li>• Consistent location</li> <li>• Example of the lay-out and physical features of the Cologne Communication Binder (German, English, Spanish, Arabic)</li> </ul> </li> </ul>	Boenisch (2014); Boenisch and Sachse (2020); Moorcroft et al. (2019); Moorcroft et al. (2021); Mothapo et al. (2021); Mngomezulu et al. (2019); Reiss and Wacker (2000); Zangari and Van Tatenhove (2009) <a href="https://www.hf.uni-koeln.de/36586">https://www.hf.uni-koeln.de/36586</a>
Background to the current study	<ul style="list-style-type: none"> <li>• Rationale for this study</li> <li>• What has been done so far in Sepedi</li> <li>• Aim of this study</li> <li>• Phases of my study</li> <li>• Case study/Persona (Lerato)</li> </ul>	Hersh and Johnson (2008); Mothapo et al. (2021); Tönsing et al. (2024)

teachers and the parents of young individuals with special needs. The interview scripts were used for the participants using AAC and the linguists. All scripts are provided as [supplemental materials](#).

An online meeting platform (Blackboard Collaborate™) was used as a video conferencing platform for those participants who could not meet in person (i.e., the SLTs). HappyScribe™ software (English transcription software) was used to develop transcriptions, and the Atlas.ti software version 22.0 (for Windows) was used for data analysis. A codebook was developed and refined during the data analysis process and was used to code the transcripts (see the final codebook included in the [supplemental material, Table S1](#)).

### Research design

In line with HCD and a decolonial approach, we used a community-engaged, participatory approach (Padgett, 2017). During Phase 1, we used a qualitative descriptive methodology (Sandelowski, 2000) in order to gain and describe the perspectives of the participants regarding the need for and design requirements of a non-electronic Sepedi GS-based AAC resource. Data was collected via face-to-face and online (synchronous) focus groups, a face-to-face paired depth interview, as well as face-to-face interviews. Focus groups enabled in-depth discussions between participants and allowed the researcher to explore and verify the ideas of participants in a timely manner (Nyumba et al., 2018). Face-to-face paired depth interviews were conducted with the two linguists in order to understand their views – since only two linguists were recruited, a focus group was not possible. Participants using AAC were interviewed individually as participants present with difficulty to communicate and it was a logical decision to scaffold each participant's communication individually.

### Researchers

The positionality of each author is provided in order to be transparent about how our backgrounds may have impacted

how we approached the study. As the first author, I am a black female researcher in South Africa. An awareness of the colonial history and experience of its remnants form part of my lived experience. I am Sepedi speaking and relate with the Sepedi culture. My clinical practice led me to the realization of the incongruent practice of attempting to fit a Western-centric approach to an indigenous population without considering the culture and language.

As the second author, I am a white female academic working in the field of AAC at an academic institution in South Africa. I grew up in South Africa during Apartheid as a privileged member of the white race. A growing realization of the Anglo- and Western-centric nature of the field of SLT and AAC (including research, practice as well as professional education), steeped in colonial values and approaches, has led me to pursue partnerships and funding avenues to work on projects that allow a platform for alternative narratives.

As the third author, I am a Hispanic scholar and educator in the field of AAC. My lived experiences as a non-native English speaker and an immigrant, navigating educational and professional spaces shaped by dominant linguistic and cultural norms have heightened my awareness of systemic inequities that impact multilingual learners who use AAC. I strive to center the expertise of families and individuals who use AAC, recognizing them as co-constructors of knowledge and change agents in the field.

### Procedures

#### Data collection

Data collection methods and time taken per group are provided in [Table 1](#). Three focus groups were conducted with (a) SLTs, (b) parents, and (c) special school teachers respectively. Prior to the online synchronous focus group with the SLTs, they were expected to view a presentation that was pre-recorded by the first author on PowerPoint and shared with them via a google drive link. The first author facilitated the online focus group, and the second author also attended, asking occasional questions. Teachers and parents met in

person for the focus groups. The first author facilitated the focus groups commencing with the presentation, followed by the discussion guided by the script. The paired depth interview with the two linguists was conducted by the first author at the university where the linguists worked. The first author commenced again with the power point presentation, followed by the interview. The adults using AAC were sent the PowerPoint electronically to view prior to the face-to-face meetings. The interviews were conducted by the first author. The second author was also present during the interview with the first adult, giving occasional input. The two participants could not be interviewed together as they were geographically far apart and traveling was logistically and practically complicated.

