Reasoning with multiple and dynamic representations

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Motivation

Technology has brought new representational possibilities to mathematics classrooms – but are they used by students, if they have the choice?

Multiple, static (MSR)	Multiple, dynamic (MDR)
Isolated, static (ISR)	Isolated, dynamic (IDR)

Multiplicity ↑

Dynamics →

Representations can be classified along the two dimensions *dynamics* and *multiplicity*, resulting in four categories of representations (see above).

Research question

Does the representation category that is used when presenting the problem to learners have the most significant impact on the representations used by learners in their justifications, or is it their individual preference?

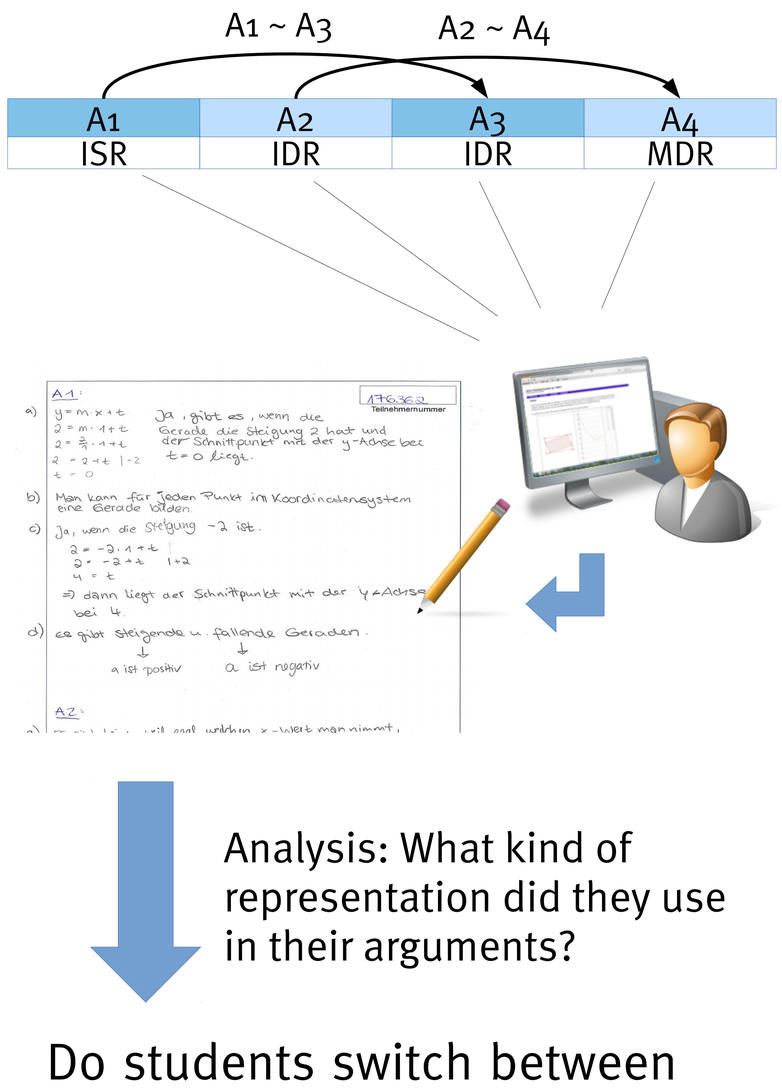
Do students switch between representation categories, according to the one presented in the task – or will they stick to the representation used in their first task?

The questions were purely **inner-mathematical**, and students were always asked to give **justifications** for their claims.

Method

The empirical investigation was taken in four German mathematics classes, grade 11 (students aged 16-17 years) with a total of **89 probands** with mixed levels in school mathematics. Tasks were presented on a computer screen using **GeoGebra**, but the students were to answer their questions with paper and pen.

Each student was asked to solve four mathematical problems, which consisted of **two pairs a and b with analogue tasks**, but **different representations**, in an "abab" order (see example below).



Results

The p values were calculated using the binomial test where the null hypothesis is that the types of representations in students' arguments were distributed equally in two analogue tasks.

Table 1: Results of group A

	A3 (IDR)				A4 (MDR)		
		Stat. Arg.	Dyn. Arg.		Isol. Arg.	Isol. Arg.	Mult. Arg.
A1 (ISR)	Stat. Arg.	1	**9**	A2 (IDR)	Isol. Arg.	2	**14**
	Dyn. Arg.	2	28		Mult. Arg.	2	10
	$p < .05$				$p < .01$		

Table 2: Results of group B

	B3 (MSR)				B4 (MDR)		
		Isol. Arg.	Mult. Arg.			Stat. Arg.	Dyn. Arg.
B1 (ISR)	Isol. Arg.	23	**16**	B2 (MSR)	Stat. Arg.	14	5
	Mult. Arg.	2	1		Dyn. Arg.	11	9
	$p < .001$				$p > .10$		

Conclusion

While in most cases, **students clearly tended to switch** from static or isolated representations to dynamic or multiple ones when they were presented to them, in the case of MSR → MDR, this was not the case.

The reason for this might be the particular task or cognitive overload from multiple, dynamically linked representations but it will require further investigation to be certain.