

TRANSITIONAL STAGE: LANGUAGE DISJUNCTURE FOR INTERMEDIATE PHASE MATHEMATICS TEACHING, CHRIS HANI EAST EDUCATION

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Abstract. *It becomes worth noting that as learners transition from one learning phase to the other, instructional strategies get redefined in a manner that interchangeably affects the greatest percentage of subjects in line with academic performance, buttressing the prescribed curriculum within the context of the South African schooling system. Mathematics learning has since been adversely impacted because of the language disjuncture of transitioning from home language instruction offered at the Foundation Phase (FP), yet as learners enrol for the Intermediate Phase (IP), policy depicts the application of an additional language at this stage, specifically the English medium for the purposes of this study. Therefore, this paper investigates how the teaching and learning of mathematics for IP learners in multilingual classrooms is affected by language disjuncture. For this qualitative inquiry, four IP Mathematics teachers were purposefully nominated as data informants. Although related studies have been conducted, there are some identified yet crucial gaps in the existing literature and practice in accordance with the intersecting language and mathematics education as normally depicted by classrooms within multilingual settings. This study revealed that (i) language transition creates barriers to mathematical comprehension and (ii) limited understanding of the mathematical vocabulary has been proved to hinder learner academic attainment. It is concluded by this paper that substantial challenges for Mathematics teaching and learning are steered by transition within the instructional languages. Hence, this paper recommends that to bridge the gap, there is a need for policy makers to redefine instructional teaching and learning strategies.*

Keywords: *Language transition; Comprehension; disjuncture; Mathematics instruction.*

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Introduction

Barriers in language, in one way or the other, impact learners' mathematical understanding. No single individual can divorce language from mathematical literacies, thereby leading one to explore how language is intertwined with mathematics education (Adler, 2021a). It is through this intersection that for IP mathematics teaching, it seems crucial to delve into the language disjuncture imperatives as learners transition from home language instruction prior to enrolling for the IP, abruptly faced with an enforced situation of English medium instruction as they commence IP, as prescribed by the language policy (Ávila et al., 2022).

To avoid confusion that might erupt among all stakeholders involved in the education sector, it is an obligation for this study to delve into defining some terms as the key variables of this inquiry. Simpson (2019) resonates that language disjuncture is referred to as that state where disconnection arises due to learner transition from one language to the other, by the nature of it being declared a medium of instruction. Be that as it may, Tsitsi (2017) contends that such practice normally leads to hurdles in understanding and expressing concepts, with reference to Mathematics, with its crucial aspect of precision in language. On the very same accord, Tsanwani et al. (2014) depict that as learners emanate from diverse language constituencies due to background complexities, to maintain proficiency, there is a need to reconsider multilingual education, thus ensuring subject content access by all learners, irrespective of diversity and cultural intonation. Therefore, it goes without saying that for

learners to functionally comprehend the subject content, it is crucial that through language expansion, they are assisted in grasping numerical concepts to be able to adhere to given instructions as well as interpreting the given problems, be it in the form of words or figures (Hall et al., 2018). Although scholars have conducted studies on Mathematics learning, little is revealed by literature on comprehensive studies that have been undertaken to enquire about language disjuncture affecting the IP intended learning outcomes for some fundamental subjects (González-Rodríguez et al., 2019). This is the reason why this paper navigates not only the general transitions but also burrows into the unique linguistic challenges that surface in Mathematics instruction.

Henceforth, the aim of this paper is to explore how the teaching and learning of Mathematics for IP learners in multilingual classrooms is affected by language disjuncture. Embedded within this main research question are the objectives intended to explore teacher perspectives on how language disjuncture affects Mathematics learning and provide valuable information on how they circumnavigate language challenges in the classroom environment. In addition to that, this study also evaluates the effectiveness of bilingual instructional methods like translanguaging and code-switching as the anticipated strategies for enhanced learning outcomes (Heugh, 2021).

