The Effect of Multiple-Perspective Thinking on Problem Solving

Yan Wang, Enis Dogan, Xiaodong Lin, Teachers College, Columbia University,
525 west120th street, Box 8, New York, NY, 10027
Email: yw2009@columbia.edu, ed346@columbia.edu, xlin@tc.edu

Abstract: The purpose of this study was to explore the relationship between people's multiple-perspective (MP) thinking ability and their problem solving performance (defining problems and generating solutions). The reasons why people seek other perspectives were also investigated. The results showed that the number of perspectives used in defining problems was significantly correlated with the number of solutions generated later. Subjects with higher MP thinking scores were able to define problems from more perspectives and generate more solutions. Native English speakers wanted to hear other perspectives more because they wanted to confirm their thinking, while non-native English speakers wanted other perspectives more because they wanted to understand the scenarios better. The main implication is that there may be a culture difference in people's MP thinking ability and perception of multiple perspectives, and it might be possible to train people on their MP thinking to improve their problem solving performance.

Introduction

The purpose of this study was to explore the relationship between people's multiple-perspective (MP) thinking ability and their problem solving performance. The reasons why people seek other perspectives were also investigated.

Wicklund (1999) defined "multiple perspectives" as a certain social phenomenon: people can recognize that an event may be viewed, defined or perceived in more than one manner, through several social focal points. Learning from multiple perspectives is not a new idea. Researchers have been experimenting with this idea in different fields. For instance, Case Technologies to Enhance Literacy Learning (CTELL) incorporated different perspectives (from different experts) to help pre-service teachers understand best practices of early literacy education (Schrader et al., 2003). Schwartz et al (1999) used MP approach to help preservice teachers design and learn about inquiry-based instruction in Star.Legacy program. Especially, learning from multiple perspectives is considered to be helpful for students in mastering skills in ill-structured problem solving and decision making (Spiro, Feltovich, Jacobson, & Coulson, 1992). According to Cognitive Flexibility Theory, acquiring knowledge through multiple perspectives and use of cases would increase learners' cognitive flexibility (which could be reflected by MP thinking), and thus facilitate knowledge transfer (Jacobson & Spiro, 1995). However, before designing MP learning environment, the relationship between MP thinking and problem solving performance should be investigated. Research has been carried out on the relationship between multiple-perspective thinking and problem solving thinking of well-defined problems (Russo, 2004; Gorenflo & Crano, 1998), but few of these research explored how multiple-perspective thinking affect people's performance in solving ill-defined problems. In addition, the reasons that drive people to seek other people's perspectives were seldom explored. To address these issues, the following questions were investigated in this study:

1. Are people with higher multiple-perspective thinking ability able to view a problem from more perspectives? Are they able to generate more solutions?

2. What are the reasons people seek other people's perspectives? Do people with different multiple-perspective thinking ability have different reasons? Do people with different problem solving performance have different reasons?

Theoretical Framework

D'Zurilla and Goldfried (1971) defined five-stage in problem solving: (1) Problem Orientation; (2) Problem Definition and Formulation; (3) Generation of Alternatives; (4) Decision-Making; and (5) Solution Implementation and Verification. Ill-structured problems are usually defined as problems which present one or more of the problem elements (Shin, Jonassen, & McGee, 2003) and possess multiple solutions, solution paths, or no

solutions at all (Kitchner, 1983). Many of the complex problems faced by teachers are ill-defined or ill-structured because these problems are situated in and emergent from a specific content (Jonassen, 1997) and lacking solutions that are indisputably correct (Kagan, 1993). Because of these reasons, being flexible in the second stage of the problem solving process – problem definition – is especially critical in solving ill-structured problems.

Theories on creative problem solving suggest the advantage of being able to think from multiple perspectives. Guilford (1984) stated that the ability to generate a large number of alternatives can increase the number of options one has in problem solving. He also argued that the most obvious aspects of creative thinking appear to depend on the ability to do divergent-productive thinking and to effect transfer of information. Therefore flexibility and divergent thinking are pointed out as important components in creative thinking and in the context of problem solving (Guilford, 1975; Runco, 1991).

