## Studying Student Experience of Complex Design Projects with No Prototype

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### How do students approach design without prototypes?

Unlike more common design-build-test capstone design projects, naval architecture students do not have recourse to a complete physical prototype to help them understand design interactions and visualize the complete design artifact. This vessel synthesis problem is a type of “physically large and complex” system design, as defined by Andrews (2012). The students must synthesize the vessel in their own mind from pieces in different software or formats. This process is a challenge to the students. It relies on a mix of curricular and extra-curricular skills that have not been subject to detailed experimental investigation.

Data was collected over two cohorts to identify factors which influence mental synthesis

- The objective of this project is to identify factors which influence this mental synthesis model formation and the trial new learning methods to support its formation.

- All members of three highest-ranked design teams
  - Design is a small part of discussion
  - Podcasts and offline resources mentioned
  - Specific tools not mentioned

- All members of three lowest scoring groups
  - Hull and hull manipulation programs more common
  - Known area of struggle
  - Suggests tool refinement may help

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### Focus group responses showed little discussion of overall synthesis strategy

Students asked about experiences in three 90-minute focus group

Transcripts from focus groups were dual-coded by two readers to examine which topics were most discussed. Coding was compared via Cohen’s Kappa inter-rater reliability with good results. Struggles on specific topics dominated with little discussion of overall synthesis strategy.

<table>
<thead>
<tr>
<th>Group</th>
<th>Cohen’s Kappa</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.66</td>
</tr>
<tr>
<td>2</td>
<td>0.80</td>
</tr>
<tr>
<td>3</td>
<td>0.79</td>
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</tbody>
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### The words the students used to describe their experience compared to look for trends

The ability to mentally synthesize the vessel before spring break appears correlated with project grade

The period around spring break seems to mark a key point in the design process. The majority of the members in the highest-scoring groups could visualize the vessel by this point, while the lowest scoring groups only had 50% of their members able to visualize the vessel at this point.

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### Co-curricular experiences provides a significant advantage to mental synthesis for all groups

Acknowledgements & References

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