Literature Review

Empirical Literature

In this section, references have been explored regarding challenges faced by learners as they transition from their home languages to the English medium for all subjects underpinning the prescribed IP curriculum (Language policy, 2015). As one of the fundamentals, Mathematics is considered one of the core subjects. Considering the jargon of Mathematics, learning consists of aspects like the definition of terms, word statements, and the complexity of mathematical signs that need to be translated into words (Kim, 2018). All these need one to be well conversant with language dynamics to be able to master the intersected mathematical language learning. Such claims are in line with Chiphambo and Feza (2022), who argue that lack of fluency normally leads one to lack articulation of critical mathematical concepts, as experienced by the so-called transitioning learners, specifically in diverse classroom settings.

The diagram below depicts an intersection of Mathematics and language education. These two components of learning are considered to have a mutual nexus as they share crucial elements of logic, patterns, and symbols. The Venn diagram, as indicated by its interconnectedness, displays how mutual reinforcement to learning outcomes is revealed by mathematical and linguistic competencies. Both these subjects, Mathematics and language learning, are bound together by their similar and critical rule of pattern recognition (Atnafu, et al., 2023). This significant element serves as a basic skill that bridges mathematical concept formation with linguistic rule acquisition, and as learner ability is enhanced, the application of regularities for both domains is planted and developed. The essence of this diagram is to strengthen linguistic capabilities that, in turn, help learners to gain extended expertise for expressing mathematical relationships (Atuhurra & Kaffenberger, 2022).

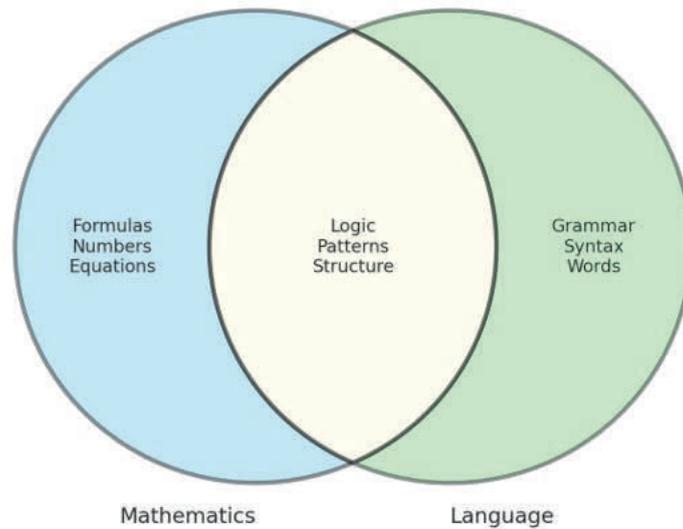


Figure 1 Mathematics and Language Intersection

In line with the outlined intersection of Mathematics and language learning, as described above, some investigation to study the underlying problem was conducted through studies in Vietnam by Joyce-Gibbons, et al. (2018) focused on learner challenges in Mathematics learning. As outcomes of their investigation, these scholars noted that language barriers did impact learner progress as the research highlights struggles with mathematical vocabulary in English medium, thereby hindering problem-solving abilities (Wei & Lin, 2019). Hence, their recommendation is that Mathematics curricula need to be integrated with language support for improved comprehension to be accelerated (Atuhurra & Kaffenberger, 2022). Of a similar accord, Ávila Francés, et al. (2022) embarked on a study in the United Kingdom. It emanated as one of the key findings of this investigation how infusion of theoretical frameworks was proved to be essential in educational practices. Their findings opine that understanding learner-sociocultural context and language background is essential for the effective implementation of educational interventions, including those in Mathematics education.

