The Nature of Research on Problem Solving

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Joachim Funke was the chair of the Problem Solving Expert Group in the fifth cycle of the Program for International Student Assessment (PISA). The data-collection phase of this cycle was in the spring of 2012, but outlining the conception and preparing the frameworks and the instruments required more than three years before the actual assessment. The analyses of the data and drafting the report took one more year. The time of the mandate of this group was the period when we had a common task, a few years of intensive work when we ourselves also acted as collaborative problem solvers.

Science is conducted by scientists, individuals who typically work in groups. They are personalities with different characters, backgrounds and skills; people who have specific roles in groups and contribute in many different ways to the success of the collaboration. In most cases, the scientific community and the general public only see the end product of a research and development process. This is usually a publication, in rare cases a license, a new method or a new instrument. The process itself, the overcoming of challenges, the debating of alternatives, the making of crucial decisions, the sharing of work among members, remains usually hidden and only in rare cases do historians of science reconstruct the process and the key events.

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If we include the preparations for the first cycle, PISA now has a history of about a quarter of a century. The seven assessment cycles have produced an enormous amount of reports, books, papers and huge databases for secondary analysis. The program has sparked fierce policy debates and has also contributed to the development of education systems in a number of countries. Despite its unprecedented impact, little is known about the work of the expert groups, but the activities of these scholars are interesting, and those responsible for the innovative areas may be particularly adventurous.

In this chapter, I present such a process, focusing on the phase in which Joachim formally played the leading role. However, his scientific work had an impact on the previous period as well, and the group he headed continued and even expanded the joint work further in a period when his activities in PISA had already officially ended. Accordingly, I divide my overview into four parts. First, I outline the context in which the Organisation for Economic Co-operation and Development (OECD) renewed the evaluation of students' knowledge, and from which the assessment of problem solving in a large international assessment program emerged. Then, I describe the period of the first and the second problem solving assessment, finally, the work and the impacts that followed these stages. I am not, of course, attempting to describe the wide-ranging impact of Joachim's work, but to focus on the events and processes—within and beyond PISA—in which I myself was involved. I summarize what I have learned from Joachim, and how I see his role and impact on the research on problem solving.

The Role of OECD in Renewing the Assessment of Students' Knowledge

The OECD aims to support social and economic development in all countries of the world, as summarized in a current statement: "Our goal is to shape policies that foster prosperity, equality, opportunity and well-being for all."[1] The

[1] See https://www.oecd.org/about/, retrieved December 20, 2022.

OECD has a large statistical database which allows sophisticated analyses and modeling the forces that drive social progress and economic growth. As became clear from economic research, education is a main engine of development and the OECD therefore collected data about schooling as well. However, the data that were available earlier about the education in the member countries did not really characterize the quality of education.

It is well known that there are countries in which students acquire more knowledge of a higher quality in a shorter period of time than students in other countries with a weaker school system. Thus, simple school enrolment data do not say much about how a school system (or more broadly, a society as a whole) is able to create new knowledge, the type of knowledge that really supports development, prosperity, and well-being. This demand triggered the construction of a measurement system that can provide a sufficiently detailed description of the performance of school systems. PISA was designed for this purpose, assessing knowledge with the most advanced instruments and completing data-collection with a broad range of background variables to offer a sound basis for policy-relevant analyses.

An essential prerequisite for creating such an evaluation system is to clarify what kind of knowledge young citizens of developed societies need for preparing a successful private and professional life. This question was explored by several OECD expert bodies. These efforts included the *Definition and Selection of Key Competencies* (DeSeCo) project. The initial ideas were discussed in the framework of a series of workshops and two symposia in 1999 and 2002. The conclusion of this work was, in brief, that in order to live a successful life, citizens of a well-functioning society have to be able to work in heterogeneous groups, act autonomously, and use tools such as language or technology interactively. The results of DeSeCo were published in two volumes (Rychen & Salganik, 2001, 2003) and influenced several further programs.

It was also obvious that PISA had to follow the common standards of international assessments and so had to include the three main domains that are usually assessed in large-scale national and international programs: reading, mathematics, and science. However, the conception of knowledge was renewed in these areas as well, by extending the concept of *literacy*. Reading literacy, mathematical literacy and scientific literacy were defined so that they included how well students understood key concepts, how they mastered certain processes, and how they could apply their knowledge in real-world situations. In contrast to some previous programs, PISA did not aim at examining how successfully students mastered the school curriculum, but rather how young people were able to apply their knowledge and skills in order to successfully cope with life's challenges. These principles were set out before the first assessment (OECD, 1999), and are slightly revised before each survey cycle in the assessment frameworks, which are published well before the actual data collection.