Time was spent in acquainting everyone in the meeting with each other and building rapport. This included brief introductions and sharing some relevant background information with the group. Especially when engaging with participants who were not SLTs, the first author took specific care to counteract the professional hierarchy that is at times encountered in the field where SLTs are seen as the AAC experts and sole decision-makers (Mophosho, 2016). She confirmed the participants as experts in their own right and emphasized the dependence of the success of the project on their input and engagement. All interviews and focus groups were conducted using both English and Sepedi. Code switching is a common feature of multilingual South African interactions (Mabule, 2015). A scheduled break was given between the researcher's presentation and the focus group discussions/interviews. The researcher furthermore offered additional comfort breaks to participants on a regular basis (e.g., every 1-1.5 hours).

### Data analysis

The audio-recordings of focus groups and interviews underwent a five-step transcription process. Two research assistants were involved in the transcription. As a first step, the artificial intelligence of the transcription software (i.e., HappyScribe) produced written transcripts of the focus groups and interviews, and the first author de-identified participants by giving them codes (e.g. S1, S2, P1, P2 and AD1). Step 2 entailed that Research Assistant 1 listened to the recordings and added the Sepedi utterances with English translations into the transcripts generated by Happy Scribe. In Step 3, translations of the Sepedi utterances were checked for accuracy by Research Assistant 2. Step 4 entailed that transcriptions and translations were checked and corrected for accuracy by Research Assistant 1 through listening to the recording and correcting the transcriptions. Finally, in Step 5, the first author then checked the accuracy of both transcription and translation on all the transcripts.

This was followed by qualitative content analysis to identify codes and frequencies within the transcripts. The three phase approach outlined by Foreman and Damschroder (2007) was followed. This process included; a) immersion (which entailed the first author engaging with the data to obtain a sense of the whole picture by keeping a memo entry for first impressions of data, listening to the recordings

as well as reading the transcriptions several times and recording thoughts that arose when listening to recordings and reading the transcripts as memo entries), b) reduction (the development of a systematic approach to analyzing the data further explained in the following paragraph), and c) interpretation (the data was interpreted and synthesized to formulate results in terms of identifying patterns and making conclusions).

A combination of inductive and deductive coding was used. Deductive coding was warranted by our identification of a-priori categories and subcategories, in alignment with prior HCD research (Steen, 2011) and the research aims of this phase. Inductive coding was, however, used to identify specific codes. This allowed for the nuances to be captured as led by the data. Such a combination of in- and deductive coding can lead to a comprehensive and nuanced analysis of the data (Azungah, 2018). In alignment with HCD research, five a-priori categories were identified, namely the *need and justification* for an extensive non-electronic Sepedi GS-based AAC resource, *the purpose of use, context of use, the design requirements*, as well as the *design process*. For the category *design requirements*, five subcategories were established a-priori, namely *vocabulary content, vocabulary size and growth, graphic symbols, lay-out and organization, and physical properties*. No codes were identified, as these would be developed inductively based on the data obtained. The researcher read through one transcript, and identified text segments related to the categories, coding these with inductively identified codes. This resulted in a preliminary codebook. The second author checked the coding of the transcript and the preliminary codebook and changes were discussed between the first and second author. Thereafter, the first author used the amended codebook (Foreman & Damschroder, 2007) to code the rest of the transcripts, adding codes inductively as needed. Most added codes could be aligned to five a-priori categories. However, one additional category was added inductively, emanating from the data, namely the category *design team*. The second author checked all the coding, and changes were again discussed in a number of rounds, which entailed recoding and reducing codes by merging and renaming. The final step entailed a rechecking of the analysis of all transcripts by the first and second author. The final codebook is provided in the [supplemental material \(Table S1\)](#).

