28TH INTERNATIONAL CONFERENCE ON ENGINEERING AND PRODUCT DESIGN EDUCATION
2 – 4 SEPTEMBER 2026, UNIVERSITY OF BRISTOL, UNITED KINGDOM

SKETCHING COMPLEXITY: TEACHING STUDENTS TO VISUALISE TANGIBLE AND INTANGIBLE SYSTEMIC RELATIONSHIPS.

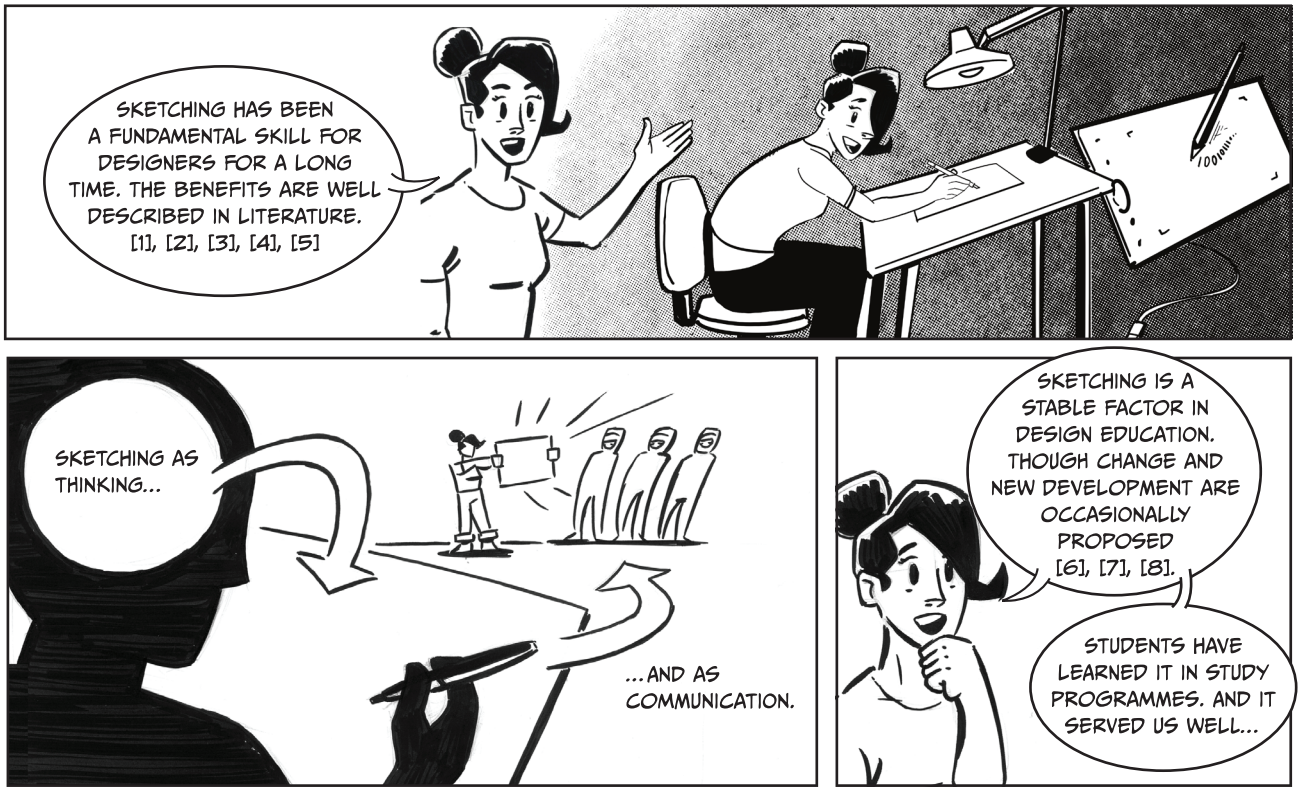
Tom FEIJ[1], Yannick HEIJS[1] and Wouter EGGINK[1]
[1]University of Twente, Enschede, The Netherlands