Such narratives bring to the fore how globally relevant it is to address aspects of language disjuncture in Mathematics education, thereby also catering to learner-linguistic diversity (Ramollo, 2014). These narratives, in a broader perspective, highlight how learning outcomes are influenced by language learning and this being equated as an emphasis to integrate learner linguistic resources into educational pedagogies. Henceforth, as prescribed by the South African Schools Language Policy (Department of Basic Education, 2014), IP learners are at the core of the paradox of language disjuncture as they transition from their home language to English medium instruction for all the subjects offered. With the characteristics of the South African multilingual classroom setting, such drastic changes adversely impact Mathematics education (Bowden & Barrett, 2022). For learners to be expected to learn complex mathematical concepts in an English medium context, not a home language, defeats efficiency in the expected academic content, resulting in a decline in academic performance (Robertson, & Graven, 2020). Therefore, for enhanced learning outcomes, there is a crucial need for teachers to redefine techniques and approaches implemented.

Theoretical Literature

The theory underpinning this inquiry is the Sociocultural Theory of Learning/Development by Wang et al. (2011). The bone of contention for this theoretical framework is an emphasis on how essential the cultural context and social interaction are during the process of learning and teaching. In line with this claim, Olawale (2024) harmonizes that the Sociocultural Theory of Learning encompasses that social process which is influenced by the learner's linguistic and cultural backgrounds. Research affirms that this theory is predominantly pertinent in multilingual schooling environments where language disjuncture is reported to significantly impact mathematical understanding. Also, it is affirmed by this framework that translanguaging, as one of the vital functionality aspects in multilingual settings, benefits learners as they grasp mathematical concepts through their full linguistic repertory (Rohaeti, et al., 2019).

Looking at the educational implications for Mathematics education, the theory can serve as remedial in exploring the intersection of cultural practices and home languages when delving into the actual classroom experiences. This strategy is considered relevant for the cohort of learners experiencing disjuncture between their home language and the instruction languages, specifically for bilingual learner settings (Siyang, 2018).

The figure below confirms that when social interaction, language, and culture are merged, the probable outcome is a development that has a firm base of diverse combined features. This resembles the intertwining language and mathematical imperatives, which, when fused together, are a leeway for ease of understanding to learners who struggle to understand Mathematics terminology due to its nature of ambiguousness and complicatedness for most learners. This theory of learning affirms that enhanced reading and writing skills among learners lead to improved academic performance (Atuhurra & Kaffenberger, 2022). As Mathematics is a subject with texts and terms to be interrogated, interpreted, and analyzed for recipients to understand, the Sociocultural Theory of Learning/Development emphasizes that social interactions and experiences need to be considered core for the cognitive process of school subjects related to language learning (Biseko, 2023).