### Trustworthiness

The credibility of the study was enhanced through member checking – firstly during data collection, where the first author summarized the main points raised by the participants at the end of each focus group or interview from the notes she had kept. Participants were asked to verify the accuracy and the completeness of the summary. Secondly, 11 of the participants verified the analysis during Phase 2. The categories and main codes per category were presented to these participants in a PowerPoint during a face-to-face meeting, and they confirmed that their views had been adequately captured. The coding process based on numerous rounds of consensus building among first and second author also increased credibility. An audit trail of the analysis

process and all decisions made was kept to ensure confirmability. The use of scripts to guide interviews and focus groups ensured that procedures were kept similar across participant groups to enhance dependability.

## Results

A total of 317 text segments across the six transcripts were assigned one or more codes from the codebook, aligned to the five a-priori categories. All participant groups contributed to all five categories, although the content of their contributions differed at times. An overview of the categories, subcategories, and examples of the most frequently used codes is provided in Table 3. Each category is discussed here following. Direct quotes are inserted in italics when participants used speech. Italicized text in quotation marks indicates sentences produced by synthesized speech. Translations into English provided in parentheses where appropriate. The abbreviations T, P, S, L and A are used to describe participants who were teachers, parents, SLTs, linguists and adults using AAC respectively.

### ***Need and justification for an extensive non-electronic Sepedi GS-based AAC resource***

Participants from all five groups highlighted the need for such a resource. Participants elaborated on the reasons for the need. The most frequently mentioned reason (mentioned by participants from all five groups) was that the resource would be culturally and linguistically appropriate. For example, participants pointed out that pictures should be

culturally appropriate, and that language (and hence the communication resource) is a vehicle for culture. It was mentioned by participants that English resources are not appropriate for young individuals who have little or no understanding of English and who live and learn in Sepedi communities. Participants made comments such as:

...I really like it because it looks at the home language, Sepedi. This is because the primary educator uses Sepedi, so when he (child) arrives at school and he does not have the structure, this may lead to confusion. This child now has to learn in another language (English) when they do not fully understand their own language. Whereas the outcome would be better if he continued in a language they are learning already. (T3)

### ***Purpose of use***

The most frequently mentioned purpose of use was the purpose of communication access. Participants from all five groups mentioned that individuals using AAC should be able to communicate anything they want to communicate in the child's home language and not be restricted by a limited AAC resource. Partners specifically highlighted that individuals using AAC should be able to report any negative experiences, abuse, or victimization. Parent 5 commented:

Haai yona e bohlokwa, ka gore ngwana O tla gona go hlalosa mo go sa tshwaregang gabotse. Of which e tla fokotša gore re ba naganele. (It is important as the child will be able to express grievances which will reduce us thinking on the children's behalf.) (P5)

Social inclusion was highlighted by parents, SLTs and linguists - the envisioned AAC resource should enable young individuals who require AAC to socialize with friends and family in various

**Table 3.** Categories, subcategories, and examples of frequently used codes.

Category	Subcategory	Examples of frequently occurring codes	Frequency	No. of participants	
Need and justification	Agree Reasons	Yes, there is a need	27	18	
		Cultural and linguistic appropriateness	19	11	
		Contextual appropriateness	2	2	
Purpose of the system		Communication access	18	13	
		Social inclusion	8	7	
		Stimulation of various communication and language skills	5	5	
		School environment	11	9	
Context of use		Home environment	10	8	
		Community environment	6	2	
		Specific content	27	13	
Design requirements	Vocabulary content	Factors to consider	19	7	
		Core and fringe use	18	13	
		Match to child's abilities	15	9	
	Vocabulary size and growth	Specific number (around 200 items)	6	5	
		Start with less (about 20 items)	6	5	
		Start with more (about 1 000 items)	5	4	
		Cultural appropriateness	20	11	
	Graphic symbols		Use of color	11	8
			Iconicity	8	4
			Images from downloadable libraries	7	6
			Single page with changeable overlays, foldable	17	10
	Layout and organization		File format	12	10
			Left-to-Right organization of words	11	10
Size: A3, bigger than A4			13	11	
Envisioned aesthetics			11	8	
Cost to consider			10	7	
Physical properties		Durability	9	9	
		Design team	12	9	
		Vocabulary selection team	7	6	
Design team	Who				

contexts in their home language. SLTs, teachers and linguists additionally mentioned that the resource should support the acquisition of communication, language and cognitive skills, such as pragmatic skills and reasoning.

