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Since PISA, the Program for International Student Assessment, was created there is an international framework of classification and assessment of competencies in reading, mathematics and science. In several countries this has led to the formulation of educational standards in other subjects as well. These standards scale the dimensions of knowledge, skills and attitudes and mark achievement levels on certain moments in students career of schooling. In Switzerland, Austria and some 'Länder' of Germany educational standards and competency models in the visual arts were formulated. These competencies in visual arts are written in a largely data-free mode, that is they formulate what students are supposed to know or be able to do, but have little empirical groundings. According to its subtitle: 'Empirical Studies to determine visual-spatial competencies in art education' the publication 'Drawing: Perception, Processing, Depiction' by Edith Glaser and colleagues takes a different direction. The researchers chose visual spatial competencies because they are considered fundamental in visual perception and visual production and in art education they refer to both intrinsic, artistic aspects as well as instrumental aspects, namely transfer to spatial abilities in non-artistic realms. Moreover there is a starting point in the body of research on developmental stages in the graphic representation of space. However, much of this experimental research uses artificial tasks on drawing geometric forms, which limits the ecological validity of the results. In the study by Glaser there was no data collection in a laboratory like setting, but pupils were followed in school during a year and they were given a series of drawing lessons. Assignments on the theme 'pirates' involved not only visual spatial aspects but also fantasy and narration. Subjects were 10 to 13 year-olds. Pupils of this age are old enough to verbalize their reflections on the drawings and the preceding drawing process. Moreover in this age range the measurement of competencies has most consequences for decisions regarding the level of further education. The researchers made videos of the drawing process and held topic

interviews with the makers. The content analyses of videos and interviews as well as analyses of the drawings themselves formed an extensive amount of qualitative data.

Frame of reference in the first part of the analysis was a stage model of visual products with purely 2-dimensional representation as the lowest level, followed by levels that include increasingly complex 3-dimensional dimensions. The results confirm previous research that only 13 year-olds were able to make perspective drawings with lines converging on a vanishing point. But the results also showed that few drawings could be assigned to pure developmental stages and many drawings are mixed forms of visual spatial representations. Pupils use different visual spatial strategies and seem to be able to choose between them. Factors influencing theses strategies are the different assignments given, examples of popular visual culture and individual factors concerning ways of problem solving. The occurrence of the mixed types and the large amount of intra- en inter personal differences in spatial representations lead to a second stage of data analysis. This time the coding of the data was inductive and open and resulted in the formulation of a number of processing competencies. One is directly related to visual space, namely the positioning of self in space. Others are broader such as use of fantasy (narrative and formal), ability to judge the aesthetic qualities of one's own drawing, visual problem solving, ability to develop a personal visual language and what the researcher call 'the experience of discrepancy'. By this they mean that a pupil can critically compare the envisioned intentions and the actual drawing in progress. The two kinds of data analyses, the first showing the often mixed stages of visual spatial representation and the second revealing different processing competencies, are both illustrated by 10 examples of pupils drawings and their interpretations.

The authors present their study as a farewell to cognitively oriented, linear stage models of graphic representation and a study that is exceptional in its attention to individual (meta)cognitive, creative and emotional aspects of the drawing process. But this farewell sounds familiar: already a decade ago Paul Duncum wrote about a multiple pathways/multiple endpoints model of graphic development. And in the Studio Thinking model by Ellen Winner en Lois Hetland, processing competencies such as engage and persist, stretch and explore, envision and reflect play an important role. So the present study fits in the existing paradigm of research into drawing development and does so in a convincing way. It is an excellent example of thorough qualitative research using triangulation of observations, interviews and analyses of visual products. It gives the reader insight in the differentiated ways children can graphically represent space and in individual developmental paths of visual spatial competencies. It has didactic implications because the results indicate how different kinds of assignments can stimulate learning in this realm. The study is also meant to provide an empirical basis for product and process related visual spatial competencies and subsequently for standards in art education. But educational standards are by nature general and normative, whereas the study describes the often mixed stages of visual spatial representations and the idiosyncratic ways pupils can master visual problems. This tension indicates that studies like these can help to underpin educational standards, but one cannot go directly from an empirical finding to an educational norm.