ABSTRACT

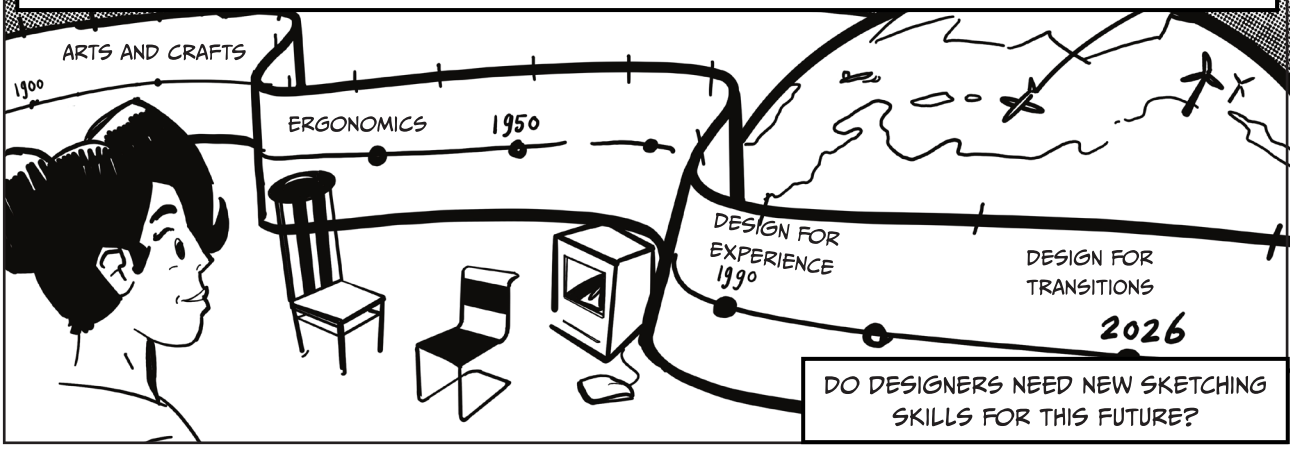
The design discipline has for some time been concerned with matters beyond traditional physical products. Increasing interest in systemic design leads to design activities that include elements of intangibility, relational aspects, and an increasing complexity. Therefore sketching education, as a foundational competence for industrial design engineers, also has to evolve.
In this visual paper, we describe a new design sketching course that uses the foundational assessment criteria of traditional product design sketching, such as: perspective, construction, marker shading and composition. Ten of these criteria are revised for the new course to expand the sketching skillset of first year Industrial Design Engineering students. The list of new criteria includes: viewpoint, material selection, sequence, visual thinking and figuration. This course allows the design sketching skills that industrial design engineers traditionally have to expand to include the complexity and intangibility of future design practice.

Keywords: Design Sketching, Design Education, Systemic Design, Visual Design Thinking

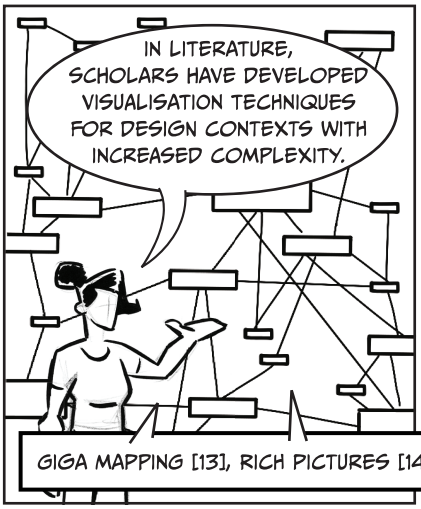
1 INTRODUCTION

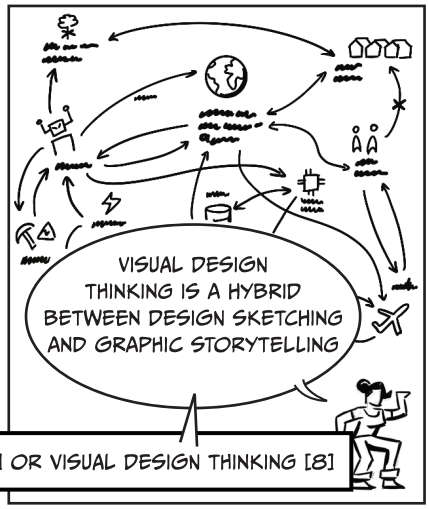


...BUT THE WORLD OF DESIGN IS ALWAYS EXPANDING. AND THE FUTURE OF DESIGN WILL BE DIFFERENT [9], [10], [11], [12].



DO DESIGNERS NEED NEW SKETCHING SKILLS FOR THIS FUTURE?

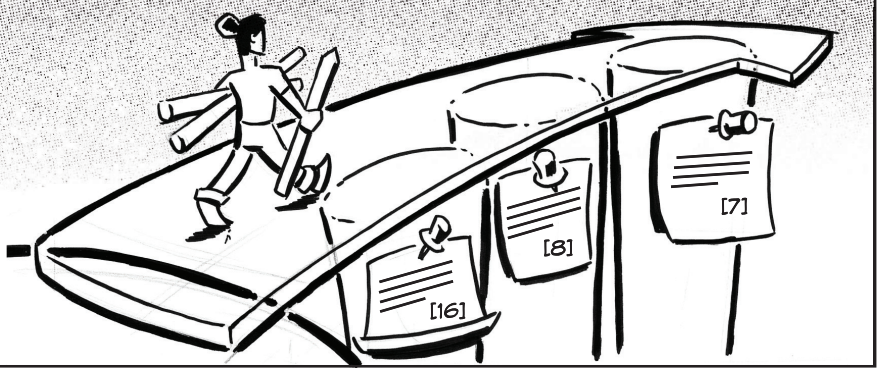






GIGA MAPPING [13], RICH PICTURES [14] OR VISUAL DESIGN THINKING [8]

SKETCHING IS A UNIVERSAL SET OF SKILLS THAT DESIGNERS CAN USE TO DRAW ANYTHING THEY IMAGINE. WE DEVELOPED A FIRST YEAR SKETCHING COURSE AROUND SKETCHING FOR INTANGIBILITY AND SYSTEMIC COMPLEXITY BASED ON THIS IDEA. THIS COURSE FOLLOWS UP A PREVIOUS FOUNDATIONS COURSE EARLIER IN THE FIRST YEAR [15].