### Context of use

Participants from all five groups indicated that the envisioned resource should be used in the home and school context. Participants made comments such as:

Like gona le bana ba (there are children) who actually go to school. So it needs to be used for academic reasons. (S5)

Parents and linguists also mentioned the community as a context of use. Participants made comments such as:

... Gore a be introduced to external environment gore., ge a kgone go krea opportunity ya go ya ka ntle (so that the child is introduced to the outside environment and gets an opportunity to interact with the outside world).(L1)

The participant (L1) described the participation of children in community events such as unveiling of tombstones, church gatherings and prayer vigils.

### Design requirements

Participants' comments were categorized according to the five a-priori subcategories. These include *vocabulary content*, *vocabulary size and growth*, *graphic symbols*, *lay-out and organization*, and *physical properties* of the envisaged resource.

#### Vocabulary content

SLTs, parents, linguists, and adults using AAC suggested that specific categories and specific vocabulary items be added to the resource. These included social etiquette words, specific foods, kinship words and honorifics, common medical terms and clothing items. Participants from these groups also elaborated on the factors to consider in vocabulary selection, such as child preferences, context and the activities that the child is exposed to. Furthermore, language and culture should also be considered – kinship terms and honorifics, for example, are important in the Sepedi culture in order to address others with the required respect. SLT 2 commented, for example, that family members should be addressed with titles and not just their name, for example, *Sister Lerato*. One linguist specifically indicated that adding words about cultural artifacts and traditions was a way of keeping culture alive, and of resisting what he termed colonization, which happens subtly when people assimilate other traditions and customs at the expense of their own. He said:

By the way in which we consume certain cultures and we are moving away from how, traditionally things were done... And language is one of the important things that we can use to decolonise, and re-centre our cultures. (L1)

Participants from all groups emphasized the use of core and fringe vocabulary in AAC resources which enables young

individuals to produce multiple, grammatically complete utterances that are specific to the context and activity.

#### Vocabulary size and growth

SLTs, parents, linguists and adults using AAC pointed out that the number of vocabulary items included on the AAC resource should match the child's abilities. Participants from the same four groups also had various suggestions about the specific number of vocabulary items to be made available, ranging from 20-1,000 items.

SLT 5 expressed her reasoning about vocabulary size as follows:

So I feel like the top down approach is good. So let the system be as intricate, as complex as possible, and then as therapists, we will then decipher if that approach would work... If we see that the patient is not going to cope, then rather do a bottom up approach... So it should be client specific. (S5)

#### Graphic symbols

Participants from all five groups highlighted that the graphic symbols used should be culturally appropriate. Participants highlighted that Sepedi-speaking individuals take pride in their culture and ethnicity, and therefore materials should align with graphic symbols that reflect these aspects, such as people's physical characteristics (like dark skin tone and coarse hair). Parent 2 commented

We should remember the skin tone... so that it is relatable for a black person. (P2)

Participants from all five groups further indicated that the graphic symbols should incorporate the use of color. Participants outlined that colors would make the resource more captivating and attractive to young individuals requiring AAC as the end-users.

Participants discussed that graphic symbols needed to be easily guessable and have high iconicity for ease of use for end-users. SLTs and linguists discussed that graphic symbols should be as iconic as possible, to be easily recognizable. Participants made comments such as:

For me, I think we should make them as real as possible. (S2)

SLTs, parents and linguists furthermore indicated that graphic symbols from downloadable libraries should be used. Unsurprisingly, this was a point mentioned most frequently by SLTs. A symbol library that could be downloaded through a onetime purchase was regarded as ideal, as this would avoid the need to go online every time a picture is needed.