The goal of PISA is to monitor the achievements of the educational systems by assessing various aspects of knowledge of 15-year-old students. The topics of the measurements are aimed at being aligned with social changes and reflecting new challenges. The realization of this goal does not always fit into the three traditional domains; there are several interesting and relevant novel fields which cannot easily be included into their assessments. Furthermore, a basic requirement is that the trends of change in each country should be clearly seen from the results. This expectation can be met only if the measuring instruments remain unchanged. Thus, it is not possible to significantly change the tests from cycle to cycle: the instruments used for the three main domains must remain stable.

As the assessments of reading, mathematics, and science were used in this way to outline trends, further domains had to be added to assess novel aspects of students' competencies to reflect changing expectations. Therefore, a fourth, so called *innovative* domain is assessed in every PISA cycle. This innovative domain can always be a new one without any restriction concerning its content and the method of measurement.

By adding such an innovative domain, PISA faced a new challenge: agreeing on an original topic which is interesting, relevant for policy making, and measurable in international contexts. A further expectation is that the innovative domain should measure something, which cannot be predicted from the data of the other domains. In other words, the innovative domain should add a new measurement dimension, so that it can distinguish countries which are similar according to the achievements in reading, mathematics, and science.

In the first assessment in 2000, the innovative domain explored students' approaches to learning by examining their learning strategies, their motivation and their confidence in their own learning abilities. A questionnaire using a set of scales was used to generate a picture about the way students learn in the participating countries and the results revealed several so far unknown aspects of education. For example, they have shown that there are large differences between countries in the frequency with which students use rote memorization versus elaborative learning strategies, and they help explain some of the differences in cognitive test performances (Artelt et al., 2003).

The First PISA Problem Solving Assessment—The Early Period of Cooperation

The origin of assessing problem solving in PISA can be traced back until 1999, when the Network A of the OECD (a group responsible for the development of indicators of learning outcomes) commissioned a paper on the possibility of assessing problem solving within PISA. A group of experts were invited for further elaborating this idea under the umbrella of Network A. These experts (Network A Problem Solving Group) met for the first time in Chicago in April 2000, around the same time when the data collection of the first cycle took place. This date also indicates that the preparation started well before the actual survey and it took three years. This group consisted of five members: John Dossey, chair, Illinois State University (USA); Benő Csapó, University of Szeged (Hungary); Ton de Jong, University of Twente (The Netherlands); Eckhard Klieme, German Institute for International Educational Research (Germany) and Stella Vosniadou, National and Capodistrian University of Athens (Greece). Two further working meetings were organized within Network A, also attended by Eugene Owen, a representative of OECD. The initial results were presented to the Board of Participating Countries (BPS) in October 2000 at its meeting in Bremen. After some discussion the conceptual framework was accepted by the BPS, and a decision was made to include the assessment of cross-curricular problem solving within PISA 2003.

Subsequently, the Problem Solving Expert Group (PEG) was officially formed and its first formal meeting took place in Brussels in February 2001. The research experience of the members of PEG covered a broad range of fields in cognition, cognitive development, and educational testing. Although our fields of research were related to some aspects of problem solving, none of us was a specialist in research on problem solving. When I asked the colleagues working in the OECD, why this group was put together in this way, they explained that by this composition the probability of non-traditional, creative solutions could be increased. Furthermore, designing and implementing large-scale assessment in international context, where the participating countries are culturally diverse, require other approaches than usual in psychological research. Later on, we realized the challenges that emerged from this expectation.

Problem solving is one of the broadest intellectual processes known, and it is also one of the most intensively researched cognitive constructs. It is used almost everywhere, and has many different definitions and interpretations. So the first task of the expert group was to narrow the conception of problem solving and define it in a measureble format to fit the general aims of the PISA assessments. Looking back to that period, I see three main challenges.

