

# Learning synthesis: how useful has THM been?

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## Introduction

Our research was conducted as a formative evaluation of current organic chemistry synthesis teaching through Top Hat Monocle (THM). Our research question was How useful have the synthesis questions on Top Hat Monocle (THM) been in learning how to do synthesis on tests? Organic chemistry synthesis questions are the hardest concept to grasp for most students since they require the students to use everything they have learned in the course in one question. This higher order of thinking is the top of the pyramid in Bloom's taxonomy of learning which consists of six orders of thinking.

## Bloom's taxonomy of thinking

Synthesis

Evaluation

Analysis

Application

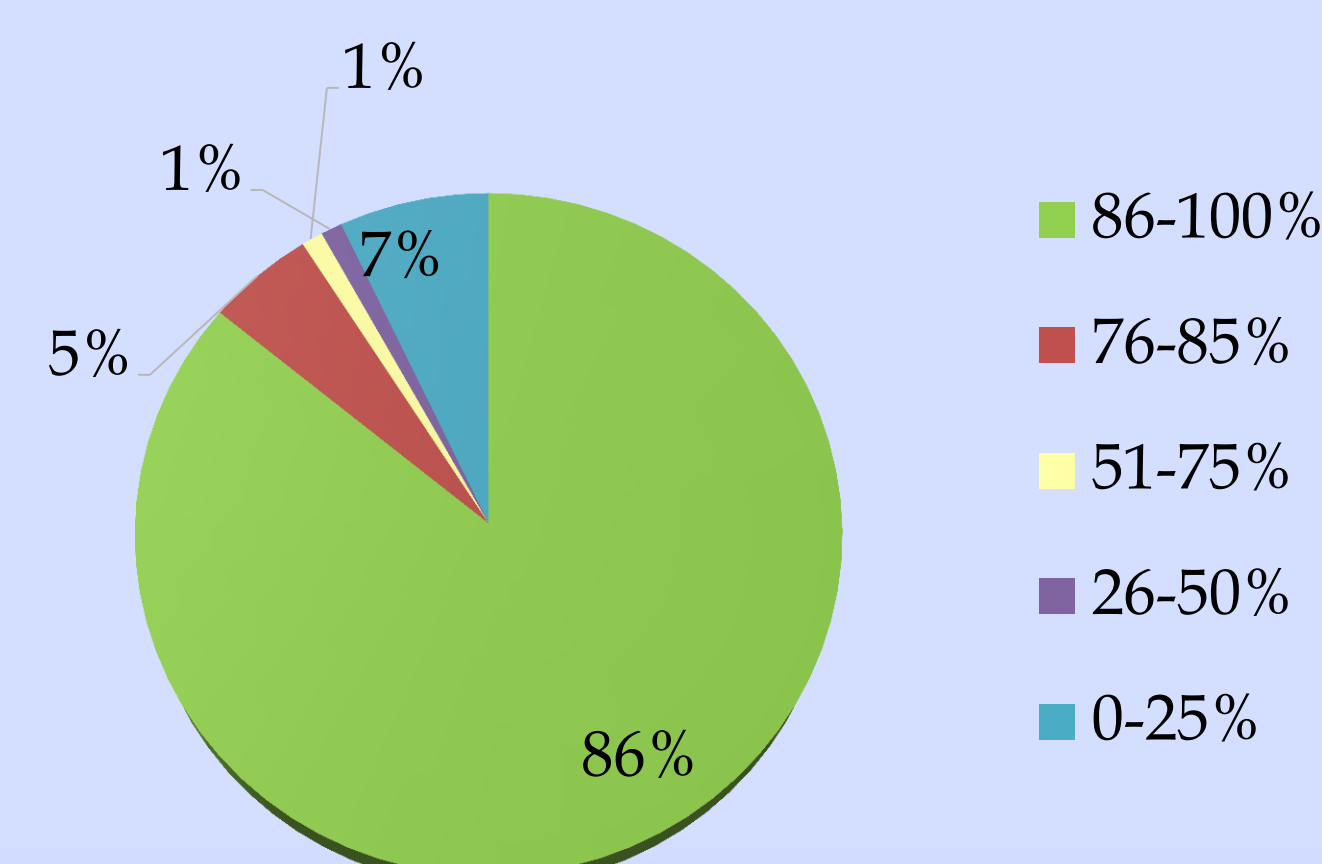
Comprehension

Knowledge

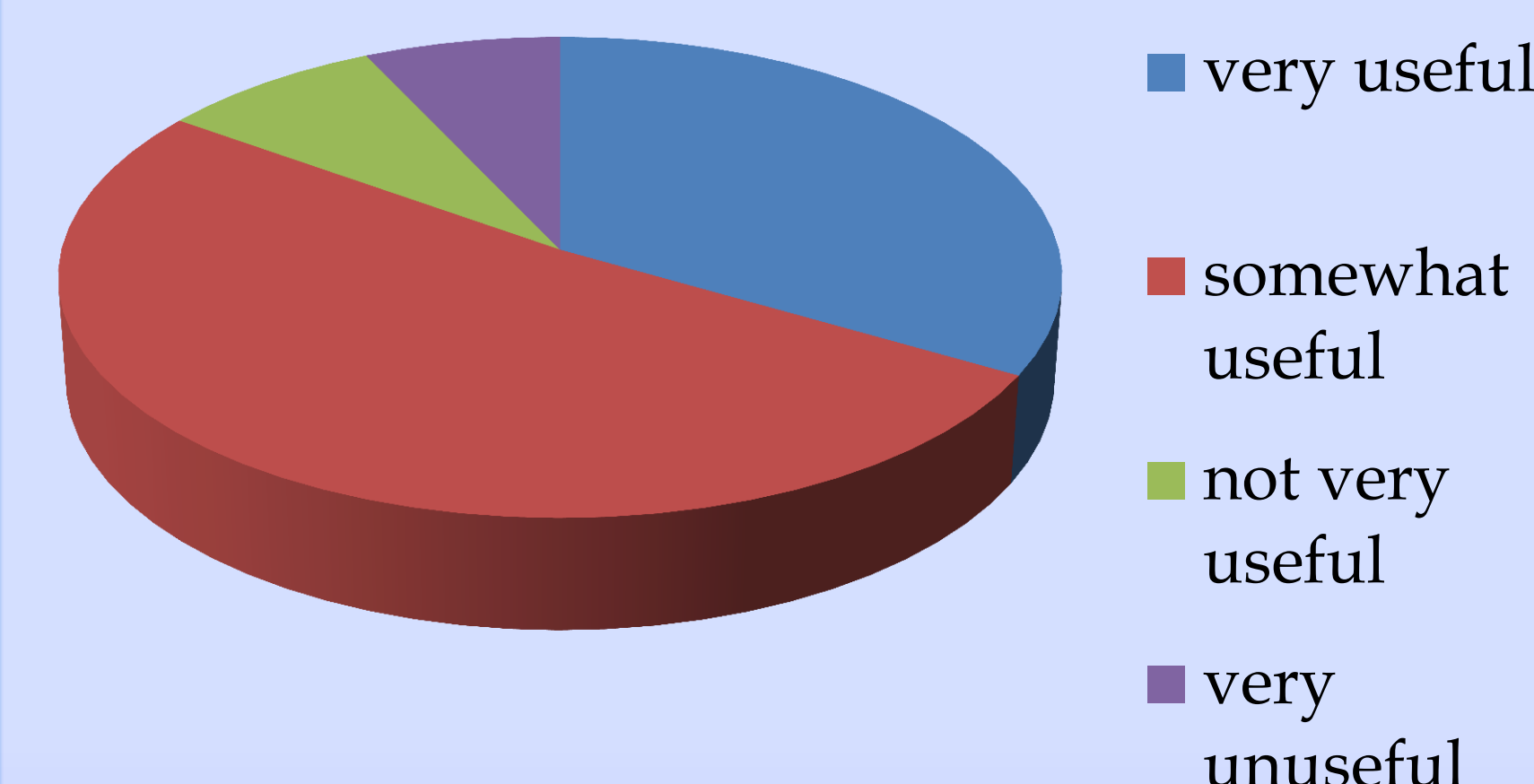
## Methods:

- ❖ A survey was administered online to students who took the Organic Chemistry II course in the Fall 2011 term when THM was first used.
- ❖ The survey had 73 participants out of 400 students who registered for the course.
- ❖ The survey contained a poll to which six students responded with availability to have a one-on-one semi structured interview.
- ❖ The student researcher conducted, transcribed and analyzed the interviews and the survey results.