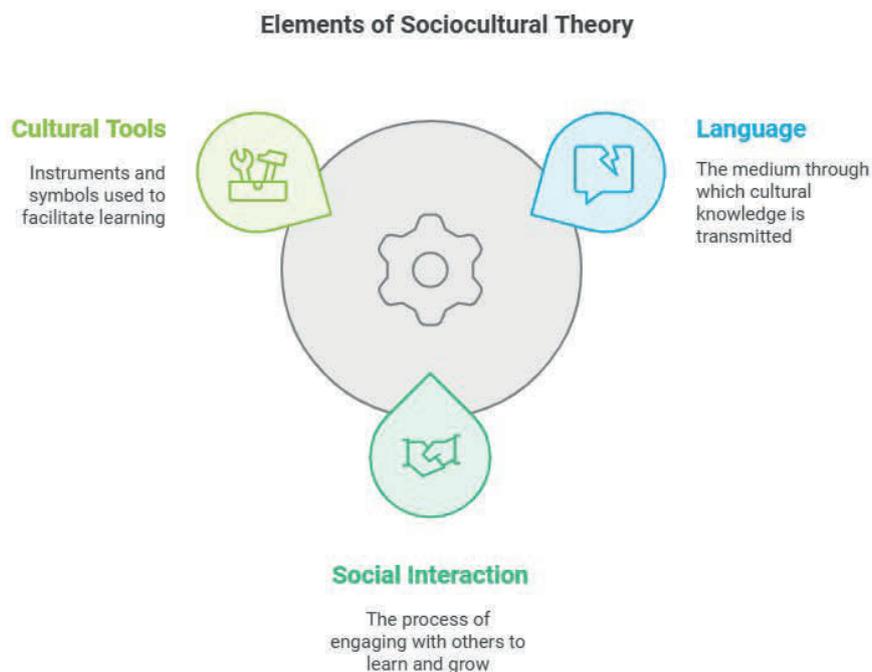


Figure 2 Sociocultural Theory of Development

Henceforth, another critical implication worth considering is the need to steer teacher training and professional development. Teachers need to be upskilled for them to be knowledgeable of the strategies to be put in place to curb linguistic challenges encountered by learners. For functionality and efficiency, such professional development programs need to have directed focus on strategies for integrating language instruction into Mathematics teaching (Cao & Li, 2018). Therefore, teachers should also have a clearer understanding of their diverse, multilingual classroom needs (Heyd-Metzuyanim, 2019). Learners can be better supported when the teachers' sense of awareness of the correlation between language, be it home or additional, and Mathematics is enhanced, thus fostering that so-called conducive learning and teaching environment that would heighten learner academic success (Sarip, 2015). Summarily, the Sociocultural Theory of Learning/Development is believed to allow for an all-inclusive exploration for the interconnectedness of language, culture, and Mathematics education, therefore aiding the provision of treasured insights for better support mechanisms entangling bilingualism and language barriers (Sedibe, 2011).

Methodology

This is the section outlining procedures and research methods administered during the investigation till the ultimate processes of collecting data. As a specific focus for this paper, a qualitative research approach was deemed fit with its characteristic of allowing engagements with the target audience as participants share lived experiences regarding the investigated topic (Myers, 2020). This qualitative approach encompasses methods like the relevant research design, sampling, data gathering procedures, and collection procedures.

Methodological Design

Entangled in this qualitative research approach is a case study design. As opined by Strauss and Corbin (2015), what assists the conducted studies to compound within their phenomena and context of occurrence are the case study designs. For this paper to have outlined its interest in the transitional stage caused by language disjuncture for Mathematics teaching in the IP, with anticipations to obtain a better understanding of the underlying language-mathematics intersection, it would not have been easy for us to assume true identities of IP Mathematics education diversities and congruencies. We had to first take into consideration the actual context of the underlying problem. As investigators, we felt there would have been no other better platform than to use a setting of multilingual schooling environments overwhelmed by home-language to English-medium instruction that transitions from FP to IP.

Population and Sampling

For this study, participants were nominated through a purposive sampling strategy. Cohen et al. (2000) argue that when selecting data informants, researchers need to consider the relevancy and accessibility of the subjects. The population of this study comprises IP Mathematics teachers across a wide range of Circuits within the Chris Hani East Education District. Although the demarcation of these schools as circuits includes both schools from the rural areas and those in town, the underlying philosophy is that by the nature of the Eastern Cape Province of South Africa, the rurality of the entire area leaves no room to debate whether schools as research sites are under or developing. For the sample of this study, four schools were identified as research sites, with the nomination of one IP Mathematics teacher from each school, totalling up to four participants from various schools around the district. This purposeful sampling strategy also acted as a guide to include teachers who varied in their experience levels and period of exposure to teaching Mathematics in multilingual environments (Sapire & Essien, 2021). Henceforth, it is worth mentioning that the realistic characteristic of the schools' location is what enhances the administered sampling strategy.

Research Instruments

To gather data, the instrument used was semi-structured interviews. As outlined by Guest et al. (2017), this tool has flexibility and is renowned for its characteristic to permit open conversations and further probing. Such a strategy allows both parties, data informants and interviewers, to delve more concisely, through probing into the gist of the investigated variable. To ensure all the necessary detail was captured, each response or engagement, no matter minor or huge, was not left unattended, meaning, we made sure we unturn all the stones. With open-ended questions contained by the interview schedule, we ensured neutrality, thereby avoiding assumptions as all subjects responded to questions centred around intersecting dynamics of language and Mathematics education, with a special focus on the challenges encountered (Denzin, 2018). Semi-structured interviews as the appropriate instrument helped to explore teacher perceptions of language transition challenges and applied strategies thereof toward learner support.