First, we had to study the relevant literature on problem solving in depth. Besides reading or re-reading several classical works on problem solving, this was the phase when I realized the importance of Joachim's contribution to the field. When the group had decided, that the complex problem solving (CPS) paradigm will be the main direction of the approach, several aspects and characteristics of CPS were adopted from his publications, for example, the concept of complexity and the difference between analytical and complex problem solving (Funke, 1991, 1995; Frensch & Funke, 1995). As I was interested in computer-based assessment, I was especially impressed with his works on the use of computers in the assessment of CPS (Funke, 1998). For a while, the expert group considered computer-based assessment as well, but as the conditions were not present in many countries, this idea was dropped in earlier assessment cycles. (For the first conceptualization see Dossey et al., 2000).

A second challenge arose from the fact that each main domain (reading, mathematics and science) already had problem solving components as part of their literacy definition in the framework (see OECD, 1999). The potential overlap was especially large for mathematical literacy. So the expert group had to pay attention to avoid the possible overlap with the other domains and clearly separate CPS from them. Therefore, the content of the assessment was moved from familiar to unfamiliar settings, the context from school-based topics to real-world, and the complexity increased from single discipline to multiple applications. For harmonizing the assessment of CPS with the other domains, the chairs of the other PISA expert groups, Jan De Lange (Utrecht University, The Netherlands, Mathematics Expert Group), Wynne Harlen (University of Bristol, United Kingdom, Science Expert Group) and Irwin Kirsch (Educational Training Service, United States, Reading Expert Group) joined our core PEG.

Third, we had to communicate our outcomes to others. First of all, we had to report about our work to the PISA BPC. This task was usually done by John Dossey and Eckhard Klieme, as they were most familiar with problem solving research. Furthermore, the assessment of CPS needed to be explained to a broader scientific community, and finally we had to be prepared to clarify the results to the stakeholders, policy makers and to a lay audience. As this was the first time that a cross-curricular competency was measured in an international assessment program, it was not an easy job. In the first phase of our communication efforts, we realized that evaluating problem solving is by no means a self-evident and understandable idea. Although developing problem solving is a declared goal of schooling, there is no subject in the curriculum called problem solving. A question that has often been asked since the beginning of PISA is: Is it right to assess something that is not taught in school? Representatives of some countries feared (sometimes rightly) that such a survey would highlight the weaknesses of their school systems. And we have had to argue again and again that PISA (and in this particular case the CPS assessment) is not a competition for better rankings, but a tool for identifying needs and opportunities for improvement. Beyond arguing for the relevance of CPS assessment, we also had to deal with the validity and reliability of the prepared instruments, which also raised unexpected challenges.

The expert group, in agreement with all stakeholders, created a balanced definition that expressed all major aspects of CPS relevant to PISA assessment:

> Problem solving is an individual's capacity to use cognitive processes to confront and resolve real, cross-disciplinary situations where the solution path is not immediately obvious and where the literacy domains or curricula areas that might be applicable are not within a single domain of mathematics, science or reading. (OECD, 2003, p. 156).

The phases of problem solving described in the framework were in line with the well-known steps that Polya (1945) identified decades ago (understanding, characterizing, and solving the problem, then reflecting on the solution and communicating it), and this familiarity also helped to improve the acceptance of the CPS assessment. The results clearly indicated that CPS was different enough from the other domains and indicated interesting differences between the participating countries which were new compared to the results of the other domains (OECD, 2004). This was a promising direction for the future innovative domain.

The Story of the PISA 2012 Dynamic Problem Solving Assessment

When the preparation processes for the PISA 2012 assessment cycle started, I was a member of the PISA Governing Boards (PGB), more exactly, I was the vice chair of it. Although there was not a strict formal share of responsibilities within the executive group (the chair and the three vice chairs), due to my research background, I was asked to elaborate a proposal for the innovative domain of the 2012 assessment cycle. As in 2003, when mathematics was the main assessment domain, and complex problem solving was measured in parallel with it, it was an obvious idea that some kind of problem solving should be measured again.

Nevertheless, it was not required to connect it to the previous CPS assessment, therefore I was encouraged to incorporate all current developments of the field into the proposal.