## Proportions of time when students answered THM questions in class; N=73



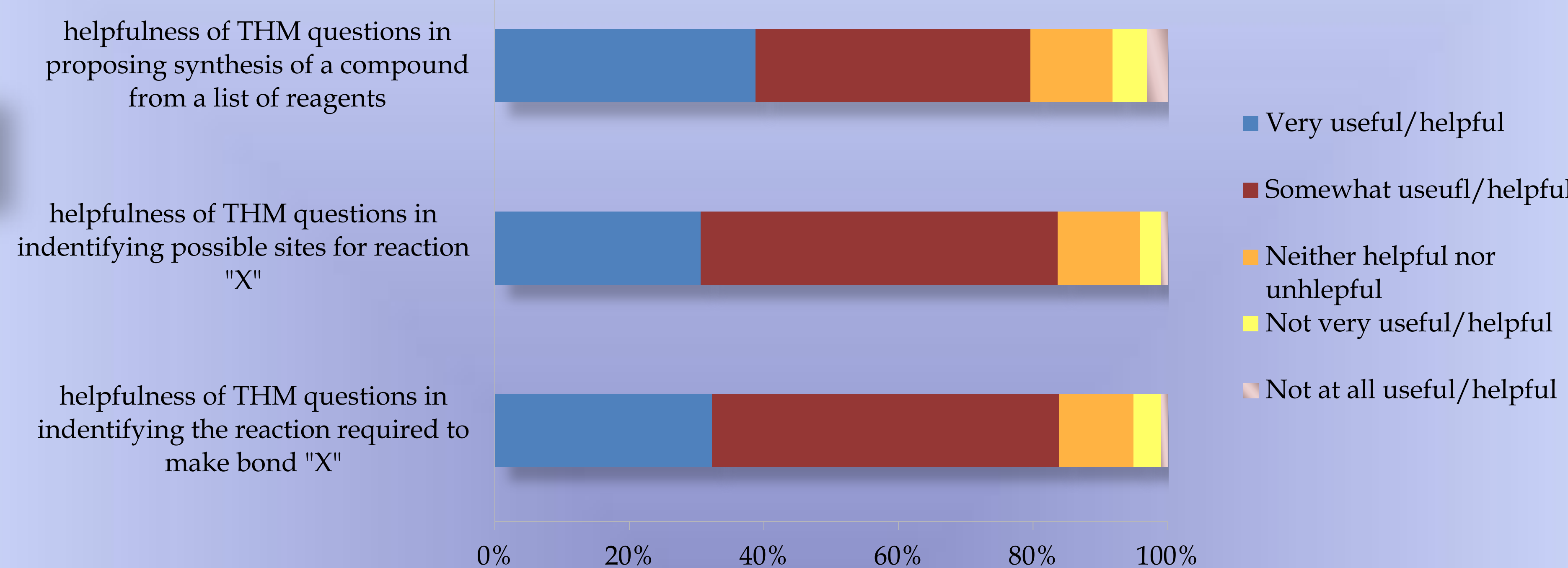
## Usefulness of THM for students; N=73



## References, acknowledgements & contact information

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- ❖ Edmunds, H. (1999). *The focus group research handbook.* NTC: Lincolnwood, Ill : NTC Business Books, c1999.
- ❖ Top Hat Monocle, <http://www.tophatmonocle.com/>. Accessed February 2012
- ❖ Thank you to Dr. A. Flynn for supervising every step of this project.
- ❖ Maria Syoufi (student researcher)
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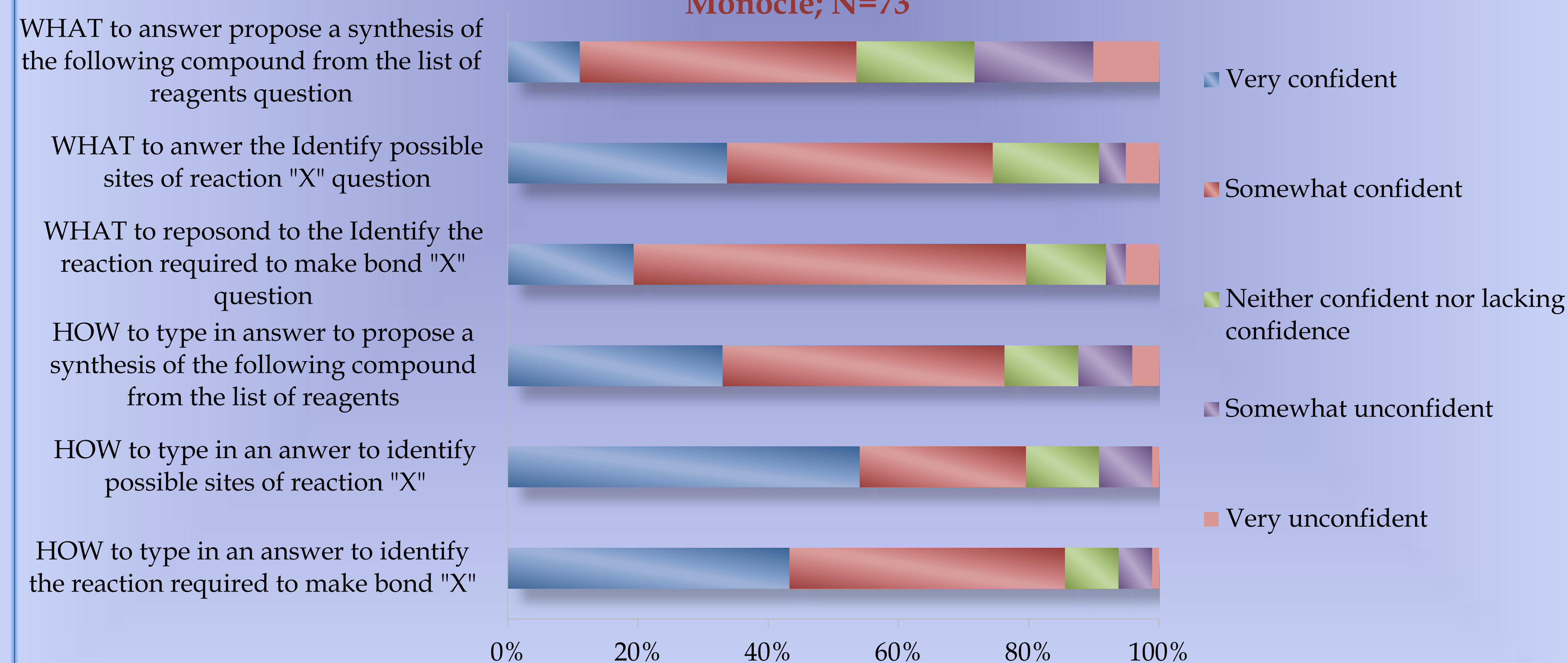
## Helpfulness of Top Hat Monocle in answering synthesis questions in class; N=73