#### Layout and organization

The participants discussed the envisioned layout and organization of the resource. Participants from all five groups mentioned that the resource could be a single page with changeable overlays for the fringe vocabulary. Participants agreed that a single page with a pocket to accommodate situation-specific fringe vocabulary would be an ideal solution. One of the adults, using AAC, commented, for example,

"I choose the board" (AD2). SLTs, teachers, parents, and linguists discussed that the vocabulary should be organized by parts of speech categories and that these should be arranged from left to right (reading direction) in the order in which words typically appear in Sepedi sentences. They emphasized that the pronouns and concords should be on the left side of the communication board, followed by the verbs and nouns and adding the fringe vocabulary on the right side of the board. This organization would enable the formulation of Sepedi sentences.

### Physical properties

SLTs, teachers, linguists, and adults using AAC highlighted that the resource size should be about A3 size. SLTs and teachers felt strongly about the size of the resource being bigger than an A4 size. The participants reasoned that a bigger AAC resource would have enough space and would not impede on the clarity of graphic symbols for participants who may have visual impairments. SLTs, linguists, and adults using AAC highlighted that the resource's colors should be aligned to the user's preferences and be aesthetically pleasing.

I think maybe, depending if it's a girl or a boy we could also just include the favorite color. (S2)

SLTs, teachers, and parents mentioned that the resource should be affordable for families of young individuals from a Sepedi language background. They highlight that the cost should be low as some young individuals come from low socioeconomic backgrounds. Participants from all five groups highlighted that the resource should be durable. The lamination of the AAC resource would give it a longer life span as it would not get damaged easily.

I think that laminating is the most important, if it comes into contact with water, you can just wipe it. This way it will last longer. (T2)

### Design team

Participants from all five groups highlighted that a variety of stakeholders should be part of the design team. These stakeholders may be parents, special school teachers, SLTs and other rehabilitation professionals, linguists, and the person in need of AAC, amongst others. A team approach was highlighted. Importantly, participants saw their own group as relevant stakeholders, confirming their ownership of the process.

Team effort is the best approach. (T1)

The participants also specifically emphasized that various communication partners in the immediate environment (such as special school teachers, peers in the classroom, and the parents) as well as the child in need of AAC themselves need to be consulted in the selection of the vocabulary.

The people who use AAC must choose what the words that must be on the system or communication board must be because they know what it feels like not to be able to communicate. (A1)

## Discussion

The purpose of the study was to obtain initial input from the stakeholders' perspective on the need for an extensive non-electronic Sepedi GS- based AAC resource, its desired requirements as well as its possible application. From the results, it is clear that participants from all five stakeholder groups engaged actively with the topic and gave informed and relevant input, despite coming from very different backgrounds. Each group brought their experiential, expert, empirical and/or ecosystemic knowledge (Sullivan et al., 2018) to bear on the information gathering process. While there was certainly overlap in the issues highlighted, there were also clearly unique emphases that enriched our understanding of stakeholder priorities and that were extremely valuable in guiding the design process.

Participants from all five stakeholder groups affirmed that there was a need for a resource in the Sepedi language. Participants' value, perception and acceptance of an AAC resource are critical for implementation - there needs to be a realization of the need for an AAC resource in order for it to be used long-term (Moorcroft et al., 2019). Biggs and Hacker (2021) argue that if stakeholders view an intervention as impractical, unacceptable and of less importance they will less likely implement the intervention in practice.

Participants motivated for the need for the AAC resource in various ways. The need for a resource that embraces cultural and linguistic appropriateness was emphasized. It was clear that participants felt strongly about the need to fill the gap that currently exists with regards to a GS-based resource that aligns with their cultural identity, including their use of the Sepedi language, their race, and ethnicity. The envisioned resource should be acceptable in the Sepedi culture, conform to the language rules of the Sepedi language, be sensitive to the black race and the Pedi people. This was also highlighted while detailing specific design requirements for the graphic symbols and vocabulary. The participants mentioned, for example, that the graphic symbols used should have a darker skin color to represent them as Pedi people and represent activities relevant to Pedi people. This is an important aspect to consider when designing symbols that reflect the culture and language of the local population (Draffan et al., 2015). Their comments confirmed the authors' rationale for initiating the project as a decolonial project which aims to combat the challenge of the lack of provision of AAC resources in Sepedi (and African languages) – brought about by a general disregard of the culture, identity, and human rights (including right to healthcare and education) of African people under the colonial system and later the apartheid regime (Khoza-Shangase & Mophosho, 2018; Mophosho, 2016; Pillay & Karthard, 2015).

