



Developing spatial literacy through designing origami: Advancing maker education pedagogy with maker études

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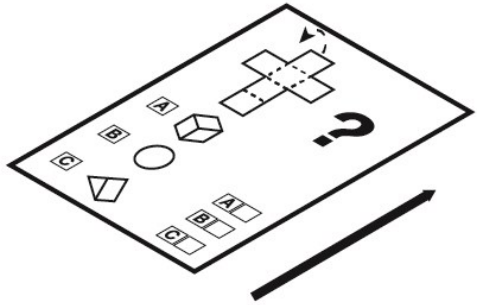
Spatial ability and STEM disciplines

- Spatial ability is a crucial to success in Science, Technology, Engineering and Mathematics (Wai et al. 2009)
- Using mental representations of objects to solve spatial tasks: e.g., how pieces of a solution might fit together (Lane & Sorby, 2022)
- Environmental factors are important to its development; spatial ability is malleable, particularly in childhood (Hawes et al., 2017; Lowrie et al., 2017)
- Diversity of spatial thinking of STEM experts exceeds what is covered by psychometric tests (Atit et al., 2020)

Spatial ability and STEM disciplines

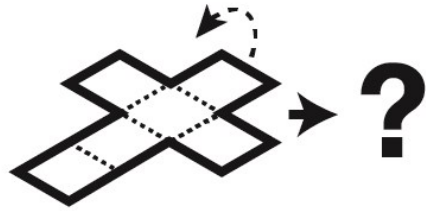
- Pedagogy tends to reduce spatial reasoning to paper-and-pencil-based activities that resemble psychometric tests (Bower & Liben, 2021)
- Spatial skills are crucial to communicating solutions to others through language and gestures, and the use of technological tools and graphic representations
- Demographics such as socio-economic status predict lower performance on tests of spatial ability; Gender-related stereotypes + lack of opportunities to develop it? (Jirout & Newcombe, 2015)
- Consequently, deficit view of spatial ability is prevalent in most literature (Bartlett & Camba, 2023)

Testing spatial ability



Paper and pencil-based tests of spatial ability

1



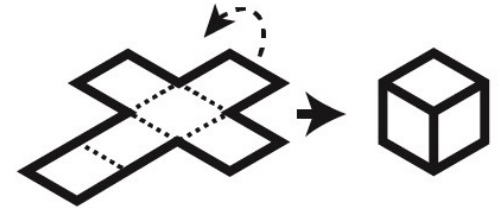
Requires single type of transformation e.g., mental folding

2

SV
Spatial
Visualisation

Loads on one specific factor of spatial ability

3



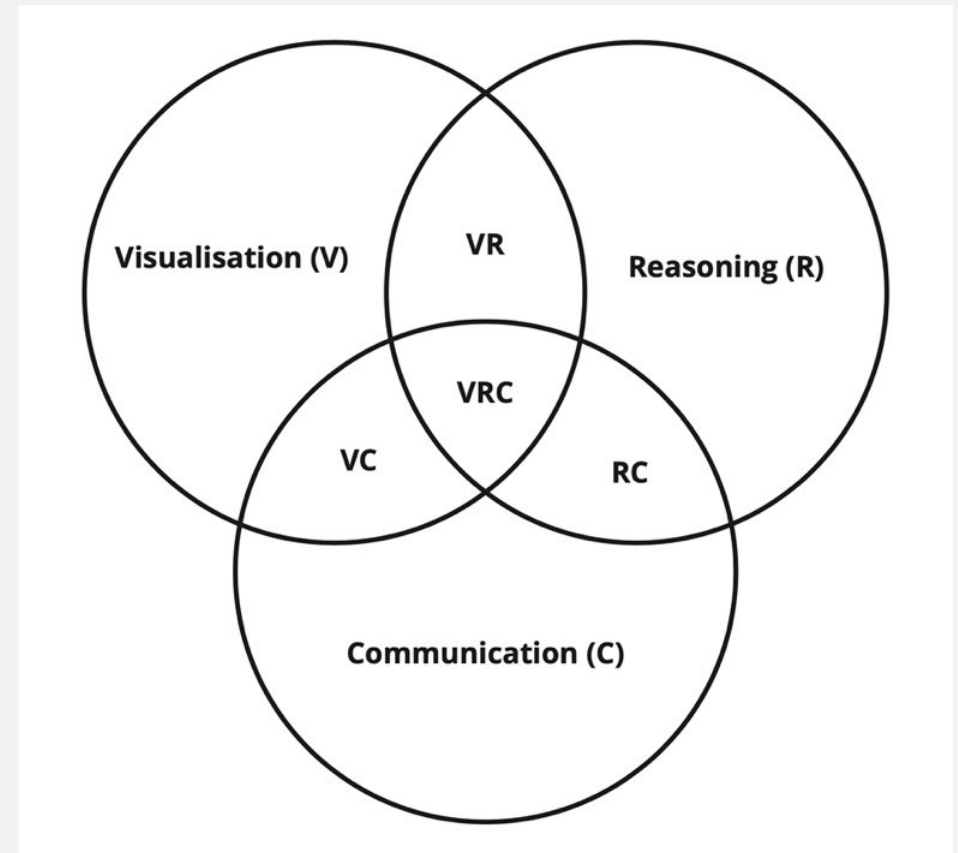






Spatial skills as repertoire of practices in STEM

- Spatial skills are crucial to communicating solutions to others through language and gestures, and the use of technological tools and graphic representations
- In STEM activities, spatial skills are mediated through the context and supported using tools, and representations (Ramey & Uttal, 2017)
- Spatial Literacy captures these skills within three domains (Moore-Russo et al., 2013)



The three domains of spatial literacy (adapted from Moore-Russo et al., 2013)

Why maker education?