## Conclusion

- ❖ The formative evaluation showed that most students benefit from using THM in class to learn synthesis even though that they think the questions presented are too simple compared to test questions.
- ❖ Many students used THM in conjunction with other resources to develop or improve their strategy to approaching synthesis questions.
- ❖ These results are important in that they reinforce using response technologies in class rooms and show these technologies helping students.
- ❖ A potential topic for further research in the future is active learning with peers while answering THM questions in class.

## Students confidence level when answering synthesis questions through Top Hat Monocle; N=73



## Survey results

- ❖ 51% of the students found THM synthesis questions somewhat useful while learning synthesis, while 7% said they did not find it useful.
- ❖ Students found THM questions asking about the reaction required to make a certain bond in a molecule most useful along with the questions that ask to propose a synthesis for a molecule from a list of reagents.
- ❖ Students also found the questions asking about a pattern for a reaction, such as an aldol reaction in a bigger molecule useful, but not as useful as the other two types.

## Interview themes: Timing & complexity

- ❖ Some students found the timing of THM questions to be disturbing.
- ❖ The question will be shown right after explaining a concept while the student is still trying to obtain a basic understanding of the concept presented.
- ❖ Complexity accompanied the timing of certain questions.
- ❖ Presenting basic knowledge questions like "what reaction is this?" right after presenting a topic in class versus going through more complex and bigger molecule synthesis questions closer to the test time.
- ❖ Students found the question asking to synthesize a molecule from a list of reagents very helpful in putting together the bigger picture of synthesis and grouping reactions with their different steps together.

## Interview Themes: Strategy & confidence

- ❖ While some students did not have a set strategy to do synthesis questions, their confidence level was not too low.
- ❖ They knew that they got the right answer or were on the right track if their final product looked like the final material asked for in the synthesis question.
- ❖ The students who had a strategy to do synthesis questions, that included steps such as jotting down possible ideas, looking for possible disconnections, and analyzing functional groups.
- ❖ All different types of questions on THM helped students with their strategy, but most students would not look at THM questions at home again unless they did not do them during the lecture time.
- ❖ Students mostly used practice assignments for studying.

## Interview Themes: Technicality, advice & emotions

- ❖ Many students experienced technical difficulties in the lecture hall while trying to access THM.
- ❖ The students thought that the idea of a response technology is great but the technical difficulties limited it.
- ❖ Students' advices for future teaching were mainly focused on having harder and more in depth THM synthesis questions.
- ❖ Other students suggested starting with a smaller molecule and using newly learned reactions to manipulate whatever product was obtained in different ways, building up on the previous knowledge.
- ❖ Students recommended doing the THM questions at least during class time, except for one interviewee who did not find them useful at all.