

Visualizing Mental Models: Application of Drawing Analysis in Educational Studies

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*“If I can't picture it, I can't understand it.”
- Albert Einstein*

DEVELOPING thorough knowledge of students' cognitive processes, conceptual understanding, and emotional states has been critical to all educational studies and practices, and collecting effective data on these inward activities has invariably been challenging. Traditional quantitative research tools, such as scales with closed ended questions and standardized questionnaires, might be efficient in handling structured information, but have limitations when it comes to gathering data on students' cognitive and emotional states, which tend to be complex and implicit. As a result, certain researchers have opted to use qualitative data collection techniques of narrative inquiry to approach students' inner worlds, such as the focus group interview, story creation, and drama performance. Drawing analysis is also one such technique with increased popularity (Selwyn et al., 2009), with which, drawing is adopted to enable students to visualize abstract concepts, implicit attitudes, and even latent inspirations as analyzable images using visual symbols as media, providing researchers with valuable opportunity for data collection and analysis.

Drawing analysis can reveal the deeper cognitive structures of students. Compared to verbal expressions, drawings can visually showcase students' comprehension of abstract concepts. Hsieh and Tsai (2016) investigated students' conceptions of “learning” through analyzing drawings by Taiwanese students in six different grades and discovered that most student participants depicted learning as a teacher-centered classroom setting, and that there were significant differences in the perception of learning between lower- and higher-graders. Through engaging a group of primary school students in drawing pictures of engineers as they perceived, Chou & Chen (2017) researched into their conceptions of this category of professionals to find the

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presence of gender stereotypes and limited types of engineers in their drawings. These findings served as strong evidence for subsequent curriculum interventions. At the same time, existing studies find that drawing analysis is highly effective in capturing students' emotional and attitudinal states. For instance, Hsieh & Tsai's analysis (2016) revealed that lower-graders exhibited more positive emotions, while higher-graders displayed more negative emotions with a stabilizing tendency, in their drawings. This finding provides a basis for understanding the developmental trajectory of students' academic psychology.

Despite the high recognition of drawing analysis as a research tool in researchers, it is not without limitations. The meanings conveyed in subjects' drawings can sometimes be vague or overly whimsical; without accompanying written explanations, researchers may have difficulty analyzing them accurately. Also, students' drawing skills can affect the effectiveness and clarity of their expressions through drawings; those who are less proficient in drawing may struggle to deliver their ideas precisely through this medium. To address these limitations, certain researchers have recommended the mixed-method strategy, which combines drawing analysis with interviews, classroom observations, or questionnaires to obtain more accurate analytical results.

Drawing analysis cannot substitute for other data collection and analysis techniques but is surely a valuable complementary research instrument. Further exploration of its application potential in education and teaching research should be encouraged with the aim of developing more in-depth understanding of students' cognitive schemas and emotional experiences.

Exploring Prospective Teachers' Mental Models of Nephron Structure and Urine Formation through Drawing Analysis in this issue is a case study of conceptual instruction for pre-service biology teachers using drawing analysis. Thirty-two participants as prospective biology teachers were assigned the tasks of drawing the structure of a nephron and diagramming the urine formation process, and semi-structured interviews were subsequently conducted with six of them to delve into their thinking behind the drawings. The research findings revealed that the participants had inadequate or even incorrect understanding of relevant concepts (Xie, 2026). Regretfully, despite identifying certain misconceptions in the teacher candidates, the study did not give a sufficiently rigorous analysis of their causes. Still, it succeeds in demonstrating the effectiveness of drawing analysis in assessing students' comprehension of complex concepts and can, therefore, serve as a helpful reference for future research in this area.

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