- Maker education holds potential to help practice spatial reasoning (Yang et al, 2020)
- Maker education is often quite focused on outcomes (Martin, 2015)
- Educators in my context tend not to evaluate learning (Pijls et al. 2022)



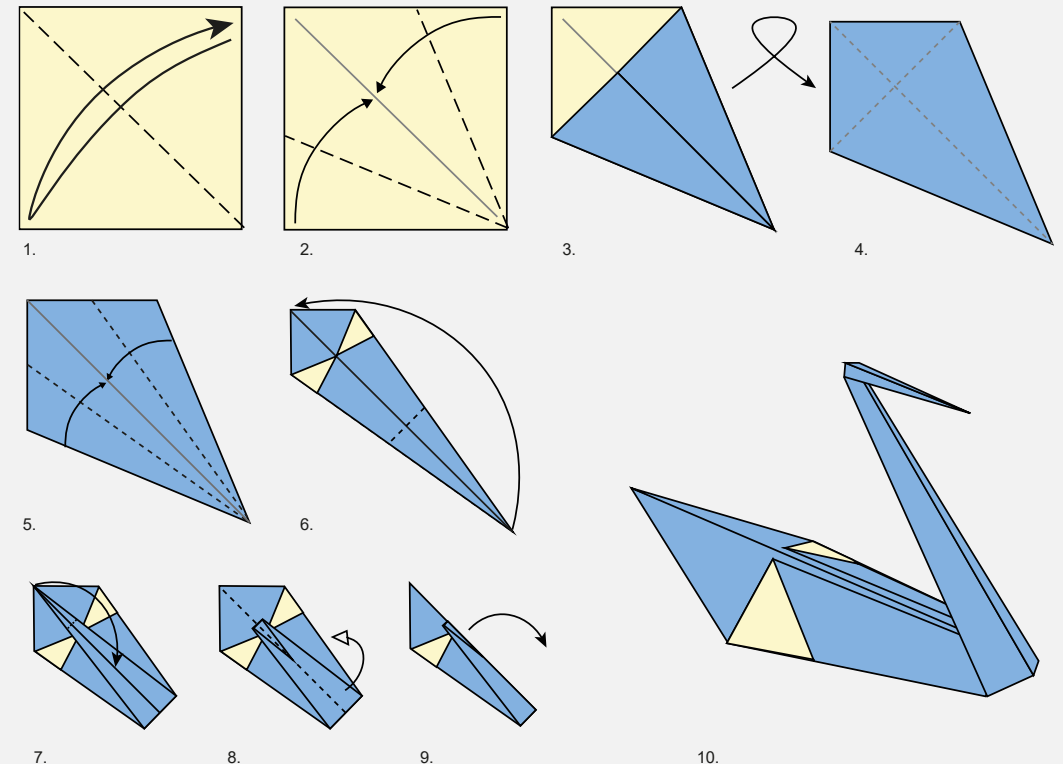
Context of the study

- Public library makerspaces in Amsterdam with 12 coaches, who are divided over multiple locations
- Diverse neighbourhoods with different demographics
- Existing programmes of about 10 weeks that primary school-age children (8-12 y/o)
- About 8-10 children per activity



Origami maker étude: learning a repertoire

- Origami design workshop
- Positive effects of origami on spatial ability test scores and the use of spatial language (Cakmak et al., 2014; Tenbrink & Taylor, 2015).
- An *étude* is an enjoyable exercise to practise a technique or skill, gives a sense of accomplishment and teaches a technique that can be used for creative expression



Origami maker étude: applying the repertoire

- Room for practice of all domains spatial of spatial literacy
- Scaffold the creative application of spatial skills



Methodology

- Case study of the implementation of the origami workshop in one public library makerspace in Amsterdam
- 14 children attended (12 primary school, 2 early secondary)
- Observations from me and the two coaches of this makerspace
- Coaches helped design the workshop, and provided feedback on the workshop and my role as facilitator



Discussion of the workshop

- More differentiation required
- Structure too linear – failed to scaffold design processes effectively
- Video helped to gain back attention but undermined constructing novel origami
- Lacked final presentation and reflection



Discussion of the role of spatial literacy

- Great diversity in children's ability to successfully fold from instructions
- Video seemed to mitigate having to hold spatial representation, perhaps circumvented spatial working memory?
- Role of spatial thinking through e.g., rotation, perspective taking in the creative process



Discussion of spatial literacy



Future work

- What diverse forms of spatial processes do children engage in within maker education → small-scale / large-scale?
- How do educators support children in developing spatial literacy?
- What entails spatial literacy within the context of early STEAM education?

References etc. →



Thank you

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