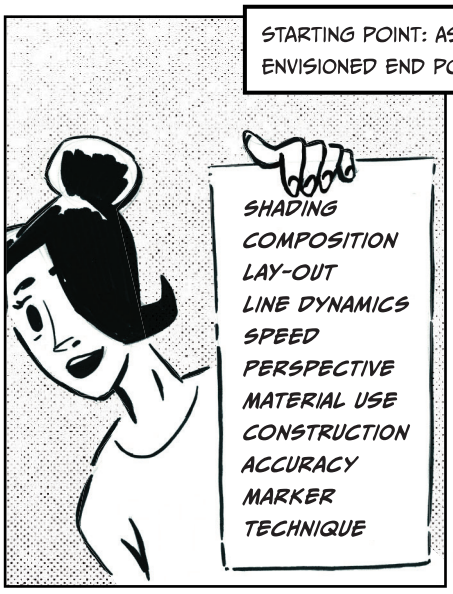


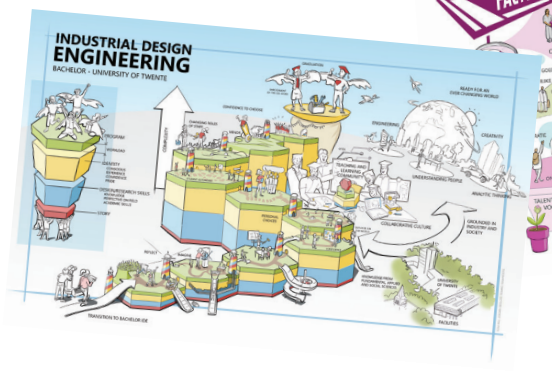
IT IS IMPORTANT THAT, LIKE THE DESIGN FIELD ITSELF, WE EXPAND THE CURRENT PARADIGM RATHER THAN REPLACE IT. WE USE THE SKETCHING ABILITY THAT STUDENTS POSSESS FROM THE EARLIER COURSE.



2 THE STRUCTURE OF THE NEW COURSE







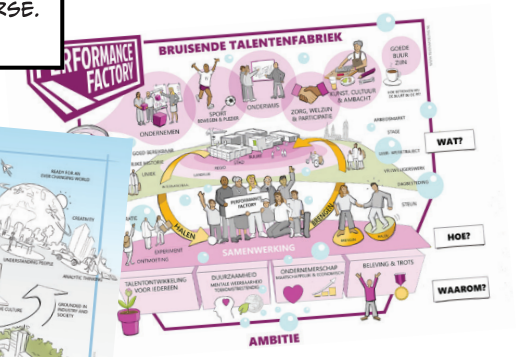
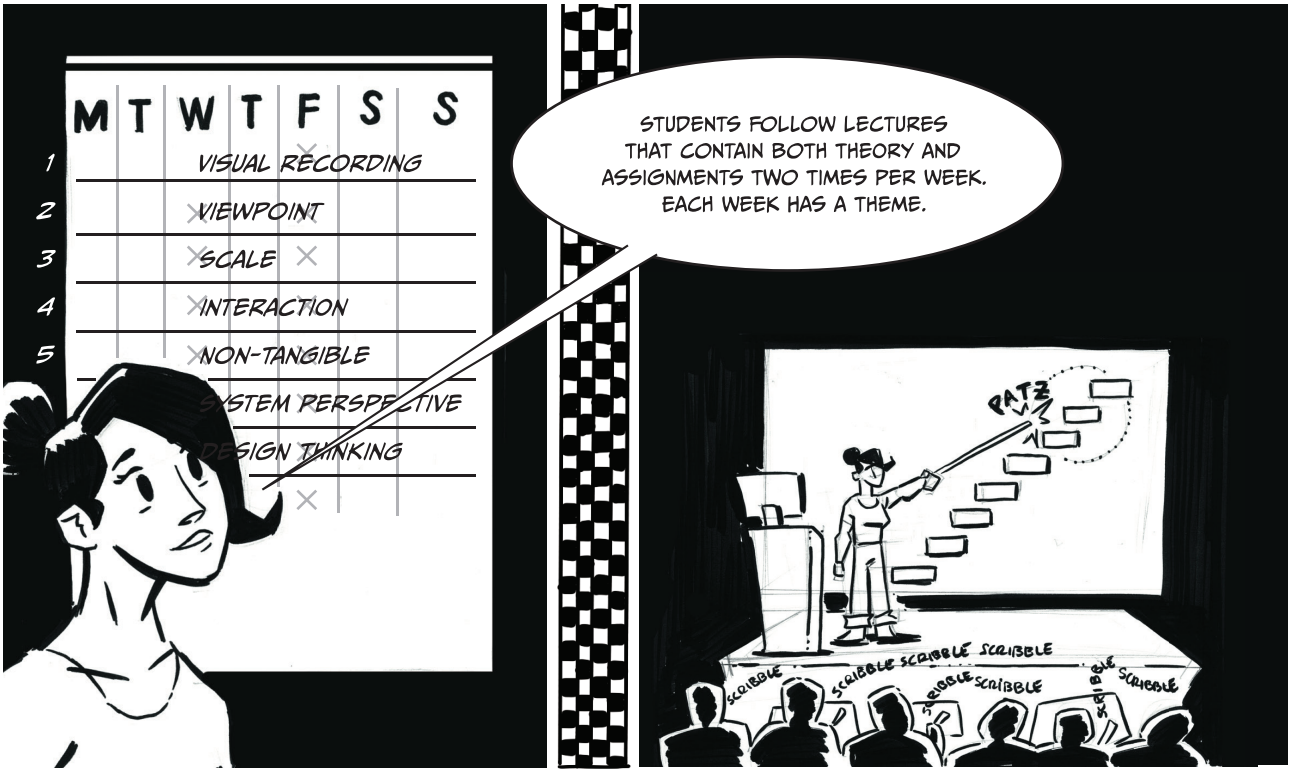
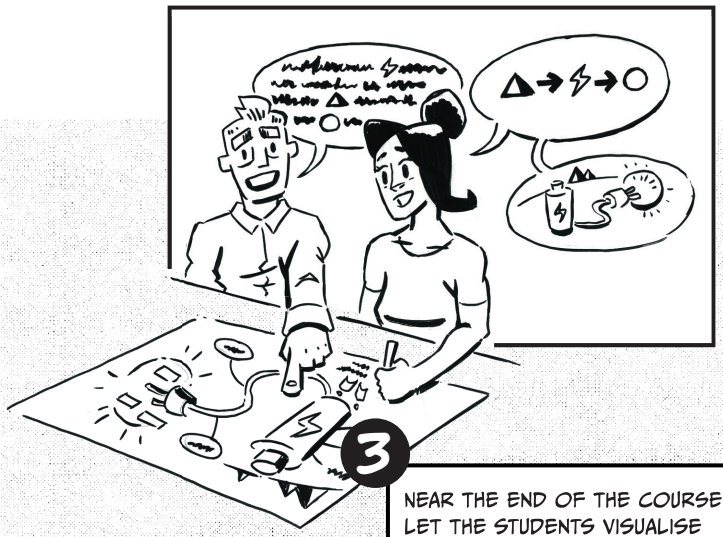