Carr and Borkowski (1987) further theorized that being able to think from different perspectives is a basic foundational element of metacognition and it enhances the development and execution of cognitive processes. Multiple perspectives serve as a basis for strategic analyzing, discriminating, synthesizing and integrating information in complex decision making. According to Flavell (1979, 1987), metacognition consists of both active monitoring and regulation of cognitive processes. Metacognitive experiences involve the use of metacognitive strategies or metacognitive regulation (Brown, 1987). Therefore it can be argued that, because people with high multiple-perspective ability are able to view a problem from more aspects, they would be more inclined to reflect and evaluate their ideas and decide which one is more effective or relevant. As a result, these people can be expected to have a better understanding of the problem and better chance of generating more and differentiated solutions.

Methods

A group of 84 graduate students volunteered to participate in the study. The majority of these subjects was first and second year students in education related programs. Participants were first asked to complete a MP ability survey adopted from Multiple Perspectives Inventory created by Gorenflo and Crano (1998). The survey consisted of 20 self-descriptive statements and participants were asked to rate the extent to which they agreed or disagreed with each statement on a 7 points Likert-scale. After they completed this section, subjects were presented with two case scenarios describing common problems a typical school teacher would face. One case was about a teacher's frustration over low performance of a student and the other was about a student's loss of interest in studying. There were two questions for each case. The first question asked participants to define (articulate) the problems/ issues within the case and the second question asked for suggestions of possible solutions regarding these issues. The last section of the study contained seven questions investing subjects' interest in hearing about other participants' perspectives and the reasons they might want to know others' perspectives. At the end of the experiment, participants were informed about the purpose of the study.

Data Sources

Among 84 students who volunteered to participate in the study, 7 of them did not finish all sections of the study, so their partial answers were excluded from the analysis. As a result, final sample consisted of 77 subjects with no missing data.

Seven of the 20 statements in the MP ability survey are reverse-worded items. Ratings on these items were reversed coded and added to the rest of the rating scores in order to obtain a composite MP thinking score.

Coding schemes were developed for each open-ended problem solving questions after first round of draft coding. Each coding scheme consisted of categories of issues (problem definition section) or suggestions (solution generation section). Each category represented a perspective which can be used to interpret or address the scenario. For instance, in one scenario, there was a kindergarten student who couldn't answer his teacher's question about alphabetic letters and the teacher became frustrated. The categories of problems/issues ranged from social-cultural perspective (this child is from a poor family) to instructional design perspective (the teacher's strategy for assessing students' understanding is inadequate). The details regarding these perspective categories will be discussed in the results section.

After the draft was finalized, each entry was coded by two independent raters for what categories of issues/suggestions and how many categories it contained based on these coding schemes. The inter-rater reliability

was .917 for problem definition scores and .916 for problem solution scores. Discussions between raters resolved all the differences among their ratings. The number of problem definitions generated by the subjects tapping on distinct categories was added to obtain a 'Problem Definition Score' (PDS). The number of problem solutions falling into different solution categories was added to obtain participants' 'Problem Solution Score' (PSS). For problem definition section, the association among problem definition categories was also investigated.

The participants were asked whether they would like to hear other people's perspectives about the cases and rate to what extent they agreed with the six reasons why they would like to do so. These six reasons fell into two broad categories: improving their understanding of the problems (Reason 1) or confirming their suggestions to the problems embedded in the scenarios (Reason 2). The subjects' ratings on two categories of reasons were then converted to 'Reason Preference Score' (RPS1 and RPS2) by means of adding their ratings on each reason. The difference between RPS1 and RPS2 was then computed by means of subtracting RPS2 from RPS1 to obtain 'Reason Difference Score' (RDS). Therefore higher RDS indicated that the subject wanted other perspectives because they wanted to understand the case scenarios better more than they wanted to confirm their thoughts. Because the study was administrated in English, participants were also asked whether they were native speakers of English so that the effect of language could be taken into consideration in the analysis.