Data Collection Procedures

For this examination, we collected all data through a procedure termed narrative analysis. It is this technique that permits researchers to pursue their studies by focusing on either stories or participants-personal accounts. During this process, the investigators examine the manner in which individuals hypothesize significance through their narratives (Andrews et al., 2013). The narrative for qualitative research is essential with its nature of emphasizing how critical it is to consider personal experiences and social contexts when undertaking a study. Hence, specifically for this qualitative investigation, we decided upon administering a narrative analysis to dig deep into the real-life experiences as envisaged by the IP Mathematics teachers (Marshall & Rossman, 2016). As responses were transcribed, concurrently listening and re-listening to the recorded responses, we then managed to group similar and related responses, as well as taking into consideration not to discard responses that might indicate different viewpoints (Willig & Stainton-Rogers, 2017). This crucial exercise, regarded as the core of this investigation, is the one that led to the grouping of categories later coded into themes. The emerging themes are discussed below as the study findings.

Results and Discussions

In this section, the paper discusses the findings of the study. The two themes under discussion are (i) Barriers to Mathematical Comprehension and (ii) Mathematical Vocabulary. Below, findings have been discussed as guided by the revealed themes when data was analysed.

Barriers to Mathematical Comprehension

One of the major findings of this investigation is that barriers to mathematical comprehension are created by language transition between different phases of learning. As participants, with the information they have gathered within being exposed to such multilingual settings for IP Mathematics teaching, were asked questions centered on how they helped learners with different learning needs and backgrounds, narrated below are their verbatim responses:

P1 argues:

Taking care of learners from rural backgrounds is time-consuming for me because I have too much work; I do not teach Maths only; there are many other subjects that I teach.

On the same accord, P2 declares:

The environment itself is affecting my teaching because I do not even like this subject, as such, there is no improvement.

Similarly, P 3 outlines:

I am not a Maths specialist, but I try my best to help those learners who have difficulties comprehending mathematical terminology.

With related responses to the ones above, P4 claims:

I think the use of technology can be very useful. The only problem is that there are no resources.

I say this because there are some areas I am not familiar with. I still do not understand the language of fractions. I am a new Maths teacher, and I have no Maths background. This is a challenge on its own because I have never taught Maths.

Understanding Mathematical Vocabulary

In relation to questions asked, focusing on mathematical literacies, the responses below by participants are evidence that, indeed, there are experienced glitches of language disjuncture within the Mathematics learning and teaching sphere.

This is depicted by P1 by pronouncing that:

Yes, I understand the topics covered within the given timeframe, however, it is very difficult for me to transfer the content to my learners in a more understandable manner, especially at their level of understanding.

In accordance, P2 highlights:

I do not know how to differentiate between Maths concepts, e.g., hypotenuse and adjacent; even when I studied my grade 5, I did not know how to do it, and I did not like Maths.

P3 harmonizes:

Because grade 4's is from Xhosa learning in Maths class, there is a slight problem. I code-switch to Xhosa. There should be workshops to capacitate us on these challenges. Translating maths terms is not an easy thing.

Correspondingly, P4 contends:

To encourage communication and teamwork, I use texts. I need more assistance. I am not a language person. In addition to that, with the complicated mathematics language, learners do not get assistance at home.

Indeed, shifting abruptly from one language to the other, has its own hassles, especially if the other is not one's home language. This means that home-language to English-medium instruction significantly hampers learners' ability to grasp mathematical concepts and terminologies (Coetzee Van Rooy, 2018). Findings declare that the noted struggles for most learners to experience difficulties in understanding mathematical vocabulary and interpreting word problems are equated to a lack of articulating their reasoning in the English medium perspective (Hudson, 2013). This, therefore, depicts a disconnection between prior knowledge and the learner's ability to apply learned concepts in a new linguistic context. As Mathematics education is a subject with abstract topics embedded within problem-solving activities, challenges experienced by learners then become eminent as they require the infusion of precise language comprehension.

