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# Language and students' conceptions of logic in undergraduate mathematics

Mercy Kazima, Levis Eneya and Patrick Sawerengera

University of Malawi, Zomba, Malawi, [mkazima@cc.ac.mw](mailto:mkazima@cc.ac.mw)

Issues of learning mathematics through a foreign language have been discussed by many researchers, however, the focus has mostly been on primary and secondary schools and not university. This poster presents findings from a study that focused on university and investigated undergraduate students' meanings for mathematical terms used in logic. The sample was 89 second year university students that had studied the topic of logic in mathematics in Malawi where English is the language of instruction but not the students' mother tongue. The students were asked to write down what they understood by a list of mathematical statements such as: *if and only if*, *implies*, *and*, *or*, and *not*. Findings suggest that even at undergraduate level, the mother tongue influences students' conceptions of mathematical terms. The poster presents some examples of students' responses and discusses possible reasons for the responses in relation to the mother tongue. Furthermore, the poster discusses some implications for teaching logic specifically and teaching mathematics in general, to undergraduate students' learning mathematics in English as foreign language.

**Key words:** Language, logic, Malawi, mathematical terms, undergraduate.

## INTRODUCTION

This paper reports a study that investigated students' conceptions of meanings of mathematical terms used

in Logic, which are also used and applied throughout the undergraduate mathematics courses, and their meanings are often assumed to be understood by the students. The paper focuses on four terms: *or*, *implies*, *if and only if*, and *there exists*. The study took a constructivist view of learning that meaning is not transferred from teachers to learners but that meaning is constructed by the learners. This construction of meaning is influenced and affected by the learners' prior knowledge (Vygotsky, 1962). From previous studies, we expected that ordinary English and the students' local languages might influence their conceptions of the mathematical terms (Kazima, 2006). Furthermore, it is well known that students face difficulties with mathematical terms that have different meanings in ordinary English from mathematical English (Orton, 1992).

## METHODOLOGY

Fifty (50) undergraduate students that have studied the topic of Logic in English, which is not their mother tongue, were asked to write down what they understood by a list of mathematical statements including the following four: (i) *or*, (ii) *implies*, (iii) *if and only if*, and (iv) *there exists*. The students were also given a short test where the statements were applied, These included *True* or *False* statements where they had to provide reasons for their answers, for example, ' $8 = 27$  if and only if  $2 = 3$ ' Students responses were coded

	Term	Percentage of students that gave valid meaning	Percentage of students that gave valid example
1	or	14	12
2	implies	56	42
3	If and only if	4	8
4	There exists	38	36

**Table 1:** Percentage of students that gave valid meanings and examples

	Term	Common meaning	Examples
1	Or	One or the other	A baby can be a girl or boy
		Not sure	I am not sure if I should go or not
2	Implies	As a result	I cook implies I eat
3	If and only if	The only way	if and only if it stops raining then I will go to town
		Only condition	I will have money if and only if my mother comes
4	There exists	Something is discovered	There exists some numbers

**Table 2:** Some common responses for meaning of terms

and analysed using SPSS, and common responses for each of the terms were recorded.

## FINDINGS

Table 1 shows the percentages of students that gave valid meanings of each of the terms and percentages that gave valid examples for the terms. Table 2 shows some of the common responses.

## DISCUSSION AND CONCLUSION

The findings suggest that even at undergraduate level, language is an issue and influences students' conceptions of mathematical terms. This is important because it affects the students' understanding of Logic as a topic in mathematics and their ability to apply logical statements in mathematics in general.

The common responses that *or* is a 'choice' from two things that cannot occur together, and that *if and only if* is emphasis on the condition for something to happen may not be new, but worth noting because these terms are used throughout the undergraduate mathematics courses, and therefore important for students to have precise meanings.

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