As a result five different variables were measured: Problem Definition Score' (PDS), Problem Solution Score (PSS), MP ability score, Reason Difference Score (RDS) and Language. The relationships among these variables were investigated through a series of regression and correlation analyses.

Results and Conclusions

Alpha coefficients for the 20 items in MP ability survey, the three Reason 1 and the three Reason 2 questions were .852, .903 and .850 respectively.

Independent sample t test results showed that there was a significant difference in MP ability score ($t = 3.139$, $p = .002$) and number of ideas in defining problem ($t = 2.458$, $p = .016$) and generating solutions ($t = 3.017$, $p = .003$) between native English speaking students and non-native English speaking students. Native speakers of English scored higher on all of these variables.

Results indicated that the number of perspectives used in problem definition (PDS) was significantly correlated with the number of solutions generated (PSS) ($r = .627$, $p = .001$). On the other hand, the regression analyses showed MP ability score was a significant predictor of PDS even after controlling for Language ($t= 1.99$, $p=.05$) (see Table 1). MP ability score was also a significant predictor of PSS ($t =2.00$, $p=.049$) after controlling for Language again (see Table 2). The interaction between language (English) and MP ability didn't have significant effect on either defining problems ($t = .49$, $p = .62$) or generating solutions ($t = .38$, $p = .71$).

RDS was not significantly correlated with the MP ability score, PDS, or PSS. Independent T test showed that non-native speakers of English scored significantly higher than native speakers on RDS ($t = 3.17$, $p = .002$) indicating that non-native speakers rated Reason 1 (improving their understanding of the cases) higher than Reason 2 (confirming their thoughts about the cases) as to why they wanted to hear other perspectives.

Table 1: Summary of Regression Analysis for Variables Predicting Problem Defining (N = 77)

Variable	B	SE B	β
Multiple-perspective Ability	.027	.014	.229*
English	.641	.381	.193

Note. $R^2 = .116$, $F_{2,74} = 4.875$, $p = .010$
* $p < .05$

Table 2: Summary of Regression Analysis for Variables Predicting Solution Generating (N = 77)

Variable	B	SE B	β
Multiple-perspective Ability	.025	.013	.225*
English	.831	.358	.261*

Note. $R^2 = .154$, $F_{2,74} = 6.746$, $p = .002$
* $p < .05$

A close look at the relationship between categories subjects used to define the problems/issues in two scenarios also revealed interesting results. For the first scenario (a kindergarten teacher and her student from different social and cultural background), six categories of perspectives emerged from subjects' answers to the problem definition question. They include perspectives on social-cultural influences (this child is from a poor family), special education (the child may have learning disability, such as speech impediment), inadequate prior learning experience (the child could lag behind his peers in his earlier education), cognitive misconception (the child has wrong concepts about English alphabets), improper instructional design (the teacher's strategy for assessing students' understanding is inadequate) and teacher personality (the teacher is not patient and encouraging enough). Hierarchical Cluster Analysis of these categories produced the following pattern (see Figure 1).

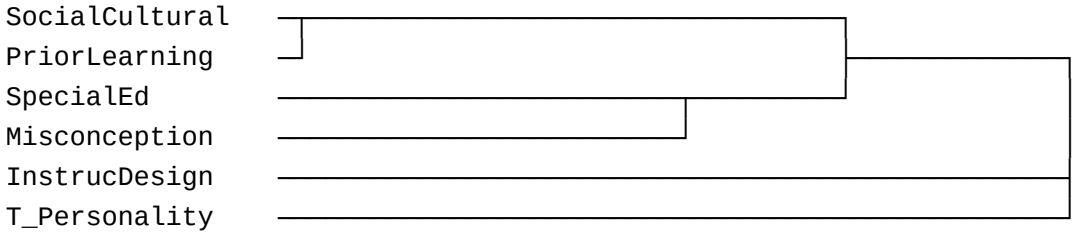

Figure 1. Hierarchical Cluster Analysis of problem definition categories (case 1)

As seen in Figure 1, the perspective of social-cultural influences and the perspective of inadequate prior learning are clustered together. Special education perspective is close to cognitive misconception perspective. The implication is that subjects who raised social-cultural perspective also tended to think the child's possible inadequate prior education could be the reason why he couldn't answer the teacher's question.