The participants commented on the purpose of use and communication access. Persons requiring AAC should be able to engage in communication functions such as requesting, greeting, giving instructions, and so forth (Beukelman & Light, 2020). Parents particularly highlighted that communication access was a safeguard against victimization of individuals who use AAC. When individuals lack communication access, they are at risk for neglect and abuse (Bornman et al.,

2011). Statistics from across the world confirm a higher incidence of crime against persons with disabilities, including violence and sexual abuse (Bornman et al., 2011).

Participants shared their views regarding the design requirements of the resource. Regarding vocabulary content, participants emphasized the importance of including culture-specific vocabulary, like food items (particular food eaten by Pedi people like pap<sup>1</sup> and samp<sup>2</sup>), as well as social etiquette words, and words related to the child's everyday activities and contexts. The alignment of vocabulary content to the personal identity of the end-user (including their cultural and linguistic identity) remains critical to ensure that the resource is supportive of identity expression, rather than suppressing it (Wofford et al., 2021).

Most participants highlighted that core and fringe vocabulary should be included. Various existing GS-based resources contain a combination of preselected core and fringe vocabulary (referred to as the core-fringe approach) (Amery et al., 2022; Boenisch & Sachse, 2020). Amongst controversies about the utility of core vocabulary on AAC resources (e.g., Laubscher & Light, 2020), a recent study found that English-speaking toddlers aged 24-36 months used core vocabulary extensively – in combination with fringe vocabulary (Binger et al., 2024). The study also showed that utterances where fringe vocabulary is used in combination with core vocabulary are grammatically superior to utterances composed of core vocabulary alone. The stakeholder validated core vocabulary list as well as additional suggestions of words and categories from the current study as well as the study by Tönsing, Mothapo, et al. (2024) may therefore provide a useful starting point for choosing vocabulary for the non-electronic Sepedi GS-based AAC resource. Participants' views regarding the number of vocabulary items to be included ranged widely. This variation mirrors the tension that AAC practitioners experience in constructing GS-based AAC resources – containing the vocabulary to a manageable size that does not exceed the learning demands of the child and partners while providing a vocabulary that is large and varied enough to scaffold language development (e.g., through aided language modeling). Practitioners are often hard-pressed to balance factors supporting short-term learnability versus those supporting long-term language growth in their decisions about the number of vocabulary items to include (Binger et al., 2024).

Participants had various suggestions around the graphic symbols. Participants emphasized that the graphic symbols should be culturally appropriate – that is, they should align to the Sepedi culture. The graphic symbols used must be relatable to black, Sepedi speaking children. Patel et al. (2007) suggest that a symbol is usually linked to a physical experience. In this regard, graphic symbols need to reflect what a child from a Sepedi speaking environment experiences in the world around them. Designers must be sensitive to skin tone, hair color and the relatability of the content of graphic symbols. Various

contemporary symbol libraries (e.g., ARASAAC<sup>3</sup> and Picture Communication Symbols<sup>4</sup>) allow for easy customization of colors and also provide for diversity, for example, in food choices clothing, and in the way humans are depicted (e.g., race, gender, age, and ethnicity). While the design of graphic symbols from scratch is costly and time-consuming, the versatility built into contemporary symbol libraries allows for relatively effortless (albeit somewhat limited) customization at no additional cost. However, this does not preclude the need to develop new symbols at times. A budget to do so was available for the subsequent phases of the project. Participants also highlighted that the use of color with graphic symbols was an important aspect to be considered. Color has been found to enhance the appeal of an AAC resource (Light & Drager, 2007) and symbols with internal color have been found to be easier to locate than those without internal color (Thistle & Wilkinson, 2015). Participants highlighted that iconicity should be taken into account when selecting all the pictures for the resource. Studies have found that iconicity is indeed a variable that influences learnability of symbols (Fuller & Lloyd, 1990; Luftig & Bersani, 1985). Likewise, easy availability of the symbol library (e.g., as a download after a onetime purchase) is another factor that stakeholders typically consider (Pampoulou, 2017).