Figure 1 (left): System visualisation of the bachelor curriculum IDE. Figure 2 (right): Vision visualisation of a cultural organisation by Tekenafdeling.



AT THE CORE OF OUR SKETCHING COURSE IS PRACTICING THE THEORY BY DOING ASSIGNMENTS. HERE ARE SOME EXAMPLES OF ASSIGNMENTS EARLY IN THE COURSE, AROUND THE MIDDLE OF THE COURSE AND NEAR THE END.



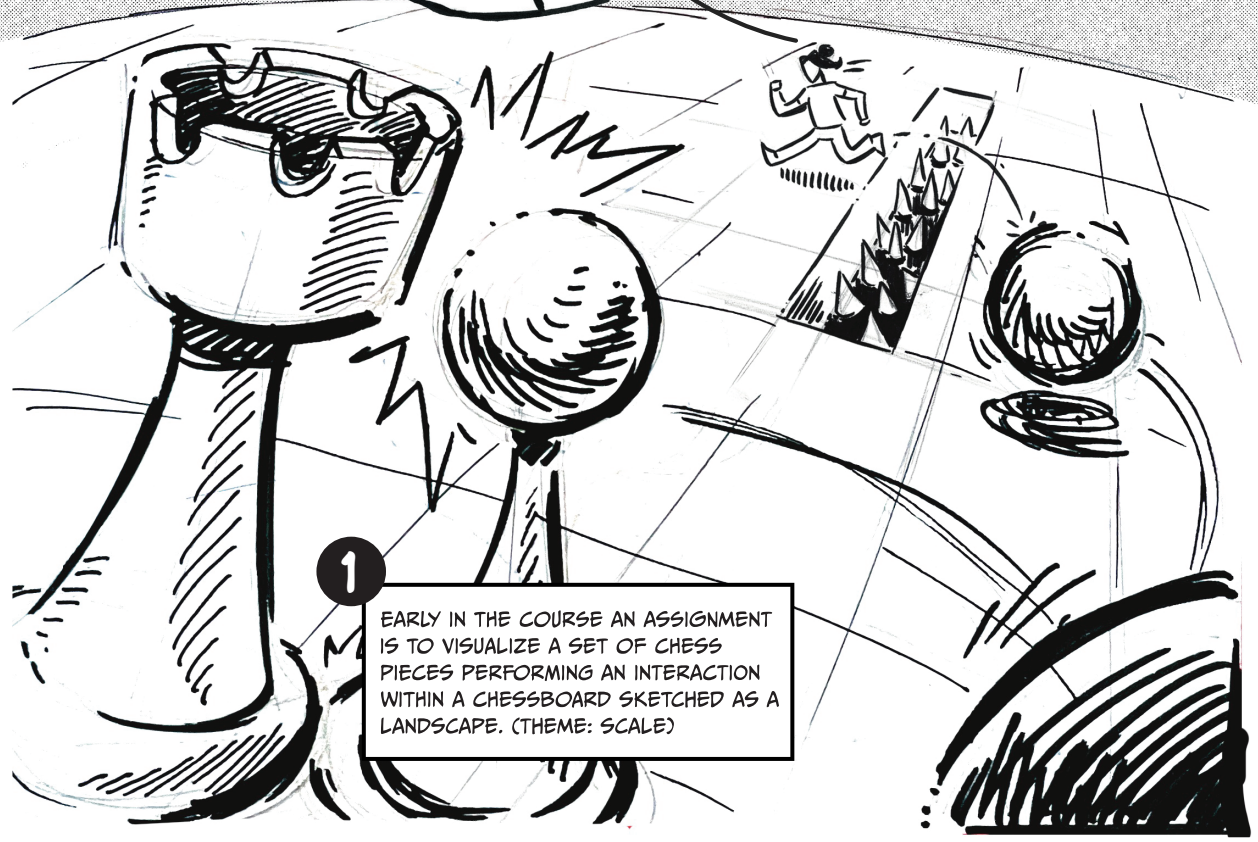
3