For the second scenario regarding a Chinese student losing interest in his course work, seven categories of perspectives emerged in defining the issues. They include perspectives on expectation (the student has wrong expectation), cultural difference (difference between Asian and American schools), adjustment management (he needs adjustment skills), environmental issues (the college doesn't have a friendly learning environment), relationship difficulties (he has problem developing connections), self-concept problems (his self-esteem, perception), academic experience/performance (inadequate contribution in class; courses too hard or too easy for him). Hierarchical Cluster Analysis of these categories resulted in the following production for the second case (see Figure 2).

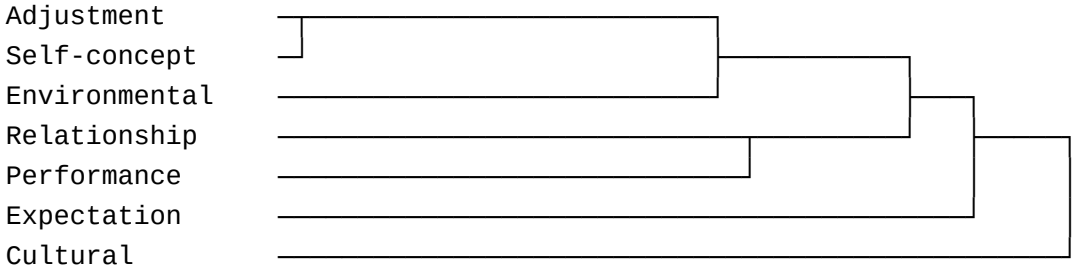

Figure 2. Hierarchical Cluster Analysis of problem definition categories (case 2)

As seen in Figure 2, adjustment management perspective was clustered together with self-concept perspective. Environmental factor joined them later. This means subjects who suggested adjustment problems of the Chinese student (in case 2) also tended to raise the perspective that the student might have improper self-concepts.

Environmental factors seemed to be considered relevant to the above two issues. The perspective of relationship factor and the perspective of the students' academic performance seemed to be clustered together too.

Discussion

This study explored how multiple-perspective thinking ability affected ill-structured problem-solving performance. It is found that although native English speaking students had better performance in problem solving than non-native English speaking students, subjects with higher multiple-perspective thinking ability defined the case scenarios from more perspectives and generated more solutions after controlling for language. The results also showed that native English speaking subjects wanted to hear other perspectives mostly because they wanted to confirm their thoughts, and non-native English speaking subjects wanted to know other perspectives mostly because they wanted to improve their understanding of the cases. This may indicate a cultural difference in multiple perspective thinking.

The study also has several limitations. First, subjects' teaching experience was not measured in this study. Teaching experience is a variable which could contribute to how well subjects perform in solving the ill-structured problems. Next, the measurement of subjects' problem solving ability can be improved. Probably in addition to analyzing the subjects' final answers to the questions, their cognitive process during the problem-solving task need to be recorded to provide further enlightenment to the relationship between multiple-perspective thinking and ill-structured problem solving. Moreover, the reason why native English speaking subjects had better performance in problem solving than non-native English speaking subjects need to be further examined.

Today, Internet and other multimedia technology have made exposure to multiple perspectives not just possible and but also unavoidable. How to live harmoniously with opinions and perspectives that are different or even conflicting to our own becomes more and more important. Also, in dealing with complex problems or situations, people may need to hold their assumptions and avoid jumping into conclusions. Enhancing people's multiple-perspective thinking could be one of the solutions to the above situations. Before designing any training projects to improve multiple-perspective thinking ability, it is crucial to understand how MP thinking affects people's performance in problem solving. This study revealed the connection between multiple-perspective thinking and ill-structured problem-solving performance. It provides the basis for future study on how to design programs to improve performance in ill-structured problem solving by learning from multiple perspectives. It is essential to investigate what kind of preparation people need in order to enhance their multiple perspective thinking ability. Whether people of different cultural backgrounds, cross-culture experience or personalities would react differently to training programs are also worthy of further exploration.