The document I prepared (Csapó, 2008) was discussed and approved by the PGB and became an Annex of the Terms of Reference for the 2012 assessment (see Annex E of OECD, 2008). In this proposal I suggested a new definition of problem solving, and, for maximizing its added value, I proposed that it should be "further distanced and better distinguished from the three core literacy domains" (OECD, 2008, p. 67). Computer delivery was also a crucial component of the proposal. This idea was not new in PISA at that time, as in 2006 the Computer-based Assessment of Scientific Literacy (CBAS) was already an optional part. Nevertheless, only three countries (Denmark, Iceland and Korea) participated in that optional assessment, and the final report about it appeared only years later (OECD, 2010). Furthermore, the second computer-based assessment in PISA, the online reading assessment in 2009, was still in preparation (see OECD, 2011), so there was little evidence that computer delivery would be possible in all participating countries. On the other hand, the 2012 PISA was planned as a breakthrough in terms of computer delivery: a computerized version of the main domains (reading, mathematics, and science) was also offered for all countries.

The problem solving expert group began its work with this background. The situation was somewhat controversial, as on one hand the expert group was expected to design an original assessment that would go beyond both the previous CPS assessment and the already planned computer delivery of the main assessment domains. On the other hand it seemed unlikely that such an assessment would be possible on an international scale, taking into account the diversity of the participating countries.

The first meeting of the Problem Solving Working Party (as it was called in the meeting documents) for outlining the new problem solving assessment was held in Santa Barbara (Richard Mayer's home university) in July, 2009. This meeting was very well prepared, and the materials distributed to the participants summarized the goals of PISA, and described in details the former problem solving assessment;

including the background processes and of what we have learned from the previous works. The main purpose of this meeting, chaired by Ray Adams, was to establish a common understanding of the conceptual framework of the problem solving assessment. The presentations, an overview of PISA in general (by Ray Adams), the PISA 2003 problem solving (John Dossey), the background of the PISA 2012 problem solving (Ray Adams) and the technical possibilities of the computer-based delivery (Maurice Walker) were followed by intensive discussion.

However, there were a large number of dilemmas and the participants were divided on several issues. For example, whether the 2012 problem solving assessment should be connected to the 2003 CPS assessment, and whether it should be linked to the Programme for the International Assessment of Adult Competencies (PIAAC), which had similar tasks. A further question remained, which had already been raised in the 2003 assessment, as to how problem solving could be a construct distinct enough from the main literacy domains if they were also assessed computer-based and included (domain-specific) problem solving components.

To come to an agreement, another meeting was organized shortly after the first one in September 2009, also in Santa Barbara. To broaden the scope of the possibilities, Kathleen Scalise and Marilyn Binkley presented an overview of the Assessment and Teaching of 21st Century Skills project (for the results of the first phase of this initiative, see Griffin et al., 2012). As the initial proposals seemed too traditional, I also gave a presentation, arguing that we should further decrease the overlap between problem solving and the other three domains and increase the novelty and added value of this assessment. I argued that it should be as innovative as possible, as a theoretical construct as well as in the operationalization of its assessment. It seemed to me that connecting it to the 2003 CPS assessment would constrain the possibilities; therefore I also proposed to give up the idea of such a connection and to construct an entirely different assessment. I argued that success in the assessment of problem solving would determine future directions and developments in this area. I also mentioned that dynamic problems seemed to be a fruitful area to pursue. In the discussion that followed my presentation, it became clear that the extent of innovation should constantly, but gradually be increased across the assessment cycles.

By that time, I was familiar with the research of Joachim Funke in dynamic problem solving (e.g., Funke, 1988, 1992, 1993, 2001). I was especially interested in the relationship between the knowledge acquisition phase of dynamic problem solving and inductive reasoning. I also knew him personally; I met him and his research group several times at the annual workshops (colloquia) of the German DFG Priority Program "Competence Models for Assessing Individual Learning Outcomes and Evaluating Educational Processes". I was invited to be a "critical friend" of the program, and my task was to read and critically comment on the materials of the participating research groups.

So, in that second meeting in Santa Barbara, I argued in favor of Funke's approach, in part because the reasoning processes involved are more visible than in traditional problem-solving tasks. However, I was not sure whether we could go this far in a large-scale assessment and whether dynamic tasks could be implemented on computers so that such an assessment could be carried out in all participating countries. The arguments of colleagues with experience in international assessment seemed convincing, and I agreed that we needed to keep the risks at an acceptable level. Luckily, Detlev Leutner also contributed to the discussion and had a number of encouraging remarks when he explained that various aspects of problem solving had already been assessed in Germany in several contexts. He argued convincingly that dynamic problem solving was the best option (see also Klieme et al., 2005; Leutner & Wirth, 2005). Perhaps his thoughtful, professional argument was the final moment that decided the debate, and the majority of those present accepted that dynamic problem solving should be the innovative domain. At the same meeting, in recognition of his prominent role in problem solving research and his pioneering role in dynamic problem solving, it was decided that Joachim should be invited to chair the expert group.