NEAR THE END OF THE COURSE WE LET THE STUDENTS VISUALISE RESEARCH PRESENTED BY ONE OF OUR UNIVERSITY COLLEAGUES IN A REAL DESIGN CASE.



2

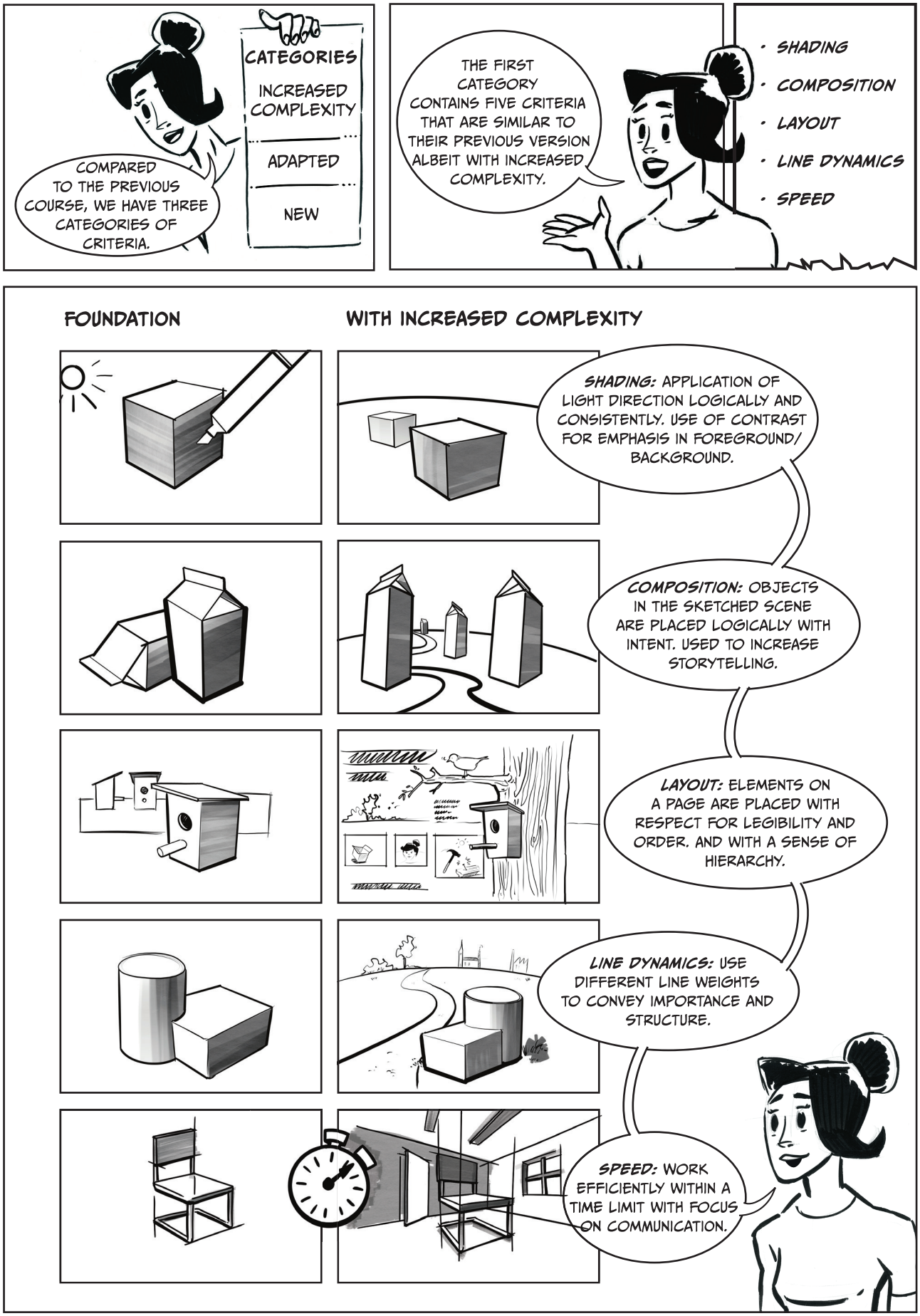
IN THE MIDDLE OF THE COURSE. STUDENTS SKETCH AN OBSTACLE COURSE OVERVIEW WITH ZOOM-IN VIEWS OF SPECIFIC ACTIONS. (THEME: INTERACTION)



1

EARLY IN THE COURSE AN ASSIGNMENT IS TO VISUALIZE A SET OF CHESS PIECES PERFORMING AN INTERACTION WITHIN A CHESSBOARD SKETCHED AS A LANDSCAPE. (THEME: SCALE)

