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Scaffolding student learning: A micro-analysis of teacher–student interaction

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ABSTRACT

Teacher scaffolding and more specifically, support that is adapted to or contingent upon a student's understanding, is considered effective in promoting student learning. Increasing control upon a student's failures, decreasing control upon a student's successes and keeping the degree of control the same in the case of partial student understanding are considered contingent support which provides an appropriate level of challenge. However, these theoretical premises have not yet been tested in classroom situations. The main goal of this study was to investigate different patterns of contingency and to explore how contingency affects student learning. Twenty-two pre-vocational teachers' lessons were analysed regarding contingency and student learning, using micro-analysis. The results show that: (1) if the initial student understanding is poor, contingent support results in increased student understanding, and (2) teachers seldom underestimated students' understanding but often overestimated students' understanding. Contingent support can be effective and future research should focus on facilitating teachers in learning how to correctly diagnose students' understanding.

1. Introduction

Similar to a construction scaffold – which is built up adaptively to a building and taken away when not needed anymore – scaffolding support is adapted to students' understanding and removed when redundant. Scaffolding is considered effective because it provides students with the right amount of challenge (Hammond & Gibbons, 2005). The scaffolding theory describes the scaffolding process in terms of adaptation of the level of control that is exercised by a tutor to students' understanding (Wood, Wood, & Middleton, 1978). That is, giving more control upon students' failures and giving less control upon students' successes indicate an adequate estimation of students' understanding. This provides students with the appropriate level of challenge (Mulvaney, McCartney, Bub, & Marshall, 2006) which is expected to result in student learning. The tutoring is contingent upon the student's understanding as expressed in his or her responses.

In contrast, giving more control upon students' successes may indicate an underestimation of the students' understanding. This provides students with little challenge and is not expected to result in student learning. Giving less control upon students' failures may indicate an overestimation of the students' understanding. This provides students with too much challenge which is not expected to result in student learning either. If the teacher's control is not adapted to the student's level, the instruction is non-contingent: there is no scaffolding.

However, these theoretical premises about the relationship between regulating control and student learning have, to our knowledge, not yet been empirically tested in classroom situations such as small-group work. Chiu (2004) for example explored the effects of teacher interventions on students' time on task and their progress in solving assignments, while working in groups. However, although he compared the effects of various teacher interventions, he did not analyse whether the interventions were

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contingent. In the present study we investigated teachers' contingent instruction, that is, their adaptations of control upon students' understanding. Furthermore, we investigated the students' learning that was exhibited within the teacher–student interaction. The goal of the current study is to investigate different patterns of contingency and to explore how contingency affects student learning.

1.1. Scaffolding

The term scaffolding was coined in 1976 by Wood, Bruner, & Ross, 1976. It is closely related to Vygotsky's socio-cultural theory and especially to his concept of the Zone of Proximal Development (ZPD) (1978). Vygotsky was not only interested in what students could do on their own (their actual level), but also in what students could do with the help of a more knowledgeable partner (their potential level). The distance between the actual and potential level is called the ZPD. Vygotsky (1978) argued that good support is that which is ahead of the learners' actual development. Scaffolding support does not focus on what a student can already do but focuses on what a student cannot do yet on his/her own. However, if the support lies outside the ZPD, the degree of challenge is either too little or too high and the support can no longer be called scaffolding. Scaffolding thus seeks to provide the appropriate amount of challenge for students in order to learn.

In the last decades, the term scaffolding has often been used as a synonym for any kind of support (Mercer & Littleton, 2007; Stone, 1998). However, we see scaffolding as support that: (1) is contingent, (3) fades over time, and (3) is aimed at transferring the responsibility to the student (Van de Pol, Volman, & Beishuizen, 2010). Contingency represents the adaptive nature of scaffolding support. In other words, scaffolding support is support that is adapted to or contingent upon students' understanding. Furthermore, the support is not provided on a permanent basis; it fades over time. Finally, the ultimate goal of scaffolding is to enable the student to perform a task alone and to transfer the responsibility for a task to the student. Contingency can be seen as the most central characteristic of scaffolding as non-contingent fading and non-contingent transfer of responsibility can never be called scaffolding.

1.2. Contingency

In their research, Wood and his colleagues concentrated on the central aspect of scaffolding, that is, contingency (e.g., Wood et al., 1978). They developed the *contingent shift principle* that consisted of two rules: increase control when students fail and decrease control when students succeed. A high degree of control is for example to provide an answer or an explanation whereas a low degree of control is for example to ask an open question. The absolute degree of control does not determine whether scaffolding takes place; it is about the *adaptation* of the degree of control to a student's understanding that determines scaffolding. Increasing the degree of control and thus providing steering support *can* be scaffolding, but only if this is done when a student fails. Table 1 shows how the scaffolding theory views the relationship between contingency, challenge and student learning.

A non-contingent increase of control indicates a teacher's underestimation of a student's understanding; the teacher provides too little challenge. Too little challenge results in no further learning because the support given is too easy and may prevent students from processing other, more elaborate information (Wittwer, Nückles, & Renkl, 2010). A non-contingent decrease of control indicates a teacher's overestimation of a student's understanding; the teacher provides too much challenge. The help (e.g., explanations) given is too complex and may cause comprehension breakdowns (Wittwer et al., 2010).

In contrast, all patterns of contingent support indicate a correct estimation of a student's understanding and also provide the right amount of challenge. In both cases, student learning can be expected; the teacher helps the student to perform the task successfully.

Helping students while applying contingent shifts in control appears to be effective in one-to-one situations with regard to e.g., self-regulated learning (Mattanah, Pratt, Cowan, & Cowan, 2005; Pino-Pasternak, Whitebread, & Tolmie, 2010; Stright, Neitzel, Sears, & Hoke-Sinex, 2001), block-building and puzzle construction tasks (Pratt, Green, MacVicar, & Bountrogianni, 1992; Pratt & Savoy-Levine, 1998; Wood & Middleton, 1975) and long-division math homework (Pino-Pasternak et al., 2010; Pratt et al., 1992). However, these studies have all been performed in tutoring or parent–child situations, not in classroom situations. In addition, most studies adopted a macro-perspective, that is, they related the contingency of support to students' performances on tasks. In contrast, in the current study we explored the direct effect of contingent support by adopting a micro-perspective.

Table 1
Contingency Patterns.

		Increase of control (Control +)	Decrease of control (Control −)	Same control (Control =)
Non-contingent support	Students' initial understanding is:	good	poor/partial	poor/good
	Teacher ….. students' understanding	underestimates	overestimates	underestimates/overestimates
	Degree of challenge:	too little challenge	too much challenge	too little/too much challenge
	Learning:	no learning	no learning	no learning
Contingent support	Students' initial understanding is:	poor/partial	good	partial
	Teacher ….. students' understanding	correctly estimates	correctly estimates	correctly estimates
	Degree of challenge:	appropriate	appropriate	appropriate level of challenge
	Learning:	learning	learning	learning