From that point onwards, the work followed the protocol established by PISA. An expert group was formally appointed, chaired by Joachim Funke (Heidelberg University) with seven core members: John Dossey (Illinois State University, United States), Arthur Graesser (University of Memphis, United States), Detlev Leutner (Duisburg-Essen University, Germany), Romain Martin (Université de Luxembourg FLSHASE, Luxembourg), Richard Mayer (University of California, United States), Ming Ming Tan (Ministry of Education, Singapore) and Benő Csapó (University of Szeged, Hungary). The first task of the group was to elaborate the assessment framework, creating a working definition, describing the organization of the domain, and specifying the characteristics of the assessment. After carefully discussing all views, a balanced definition was conceived based on Joachim's former work (e.g., Funke, 2010), taking into account the needs and limitations of a large-scale assessment:

> Problem-solving competency is an individual's capacity to engage in cognitive processing to understand and resolve problem situations where a method of solution is not immediately obvious. It includes the willingness to engage with such situations in order to achieve one's potential as a constructive and reflective citizen. (OECD, 2013, p. 122).

Of course, this simple, quite general, and easy to accept definition did not mirror the challenges the expert group faced mentioned in the previous sections. It still remained open to what extent the assessment could be based on the conception of dynamic problem solving, more specifically, on Joachim's approach. Some members proposed developing a "purely dynamic" but somewhat risky instrument, while the broader group of stakeholders preferred to remain on the safer side and following the most traditional and already tried-out tests. The difficulty of including dynamic problem solving was resolved by introducing the aspect of the "nature of the problem situation" and distinguishing static and interactive problem situations. By explaining the interactive situations, the crucial element, the first phase of the dynamic problem solving was described: "some exploration or experimentation must be done to acquire the knowledge necessary to control the device" (OECD, 2013, p. 125). Nevertheless, static problem situations were also described in the framework, leaving space for the more traditional approaches.

The expert group held a number of meetings, many of them with exciting debates, and Joachim guided the group through the risks and challenges with his calm professionalism. The final output of our work, the intellectual basis of the actual assessment, was published in the PISA results volume (OECD, 2014). The dynamic problems were described as "[i]nteractive: not all information is disclosed; some information has to be uncovered by exploring the problem situation" while there remained items that were "[s]tatic: all relevant information for solving the problem is disclosed at the outset" (OECD, 2014, p. 31). In the final instrument, there were five units with static items and altogether ten interactive units. These interactive items embodied ideas in a large-scale assessment which Joachim suggested decades ago (e.g., Funke, 1991, 1993, 2001). Six of them were based on the finite-state automata (Buchner & Funke, 1993; Funke, 2001) and four of them on linear structural equations (Funke, 1991, 1992; Greiff & Funke, 2009).

The actual assessment phase in 2012 went smoothly; the computerized tests were administered altogether to 85,000 students from 44 countries and economies. Neither the nature of dynamic problem solving, nor the computer delivery caused any specific difficulty, so the initial concerns proved unfounded (or, the foreseen risks were successfully managed). The 2012 problem solving assessment was, by any measure, extremely successful. It revealed dimensions of differences between countries that had not yet surfaced in previous surveys. It also paved the way for the 2015 collaborative problem-solving assessment, which also used interaction with a computer-simulated system and included the dimension of group dynamics in the measurement.

The Post-PISA-2012 Era—Long-Term Impacts

The meetings of the expert group were always an exciting experience. Problem solving, which never seemed like work, continued with intensive correspondence between official meetings. As with the personal meetings, problem solving was not limited to the time on the agenda, but began at breakfast and continued over dinner until late in the evening. The meetings were held in such memorable locations as

Boston, Melbourne, Budapest and Heidelberg, but even these locations could not distract the group from generating new and fresh ideas.

The main challenge in this process was to find a balance between the ideas of the participants and the possibilities of the international survey. The creative atmosphere maintained by Joachim inspired such a mass of ideas that they could no longer be squeezed into official documents and new opportunities had to be created.