3 ASSESSMENT CRITERIA OF THE NEW COURSE

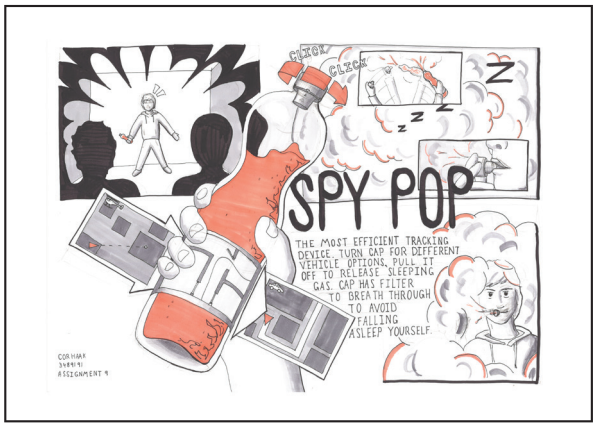



• VIEWPOINT
• MATERIAL SELECTION
SECOND CATEGORY: CRITERIA THAT ARE ADAPTED.
VIEWPOINT: SIMILAR TO PERSPECTIVE...
...OR A BIRD'S EYE VIEW
...BUT WITH MORE INTENT. FOR EXAMPLE: A WORM'S EYE VIEW.
AND MATERIAL SELECTION. TRADITIONALLY WE WORK WITH FINELINER AND ALCOHOL MARKERS. THE SET IS EXPANDED WITH THICKER, WATER-BASED, MARKERS. SINCE WE HAVE ADDITIONAL MATERIALS, STUDENTS MUST LEARN TO MAKE AN INTENTIONAL DECISION.
LASTLY, WE HAVE THREE COMPLETELY NEW CRITERIA THAT INDICATE HOW THESE SKETCHING SKILLS DIFFER FROM THE FOUNDATION OF THE EARLIER COURSE.
• FIGURATION
• SEQUENCE
• VISUAL THINKING
FIGURATION: HOW, AND TO WHAT DEGREE, TO TRANSLATE WORDS TO IMAGES.

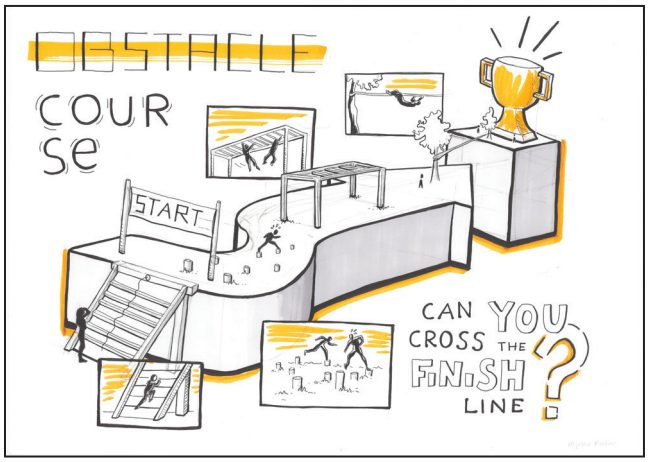

EACH WAY IS A DIFFERENT STORY
SEQUENCE: SHOWING PROGRESSION THROUGH TIME IN SENSIBLE STEPS AND TIME INTERVALS [17].
TAP
TAP
GRZMZ!
HELP!
AND LASTLY, VISUAL THINKING: USE OF A RELIABLE, SYSTEMATIC APPROACH TO TRANSLATE COMPLEXITY INTO IMAGES [18], [19].
NEXT, RESULTS

4 THE FIRST RUN OF THE COURSE: RESULTS AND EVALUATION

WE TAUGHT THE COURSE USING THE MENTIONED STRUCTURE AND CRITERIA. SOME RESULTS, WITH PROMINENT CRITERIA*



COR HAAK
- LAYOUT
- FIGURATION

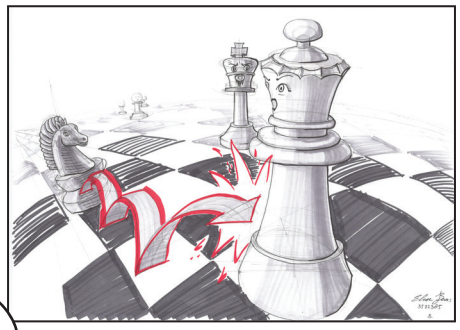


MYRTHE PORTIER
- SEQUENCE
- FIGURATION

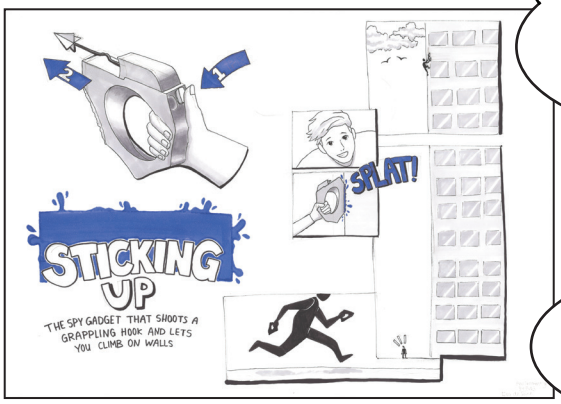
AND COURSE EVALUATION RESULTS [20]...

