Domain Specific Challenges in Developing an e-Learning Tool for Organic Chemistry

UNIVERSITÄT
DULSBURG
ESSEN

Open-Minded

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Tool Development

Opensource molecule editor Kekule.js (Jiang et al., 2016)

E-learning and e-assessment system JACK (Striewe, 2016)

Conversion of drawn molecules into a string code for verification (InChl code, Heller et al., 2015; IUPAC, 2023)

Sample

University introductory

courses in organic

chemistry for students of

chemistry / water science

(summer) and for teach-

ing degree students

(winter)

Domain Specifica

Molecule editors are based on skeletal for-

mula (standard representation, Brecher, 2008)

Object of Evaluation Studies

Structural formula

InChI-Code

Name

Students' performance

Cognitive load (Sweller, et al., 2011)

Usability (Brooke, 1996; Laugwitz et al., 2008)

Design

Paper-pencil versus digital format: within-subject design, item pairs, media comparison approach

(Buchner & Kerres, 2023; Clark & Feldon, 2014)

 $H-\dot{C}-\dot{C}-\dot{C}-\overline{O}-H$

c1-2-3-4/h4H,2-3H2,1H3

propane-1-ol

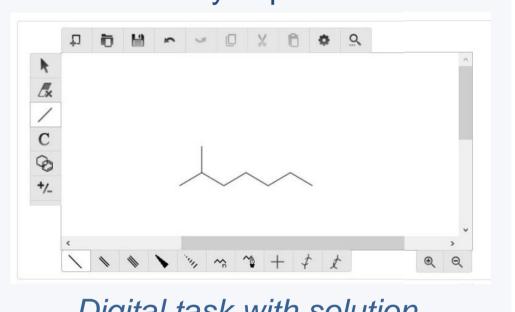
Draw a 3-ethyloctane molecule.

Item Pair

H-C-C-C-C-C-C-H H-C-H H-C-H

Paper-pencil-based task with solution (in structural formula)

Draw a 2-methylheptane molecule.



Digital task with solution (in skeletal formula)

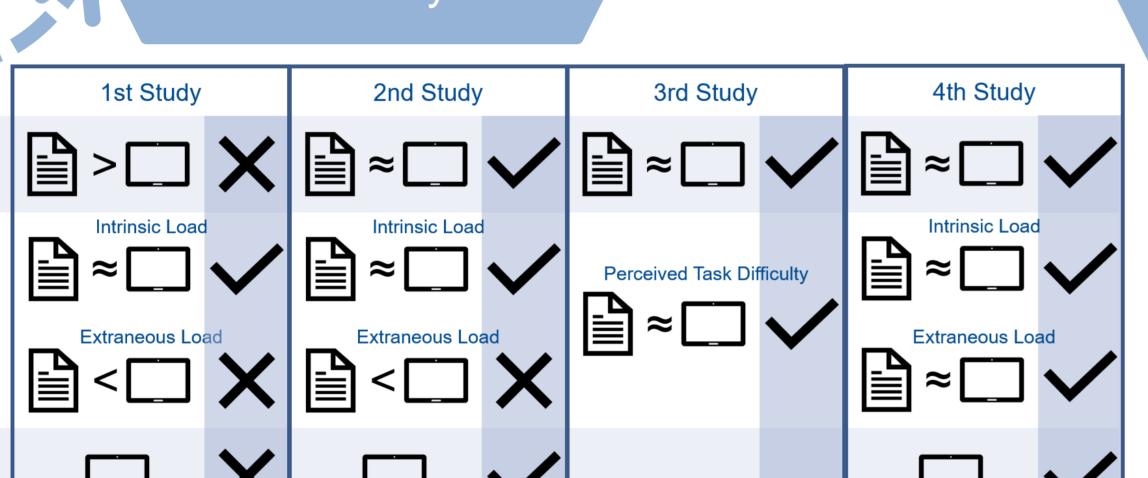
Starting Point

Need for input and automatic evaluation of drawings of organic molecules in organic chemistry

Such tools are not available in Germany

Results

Students need an appropriate introduction into the digital tool and a sufficient time of practicing using the tool to be able to enter an intended answer correctly



Results

Learners use alternative (less abstract, familiar with from high school) representations in the paperpencil format

Significantly higher number of missing answers in the digital format

Results

Learners use markings within molecules in the paper-pencil format (the digital tool currently does not allow the use of markings within molecules)

Markings within molecules

OH

Open Questions

How can students be further supported to become more familiar with the tool more quickly?

Is the skeletal formula an additional obstacle when using a digital tool (extraneous load) or does the digital tool support students in using only the skeletal formula early on (intrinsic load)?

Open Questions

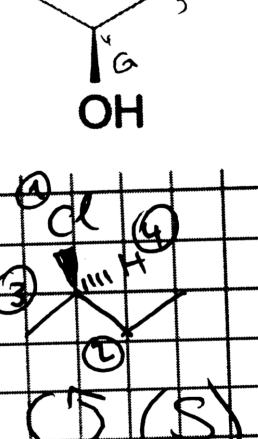
How can students be supported in using skeletal formula? (Rau, 2018)

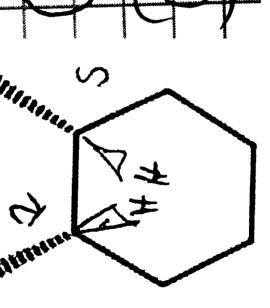
What digital functions are required for step-by-step solutions which guide beginners?

Prospects

Several unaddressed questions, even at a low technological level of use, such as substitution (Puentedura, 2006)

Need to understand domainspecific requirements to exploit the potential of digital learning environments





PRÜFUNGEN INNOVIEREN | TRANSFER SCHAFFEN | CHANCENGERECHTIGKEIT FÖRDERN

Drawing Molecules

Cognitive Load

Usability

References

"Spe

Scar Register "Mein Arbeitsbereich" "Spezielle Veranstaltungen" EARL Try

Example task



Walpuski Group





Kontakt

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