In terms of the layout and organization of the envisioned resource, most participants pointed out that a single-page with a static section (for core vocabulary) and a section for changeable overlays for the fringe vocabulary would be preferred. The design practice or principle of having one static (unchangeable) section (typically dedicated to words core vocabulary and so-called “quick phrases” such as social etiquette words and interjections) as well as a dynamic (changeable) section (typically dedicated to fringe vocabulary) has also been observed in other electronic and non-electronic resources (see, for example, Boenisch & Sachse, 2020, on the Cologne Communication Materials). A static section can encourage easy access to frequently used items and motor automaticity as items remain in the same location (Boenisch & Sachse, 2020; Thistle & Wilkinson, 2015).

Participants suggested that the vocabulary items should be laid out in a way that enables left-to-right sentence formulation. This mirrors a long-standing convention in the field of AAC, hailing originally from the field of Deaf education, where a visual method of teaching syntax, called the Fitzgerald Key (Fitzgerald, 1962), became popularized. On a GS-based AAC resource, this requires the categorization of words by parts of speech rather than by topic or activity as parts of speech have specific syntactic functions.

Participants also had suggestions regarding the physical properties of the board. Firstly, the participants outlined that the size of the resource should be A3 (bigger than A4). This size would allow for a relatively large number of vocabulary items without detracting from visibility. Secondly, participants

<sup>3</sup>ARASAAC is a product developed with funding provided by the Department of Culture, Sports and Education of the Government of Aragon (Spain), registered with the Spanish Patent and Trademark Office, Spain. <https://arasaac.org/index.html>

<sup>4</sup>Picture Communication Symbols (PCS®) is a product of Tobii Dynavox Global. <https://www.tobiidynavox.com>

<sup>1</sup>A porridge made from maize meal.

<sup>2</sup>Coarsely ground maize meal.

discussed aesthetics such as big font size and adding color to the categories. Allen (2005) condemned the lack of attention given to aesthetics in the design of AAC resources, and highlighted how this contributes to further stigmatization. A study by Light and Drager (2007) summarizes findings from studies aimed at identifying features children would find appealing in AAC resources. These features included the use of multiple bright colors – a feature that is also a characteristic of many toys.

The participants outlined that the resource should be cost efficient. Pampoulou (2019) pointed out that the cost of purchase of an AAC resource may influence acceptance by people requiring AAC. The participants highlighted that cost is an important consideration for this population. Colonial and Apartheid regime policies led to the impoverishment of the majority black population, and this economic disparity along racial lines continues to the present day, with the black population (including Pedi people) significantly more affected by poverty (Maponya & Mpandeli, 2016).

With respect to the design process, participants highlighted that a design team comprising of people from multiple backgrounds and with multiple sets of expertise should be involved in the design process. Product design has evolved - from being designer-based, where the designer has all the power to make decisions in the design process and the end-user only implements the resource, to being more collaborative, where the designer and the various stakeholders (including the user) share the responsibility of decision-making in the design process (Steen, 2011). Similar observations have been made regarding the design of AAC resources (Thistle & Wilkinson, 2015). A scoping review (Tönsing, Bartram, et al., 2024) found that different groups of stakeholders were involved in the design of electronic GS-based AAC resources. Involving different stakeholders in the design process of AAC has benefits such as giving power to the individuals who will have to engage with the AAC resource as well as obtaining diverse viewpoints and opinions during the design process of the resource.

