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# Preface

## "Ill-Defined Domains" Special issue of IJAIED

Welcome to the second half of the two-part special issue on intelligent tutoring systems and ill-defined domains. In the prior issue (Lynch, Ashley, Pinkwart, & Aleven, 2009) we sought to frame the discussion by presenting a historical overview of AI in ill-defined domains and discussing previous definitional work by Simon (1973) and Voss (2006; Voss, Greene, Post, & Penner 1983) among others. In that discussion we noted the importance of *framing* or *recharacterization* when solving ill-defined problems. By recharacterizing a problem solvers seek to: emphasize or deemphasize salient aspects of it, draw analogies to or distinctions from prior work, and render the problem concrete or *tractable*. We then presented the following definition to frame the subsequent discussion:

> [1] A problem is ***ill-defined*** when essential concepts, relations, or solution criteria are un- or under-specified, open-textured, or intractable, requiring a solver to frame or *recharacterize* it. This recharacterization, and the resulting solution, are subject to debate.
>
> [2] ***Ill-defined domains*** lack a single strong domain theory uniquely specifying the essential concepts, relationships, and procedures for the domain and providing a means to validate problem solutions or cases. A solver is thus required to structure or *recharacterize* the domain when working in it. This recharacterization is subject to debate.

This issue of recharacterization and framing was addressed in the work presented in that issue. Both Ogan, Aleven, & Jones (2009) and Kim, Hill Jr., Durlach, Lane, Forbell *et al.* (2009) addressed the issue of culture and the reframing of discussions across cultures. Ogan et al. did so in a tutor for intercultural competence where students focused on cross-cultural perspective-taking. Kim et al. tutored students in negotiation with a focus on translating ill-defined goals into specific well-accepted actions. Kazi, Haddawy, & Suebnukarn (2009) focused on the comparative aspects of a different domain by tutoring students in medical diagnosis with the focus on drawing analogies and generalities from expert examples.

The papers in this issue focus on techniques for student guidance and assessment in ill-defined domains. Bratt (2009), for example, surveys the issues raised by the application of simulation-based tutors to ill-defined domains notably in considering hypothetical variants of well-known problems. Like Kim et al. she argues for the utility of simulations that combine a well-defined model with more flexible guidance and highlights the lessons that can be drawn from expert human tutors.

This focus on the lessons that can be drawn from human tutors and the challenges of variation is continued by Weerasinghe, Mitrovic, & Martin (2009) who describe a dialogue-based tutoring system for database design. Their system uses a model-driven approach to provide student guidance coupled with human-authored dialogues, and they report positive agreement between human-experts and system diagnoses. This focus on the challenges of diagnosis is further addressed by Le & Menzel (2009) who introduce the domain of logic programming and highlight the challenges involved in diagnosing novel student solutions. Le and Menzel support their discussion with a study of the tutor's diagnoses.

From natural-language tutoring and diagnostic or design domains we turn to argument and policy domains and diagrammatic models of argument. In Pinkwart, Ashley, Lynch, & Aleven (2009) the authors describe a novel tutoring system for legal argument with a focus on arguing with legal rules or *tests*

and *hypothetical cases*. Easterday, Aleven, Scheines, & Carver (2009) focus on the problems of policy deliberation and the representation of or structuring of debate. In both cases the authors use diagrammatic models of argument to structure the students' process, helping to guide their comprehension of preexisting arguments and their production of new claims.

Taken together we hope that the two parts of this special issue will serve as a suitable framework for presenting current research in ill-defined domains and ill-defined problems and as a guide to future endeavors. Our thanks to the authors who submitted such excellent papers.

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