89% OF STUDENTS (N=54) FOUND THE COURSE TO CONTRIBUTE TO THEIR KNOWLEDGE AND UNDERSTANDING OF RELATED COURSES. (ANSWERED *STRONGLY AGREE* OR *AGREE* ON 4-POINT SCALE)

93% OF STUDENTS SAY THEY COMPREHEND THE CONCEPTS COVERED IN THE COURSE

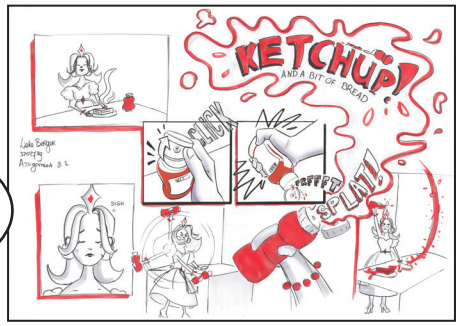


ELISE BAAS
- VIEWPOINT
- COMPOSITION



LISA DE RIJKE
- FIGURATION
- LAYOUT

26% OF STUDENTS SAY THAT THE WORKLOAD OF THE COURSE IS HARD TO MANAGE



LIEKE BERGER
- SEQUENCE
- VIEWPOINT

88% OF STUDENTS SAY THE COURSE INCREASED THEIR INTEREST IN THE FIELD OF INDUSTRIAL DESIGN ENGINEERING

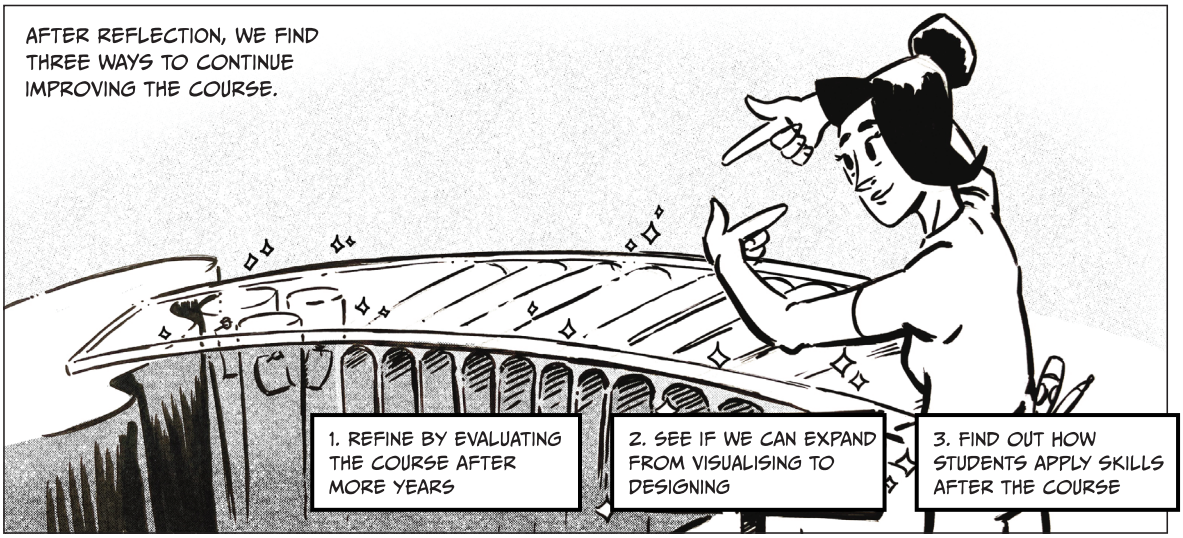


STUDENTS WERE ABLE TO USE THEIR BACKGROUND IN DESIGN SKETCHING TO APPLY THE CRITERIA IN THE COURSE RESULTS. AS EXPECTED, APPLYING THE 3 NEWEST CRITERIA (FIGURATION, SEQUENCE, VISUAL THINKING) WERE MOST DIFFICULT AND REQUIRED THE MOST GUIDANCE FROM LECTURERS.

* OTHER CRITERIA (SPEED, SHADING, LINE DYNAMICS, MATERIAL SELECTION, VISUAL THINKING) ARE PRESENT IN ALL SKETCHES

5 DISCUSSION

The course and its assessment criteria described in this paper are a shift in direction for the future of sketching for industrial design engineering . It stems from change in focus of the field and a broadening of our study programme towards designing transitions, values and systems in order to face real-world challenges [21]. The course therefore follows a larger trend, and as true designers we rather shape a future than let it happen to us.
The design background of our students makes the results of the course interesting for exploring how designers visualise complexity and how the mores of design sketching hold against an increasingly intangible world. We are sure that a visual-tangible field as industrial design engineering can contribute to human understanding and understanding humans within these complex systems. Efforts to develop this (e.g. Systems Oriented Design [22]) are however not yet mainstream within industrial design engineering. Therefore, our course teaches the foundational skills of sketching intangibles and systemic contexts. However, the course in the current form lacks an essential application area of design sketching: ideation sketching. We place focus on visualisation for communication. A next step for the future of the field will be to explore how sketching cannot only be used to visualise complexity, but also to design it.
Even though the course contains sketched examples from industry, the students apply the course contents within an academic context. They sketch for researchers, not for design agencies or industry businesses. Sketching intangibles proved valuable for this academic context. However, it would be interesting to apply the skills to cases outside of the context of our university to explore what value our developments hold for design practice.