### **Implications**

This study showed how an HCD process can be used to involve diverse stakeholders in the planning phase of the design of a non-electronic Sepedi GS-based AAC resource. The results affirm that it is both possible and fruitful to do so if indeed the desire is to design a resource that is acceptable, culturally and linguistically aligned and identity-affirming. Designers of both electronic and non-electronic AAC resources are therefore encouraged to co-design resources together with stakeholders, especially when the resource is to be implemented for the benefit of individuals from marginalized communities. In doing so, they counter the prevailing monolingual, Anglo and Western-centric practices in the field that not only ignore the diversity amongst individuals using AAC but seem to erroneously assume that the knowledge base of AAC is race, language and culture neutral. Through co-design, end-users can bring their critical knowledge of cultural and linguistic norms, preferences, and communication styles to bear on the design process to ensure that the designed AAC resources align with their values and

practices, and that the resources are experienced as relevant and useful by the end-users.

Involving end users fosters a sense of ownership of the design process as well as the AAC resource. This can lead to improved uptake of assistive technology in comparison to resources that are developer-designed and that position end-users as passive recipients of technology. Involving a diversity of stakeholders in the process acknowledges that AAC resources do not function in a vacuum - they are part of a larger communication network that includes families and communities. End-user involvement ensures these resources support natural interactions within these networks, respecting cultural norms and practices.

The current study not only affirms the importance of stakeholder involvement, but also suggests strategies to facilitate the process. Firstly, building a relationship with stakeholders and affirming the importance of their contributions signals respect for their knowledge and experiences, fostering trust. This trust is vital for long-term engagement in research and the eventual adoption and success of AAC interventions. Secondly, while respecting and acknowledging stakeholder knowledge and expertise, they may need to be provided with enough information and context in order to make relevant contributions. While there are various ways of doing so (e.g., presentations, experience prototyping), designers and researchers should ensure that this information is merely seen as a springboard for further or alternative ideas, rather than as prescriptive or limiting.

### **Limitations and future directions**

The study's findings have to be considered in light of its limitations. The number of stakeholders engaged in the study was limited, and groups were not equal in numbers. This may have implications for the results. It should also be noted that there are multiple variations of the Sepedi language, but the participants of this study represented only one. This may limit the transferability of findings. Finally, no young individuals who use AAC were involved in the study, and hence their voices were not taken into account when specifying the design requirements of the resource. Authors acknowledge that having a paired-interview with two participants who used AAC may have led to richer data.

As this study represented Phase 1 of a multi-study project, the findings from this study were used as a basis for designing a first prototype Sepedi GS-based resource, which was then further refined through a series of iterative cycles of design and stakeholder feedback, including feedback from participants who use AAC. The final resource was then implemented and summatively evaluated using qualitative interviews. Further research is needed to develop, implement and evaluate the effectiveness of intervention approaches to support the implementation of the Sepedi resource in order to enhance communication between young individuals who need of AAC and their partners. Here, too, a participatory approach should be considered to ensure that the interventions are culturally, linguistically and contextually aligned and lead to outcomes that are valued by participants.

Further research on designing AAC resources with for individuals from marginalized communities is also needed. Stakeholder-driven participatory approaches are needed, and role-players, processes and procedures should be determined by the community. Drawing on the processes and findings from such studies, it may be possible to create a framework or checklist to suggest cultural and linguistic considerations for non-electronic AAC resource design.

## Conclusion

This study arose from a need for a culturally and linguistically relevant and congruent AAC resource to support communication for preliterate individuals from a Sepedi background who require AAC. HCD was proposed as a decolonial participatory design process that would counter a Western-centric and designer-dominated approach in an attempt to pave the way for an AAC resource that is responsive to the needs of indigenous people (in this case, the Sepedi individuals requiring AAC). The study illustrated that stakeholders from a variety of disciplines and backgrounds can make informed and thoughtful contributions in the initial phase of a design project to identify the need for and the design requirements of a non-electronic GS-based AAC resource. Specifically, stakeholders highlighted a need for the resource to be linguistically and culturally appropriate in order to avoid a mismatch between the resource and the user's identity, and to maximize acceptance and use of the resource. The findings also give some initial indications of how various design requirements can support cultural and linguistic congruence.

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## Author contributions

CRedit: **Ngwanamashiane Rahab Mothapo**: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Project administration, Writing – original draft, Writing – review & editing; **Kerstin Tönsing**: supervision, writing, original draft, writing-review & editing; **Gloria Soto**: Supervision, Writing – original draft.

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