Moreover, Ntow & Adler (2019) proclaim that there are identified challenges of compromised Mathematics education where learners display difficulties in interpreting word problems. Such activities are a species of mathematical jargon that requires one to have expertise in linguistic and mathematical processing (Milligan, 2022). Learners struggle with decoding problem instructions during the transitioning period to an immediate English language learning environment, which often leads to inaccurate solutions, although one might have a glimpse of the mathematical tactics involved. To curb these identified gaps, there seems to be a lack of or limited training or workshops by policymakers, as participants reported insufficient training for multilingual education instructional methods (UNESCO, 2016). Exposure to the nature of those training would expedite teachers' ability to design integrated lesson plans that inculcate both language development and mathematical instruction in an efficient manner.

Henceforth, Mathematics teachers are faced with huge challenges to bring to the fore additional effort to assist learners in comprehending mathematical terms in the English medium. If left unattended to, lacking equivalence in learners' home versus language of instruction, often results in conceptual confusion. To support learners during the stage of transition, teachers,

therefore, should implore learning and teaching strategies that are functional enough to act as providers of support (Christie, 2012).). The use of audio-visual aids, at this point in time, and code-switching, are considered essential strategies to mitigate language disjuncture effects. However, as discovered by the study findings, resource limitations can be a hindering factor that can infringe consistent implementation of these strategies. Be that as it may, for effective code-switching, there is a need for a structured strategy so as not to hinder learner proficiency in English mathematical terminologies (Opfer, 2016).

It is evident from the discussions above that the study findings are in congruency with the underpinning theoretical framework (Wang et al., 2011) as it proposes that teachers need to adopt learner-centered approaches that would encourage collaborative problem-solving coupled with opportunities of using home languages by learners, concurrently building proficiency in English. Through this strategy, it is not only linguistic anxiety that diminishes, but mathematical reasoning is also fostered. Without denial, the transition from home-language instruction to English-medium instruction presents significant challenges that affect learners' comprehension and performance in Mathematics (Edwards, et al., 2014).

It is implied by the findings of the study that without targeted support, learners transitioning to English medium instruction are at risk of falling behind in Mathematics, which can have long-term effects on their academic performance and confidence. This has similar sentiments for the teaching folk; there is an urgent need for professional development programs focused on multilingual teaching strategies, yet, for the policymakers (Trudell & Piper, 2014), this is a wake-up call to ensure prioritizing redefined curricula that inculcate linguistic transitions and ensuring equitable access to learning materials.

Conclusion

This study explored how language disjuncture affects Mathematics learning. As discovered by the findings of the study, language transition creates barriers to mathematical comprehension. Mathematics teaching at the IP is faced with challenges as defined by the intersecting English medium instruction and mathematical terminologies. The language shift seems to disrupt learners' comprehension of mathematical concepts, vocabulary, and problem-solving processes; this indeed creates barriers likely to hinder learners' academic progress and tangible skills, enabling one ease of access toward solving mathematics impingement. Therefore, this paper recommends that to bridge the gap; there is a need for policymakers to redefine instructional teaching and learning strategies with consistent training on how to prepare lessons that would cater to mathematics-language-infused dynamics. An urgent need for systemic interventions to address the intersection of language and Mathematics learning includes policies that support gradual and structured language transitions towards promoting equitable access to learning irrespective of learner linguistic backgrounds.

Future Studies

Future studies could, therefore, dwell on aspects of effective multilingual teaching strategies as a means to mitigate Mathematics language-disjuncture effects. For enhanced strategies, what could be investigated is how impactful translanguaging, bilingual teaching resources, and code-switching are in improving learner comprehension and problem-solving abilities. Furthermore, cultural integration into Mathematics contexts could ascertain learner understanding and engagement in transitioning between languages if such studies could be conducted.

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