One such opportunity was that we participated in many conferences where we could present the results of joint activities or mutually inspired research without formal constraints. This cooperation, which was separate from the PISA activities, also went beyond the formal commitments and continued even after the publication of the volume summarizing the PISA results. Such a meeting took place, among others, at the AERA conference in New Orleans, at the EARLI conference in Exeter, and the Szeged Workshop on Educational Assessment (SWEE), held in Szeged every spring between 2009 and 2016. On one occasion, in 2011, Joachim was co-chair of SWEE, which means that he played a crucial role in the compilation and execution of the program. The most memorable event probably was the "Celebrating Problem Solving" conference in November 2015, which was organized on the occasion of the University of Szeged awarding Joachim Funke the title of Doctor Honoris Causa.

Several people in this group then invited their colleagues to these meetings, until eventually a significant informal network of researchers interested in problem solving was formed. Finally, we decided to publish a volume of the work of this intellectual community. This turned out to be a unique phenomenon among the PISA expert groups, in that researchers in a field were kept together by a common interest even years after the end of their mandate. Since the inspiration for the book came from the joint activities carried out under the auspices of the OECD, the organization undertook to publish the volume, which I edited together with Joachim (Csapó & Funke, 2017).

The collaboration with Joachim resulted in numerous other long-lasting impacts on the professional career and research orientation of the participants. To mention only those in Szeged, we developed an online assessment system, the eDia (Csapó & Molnár, 2019). The main function of eDia is to provide diagnostic information for primary school students through regular assessment in reading, mathematics, and science. It has two main parts: One is an online platform that supports all aspects of testing, from writing sophisticated items, compiling and administering tests, analyzing the results, and providing detailed visualized feedback to students and their teachers. The other part is an item bank containing tens of thousands of items.

The platform can be used for any other assessment and we have implemented the assessment of dynamic problem solving in this system as well. After the abstract simulation works, concrete items are easy to create. The background story of the problems and other parameters (the number of variables involved and the relationships between them) can be freely changed. So we can run assessments with a large number of items (which Joachim predicted in the early 1990s) and we can do so in multiple contexts. For example, we measure our students' readiness for college at the beginning of their freshman year. We have tested the predictive power of several cognitive constructs, including dynamic problem solving (Csapó & Molnár, 2017). By assessing problem solving with this system, we can separate the results of the two phases of dynamic problem solving, knowledge acquisition and knowledge application. Finally, we were also able to provide empirical evidence that knowledge acquisition is more strongly correlated with other cognitive variables than knowledge application.

Some Concluding Personal Remarks

After reviewing Joachim's scientific work and our joint activities, I realized how many similarities there are in our professional careers, despite the many differences in the circumstances of our personal lives. We were born in the same year, and although we took very different paths, we became full professors in the same year. We spent the first 35 years of our lives in different political systems on two different sides of the Iron Curtain. Nevertheless, we seem to have developed a similar value system and we think the same way about many things in life and science. The language in which we exchange our thoughts is not our mother tongue, but that has never prevented us from understanding each other perfectly.

In 1989, when I was a Humboldt Scholar in Bremen, we witnessed the fall of the Berlin Wall from the same side. It was the year that brought about a change of historic significance in both our countries. Since then, the changed world order has allowed us to be involved in the same scientific processes and to participate in the same professional and scientific events in the second 35 years of our lives.

To emphasize the importance of educational measurement, we often quote Lord Kelvin, who said "if you cannot measure it, you cannot improve it". The number of publications is often cited as an indicator of a researcher's success. Citations can be counted; impact can thus be measured by the number of citations or by other indicators derived from the number of citations. Looking at Joachim's scientometric numbers, we can say that he is a successful researcher with a high impact. However, the old English saying (sometimes attributed to Einstein) that "the things that really count cannot be counted" shows the other side of the coin. This is the case for a difficult to define concept: the respect and recognition a scientist receives from colleagues, fellow researchers, and students. Joachim has earned this recognition.

Looking back on our collaboration over the past decades, I understand not only the nature of problem-solving research, but also the nature of academic friendship; or perhaps the nature of friendship in general, the nature of friendship without adjectives. With this chapter, I add my voice to the immeasurable respect that Joachim is held in by his colleagues and friends.

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