References

Brown, A. L. (1987). Metacognition, executive Control, self-regulation, and other more mysterious mechanisms. In F. E. Weinert & R. H. KLuwe (Eds.), *Metacognition, motivation, and understanding* (pp. 65-116). Hillsdale, New Jersey: Lawrence Erlbaum Associates.

Carr, M., & Borkowski, J. G. (1987). Metamemory in gifted children. Gifted Child Quarterly, 31, 40-44.

D'Zurilla TJ, Goldfried MR: Problemsolving and behavior modification. J Abnorm Psychol 78:107–126, 1971

Flavell, J. H. (1979). Metacognition and cognitive monitoring: A new area of cognitive-developmental inquiry. American Psychologist, 34(10), 906-911.

Flavell, J. H. (1987). Speculations about the nature and development of metacognition. In Weinert, F. E., & Kluwe, R. H. (Eds.) Metacognition, motivation, and understanding. Hillsdale, NJ: Lawrence Erlbaum Associates.

Gorenflo D.W. & Crano, W.D. (1998). The Multiple Perspectives Inventory: A Measure of Perspective-taking. *Swiss Journal of Psychology*. 57(3), 163-177.

Guilford, J. P. (1975). Varieties of creative giftedness, their measurement and development. Gifted Child Quarterly, 19, 107-121.

Guilford, J. P. (1984). Varieties of divergent-production abilities or functions. Journal of Creative Behavior, 18, 1-10.

Jacobson, M. J., & Spiro, R. J. (1995). Hypertext Learning Evironments, Cognitive Flexibility, and the Transfer of Conplex Knowledge: an Empirical Investigation. *Journal of Educational Computing Research, 12*(4), 301-333.

Jonassen, D. H. (1997). Instructional design models for well-structured and illstructured problem solving learning outcomes. Educational Technology, Research & Development, 45(1), 65-94.

Kagan, D. (1993). Contexts for the use of classroom cases. *American Educational Research Journal*, 30(4), 703-723.
Kitchner, K. S. (1983). Cognition, metacognition, and epistemic cognition: A three level model of cognitive processing. *Human Development*, 26, 222-232.
Runco, M. A. (1991). Divergent thinking. Norwood, NJ: Ablex
Russo, C. (2004). A Comparative Study of Creativity and Cognitive Problem-Solving Strategies of High-IQ and Average Students. *Gifted Child Quarterly*, 48(3), 179-190
Schrader, P. G., Leu, D. J., Jr., Kinzer, C. K., Ataya, R., Teale, W. H., Labbo, L. D., et al. (2003). Using Internet Delivered Video Cases, To Support Pre-Service Teachers' Understanding of Effective Early Literacy Instruction: An Exploratory Study. *Instructional Science, 31*(4-5), 317-340.
Shin, N., Jonassen, D. H., & McGee, S. (2003). Predictors of well-structured and ill-structured problem solving in an astronomy simulation. *Journal of Research in Science Teaching*, 40(1), 6-33.
Spiro, R. J., Feltovich, P. J., Jacobson, M. J., & Coulson, R. L. (1992). Cognitive flexibility, constructivism, and hypertext: Random access instruction for advanced knowledge acquisition in ill-structured domains. In T. M. Duffy & D. H. Jonassen (Eds.), *Constructivism and the technology of instruction: A conversation* (pp. 57-76). Hillsdale, NJ: Lawerence Erlbaum Associates.
Spiro, R. J., & Jehng, J. C. (1990). Cognitive flexibility and hypertext: Theory and technology for the nonlinear and multidimensional traversal of complex subject matter. In D. Nix & R. Spiro (Eds.), *Cognition, education, and multimedia: Exploring ideas in high technology* (pp. 163-205). Hillsdale, NJ: Lawrence Erlbaum Associates.
Wicklund, R. A. (1999) Multiple perspectives in person perception and theorizing. Theory & Psychology. 9(5), 668-678.

Acknowledgments

A special thanks from the first author goes to, Prof John Black at Teachers College, Columbia University, who provided constant feedback and support during the design and the implementation of this study.