6 CONCLUSION

In a changing design landscape, designers need to change too. The future of design looks to be more systemic, complex and intangible. Our approach to this changing future is a new foundational design course that is expanding the repertoire of what is sketch-able. In this course we cover themes that are embedded in traditional design sketching, albeit with added complexity and intangibility. Student results showed that traditional design sketching skills can be adapted to provide a solid basis for sketching complex and intangible concepts.

REFERENCES

[1] Self, J. (2024) *A Distributed Approach to Design Sketching*, in Gray, C., et al. (eds.), DRS2024: Boston, 23–28 June, Boston, USA. https://doi.org/10.21606/drs.2024.205

[2] Kuys, B., Ranscombe, C., & Zhang, W. (2023). Visualising product concepts to engage manufacturers with little or no industrial design capability. *Design Studies*, 87, 101188.

[3] van der Wal, A., Hoftijzer, J., and Haans, M. (2024) *A framework for the agency of sketching*, in Gray, C., et al. (eds.), _DRS2024: Boston_, 23–28 June, Boston, USA. [https://doi.org/10.21606/drs.2024.806](https://doi.org/10.21606/ drs.2024.806)

[4] Goldschmidt, G. (1991). The dialectics of sketching. *Creativity Research Journal*, 4(2), 123–143. https://doi.org/10.1080/10400419109534381

[5] Pei, E., & Self, J. A. (2022). *Product Design and the Role of Representation*. CRC Press. https://doi.org/10.1201/9781003227694

[6] Mallya, P., et al., *Emerging Trends in Freehand Sketch Usage within Contemporary Industrial Design Practice and Education*. In DS 132: Visual Proceedings of the International Conference on Engineering and Product Design Education (E&PDE 2024), 2024 (pp. 29-40).

[7] Corremans J. and Mulder-Nijkamp M., *Towards an Extended Design Sketch & Visualisation Taxonomy in Industrial Design Education*, in Visual Proceedings of the 21st International Conference on Engineering and Product Design Education (E&PDE 2019), 2019, no. September, pp. 1–11.

[8] Hoftijzer, J. W., Sypesteyn, M., & Kormelink, S. (2020). *A new language for sketching the intangible; building on a mutual fundament*. In DS 114: Visual Proceedings of the 22nd International Conference on Engineering and Product Design Education (E&PDE 2020).

[9] Sparke, P. (2013). *An introduction to design and culture: 1900 to the present*. Routledge.

[10] Valtonen, A. (2005). Six decades–and six different roles for the industrial designer. *Nordes*, (1).

[11] Valtonen, A. (2020). Approaching Change with and in Design. *She Ji: The Journal of Design, Economics, and Innovation*, 6(4), 505-529.

[12] Redström, J., & Wiltse, H. (2019). *Changing things: Innovation through design philosophy.* In Academy for Design Innovation Management Conference 2019: Research Perspectives in the Era of Transformations, London, UK, June 18-21, 2019. Loughborough University,.

[13] Sevaldson, B.(2013) *Systems Oriented Design: The emergence and development of a designerly approach to address complexity*, in Reitan, J.B., et al. (eds.), DRS // Cumulus: Design Learning for Tomorrow*,* 14-17 May, Oslo, Norway. https://doi.org/10.21606/learnxdesign.2013.133

[14] Checkland, P., Poulter, J. (2020). Soft Systems Methodology. In: Reynolds, M., Holwell, S. (eds.) *Systems Approaches to Making Change: A Practical Guide.* Springer, London. pp. 201 https://doi.org/10.1007/978-1-4471-7472-1_5

[15] Waanders, R., Eggink, W., & Mulder-Nijkamp, M. (2011, September). *Sketching is more than making correct drawings*. In 13th Engineering and Product Design Education Conference; Creating a better world (Vol. 8).

[16] Eissen K. and Steur R. *Sketching: The Basics.* Amsterdam: BIS Publishers, 2011.

[17] McCloud, S. (1993). *Understanding comics: the Invisible Art.* HarperCollins Publishers.

[18] Roam, D. (2013). *The back of the napkin: solving problems and selling ideas with pictures - Expanded edition*. Portfolio/Penguin.

[19] Qvist-Sorensen, O., & Baastrup, L. (2019). *Visual collaboration: A powerful toolkit for improving meetings, projects, and processes.* John Wiley & Sons.

[20] Evacom (2025). Course evaluation: Design Ideation & Communication - Module 3: Human perspective - 2024-2025. Unpublished report, University of Twente, Enschede (the Netherlands).

[21] de Boer, W. F., Massa, J., Ludden, G., & Lutters, E. (2024). *Empowering tomorrow's industrial design engineers: A curriculum reform journey at the University of Twente's Faculty of Engineering Technology.* In 52nd SEFI Annual Conference 2024: Educating Responsible Engineers. Ecole Polytechnique Fédérale de Lausanne.

[22] Sevaldson, B. (2022). *Designing complexity: The methodology and practice of systems oriented design.* Common Ground Research Networks.