A new orientation for research on problem solving and competencies in any domain

Andreas Fischer[1]

[1]Research Institute for Vocational Education and Training (f-bb), Germany.

Research on complex problem solving (CPS) has reached a stage where certain standards have been achieved, whereas the future development is quite ambiguous. In this situation, the editors of the Journal of Dynamic Decision Making asked a number of representative authors to share their point of view with respect to seven questions about the relevance of (complex) problem solving as a research area, about the contribution of laboratory-based CPS research to solving real life problems, about the roles of knowledge, strategies, and intuition in CPS, and about the existence of expertise in CPS.

Why should there continue to be problem solving research (in addition to research on memory, decision-making, motivation etc.)?

Problem solving - as well as the disposition to solve tasks and problems in a given domain (i.e., "competence", see Fischer & Neubert, 2015) - is more than the sum of its parts and interesting in its own right. In particular, building and testing theories on problem solving may contribute to

- understanding where and why people fall short from optimum when confronted with complex and dynamic problems,

- deriving and teaching/training useful strategies to help people in need to become better problem solvers (Kretzschmar & Süß, 2015),

- providing assistance to people in charge (e.g., by partially automating the process of modelling or solving complex problems).

What are the connections between current CPS research practice and real problems? Where do you see potential for development towards stronger relations?

Current CPS research has a focus on interactive toy problems that can be solved by systematically applying simple strategies such as "Varying One Thing At a Time" (VOTAT). This kind of research is interesting and valuable in many regards, but needs to be put in perspective (for an overview, see Fischer, 2015; Funke, Fischer & Holt, 2018).

To establish stronger relations of CPS research to real problems, the heterogeneity inherent in some of the current CPS paradigms (e.g., MicroFIN) could be exploited. Additionally, new paradigms based on fundamental problems and dilemmata of real life may well be worth a try (e.g., Grossmann & Kross, 2014; Grossmann, Kung & Santos, 2018)

Given the artificiality of the laboratory situation, do participants really adopt the presented problems? What insights can be gained despite this artificiality and which cannot?

The artificiality of the laboratory situation is perfectly suited for (and may have contributed to a focus on) research on toy problems. This is not necessarily a bad thing: CPS research of the last decade has shown that this kind of research can be fruitful indeed.

Presenting more complex and/or realistic problems in the laboratory in an immersive manner is more challenging but it may be worth the effort (see Schoppek & Fischer, 2017; Grossmann & Kross, 2014).

What evidence exists for the influence of other kinds of knowledge besides structural knowledge on the results of CPS? Which of these kinds of knowledge should be examined in future research?

There is a lot of research on the influence of strategic knowledge, implicit knowledge, instance-based learning and the potential of case-based reasoning (see Fischer, Greiff & Funke, 2012). Future research should elaborate on the interplay among these kinds of knowledge as well as on non-cognitive factors and circumstances this interplay (or its effectiveness) depends upon (cf. Fischer & Neubert, 2015).

Table 1. Exemplary components of competency, varying in domain-specificity (cf. Fischer & Neubert, 2015)

	knowledge	skills	abilities	other
domain general	world knowledge	problem solving skills	general intelligence	frustration tolerance
domain specific	domain expertise	psychomotor skills	numerical reasoning	certificates

What evidence is available for the impact of strategies (except VOTAT) on the results of CPS? Which of these strategies should be examined more closely?

Problem solving research has elaborated on a variety of heuristics and strategies (see Fischer, Greiff and Funke, 2017), and all of these huristics and strategies can be applied to problems of varying complexity. One question that research on CPS should elaborate on in more detail is when to apply (or abandon) which strategy.

Is there intuitive CPS?

This depends on the definitions of intuition and of CPS, but I tend to agree: On the one hand a person may not be likely to have a problem when intuition can provide a solution. On the other hand – and highly characteristic for CPS situations – an expert may well be able to intuitively provide a solution to another person's problem (commonly referred to as "wisdom", cf. Fischer, 2015b; Fischer & Funke, 2016). In fact people even tend to reason *more* wisely when it comes to *other* peoples' problems - a phenomenon known as "Solomon's paradox" (Grossmann & Kross, 2014).

What distinguishes experts in CPS from laypersons?

Wisdom - i.e., knowledge and deep understanding of the fundamental pragmatics of life (Fischer 2015b; Baltes & Staudinger, 2000) - may be one of the most distinguishing attributes of an expert in CPS, but as the disposition to solve complex problems (i.e., "competence") in any domain is based on a wide range of domain-general and domain-specific kinds of knowlede, skills, abilities and other components (as explained in more detail in the KSAO-model by Fischer & Neubert, 2015) differences are to be expected in each component of the KSAO-model (see Table 1 for examples).

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Corresponding author: Andreas Fischer, Forschungsinstitut Betriebliche Bildung (f-bb) gGmbH, Rollnerstraße 14, 90408 Nuremberg, Germany. E-mail: andreas.fischer@f-bb.de