The CS Concept Inventory Quiz Show

Nafeesa Dewji
Dept. of CS
U. British Columbia
201-2366 Main Mall
Vancouver, BC, Canada
nafeesa.dewji@gmail.com

Steven A. Wolfman
Dept. of CS
U. British Columbia
201-2366 Main Mall
Vancouver, BC, Canada
wolf@cs.ubc.ca

Geoffrey L. Herman, PhD
U. Illinois, Urbana-Champaign
Curriculum & Instruction
Illinois Foundry for Innovation
in Engineering Education
glherman@illinois.edu

Leo Porter
CS and Eng. Dept.
U. California, San Diego
La Jolla, CA 92093
leporter@cs.ucsd.edu

Cynthia Taylor
CS Dept.
Oberlin College
ctaylor@oberlin.edu

Jan Vahrenhold
Dept. of CS, Westfälische
Wilhelms-Universität Münster
48149 Münster, Germany
jan.vahrenhold@uni-muenster.de

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1. SUMMARY

This session is a chance for researchers studying concept inventories (CIs)—low-cost assessments highlighting student misconceptions in a field [2]—and CS education practitioners to communicate about advances in concept inventories in an engaging and utterly ridiculous way.

We use a "quiz show" format to present CI items from various authors' work across the computing curriculum. On each question, audience members and volunteer contestants consider their own response and guess students' common responses. Then, they see how authentic student data illustrate the misconceptions these items probe.

The session's goal is three-fold: educate practitioners about recent results in concept inventory research that may suggest surprising trends in student learning, popularize concept inventories as a tool in research and practice, and collect the audience's expert responses to concept inventory items.

Along with making the session fun, the quiz show format gives audience members a stake in their own responses and in predicting students' responses to the CI items. Our challenges for contestants—which are not simply to answer the

items but rather to guess aspects of students' response to the items—focus attention on key misconceptions exposed by these items. As a side benefit, this avoids requiring anyone to **publicly** answer the questions, which could be professionally embarrassing.[1]

Below, we briefly recount background on concept inventories, give an outline of the session's activities, illustrate how a sample question might be used for the show, explain our expectations of the audience, and explain why this session's plan is well-suited to the SIGCSE special session format.

2. CONCEPT INVENTORIES

Concept inventories are inexpensive but powerful tools for probing student misconceptions and the longitudinal impact of pedagogical changes [2]. A typical CI is a multiple choice assessment of about 20–30 minutes' length. Researchers design each question and its responses to capture observed student misconceptions around key ideas in the target discipline. CIs have highlighted surprising student difficulties in grasping core concepts across a variety of disciplines [3, pp. 20–43]. Recent work has introduced CIs or CI-like instruments for various subjects in computing, including digital logic [3], introductory programming [6], data structures and algorithms [1, 4, 5], and architecture [7]. However, it remains quite difficult—in computing and other fields—to communicate the results of concept inventory research to practitioners and to collect their crucial, expert feedback on CI items under development.

3. SESSION OUTLINE

We break the session down into parts below. Both session organizers are involved in almost all parts of the planned session. However, where we use other researchers' CI items, we will solicit those researchers' help with planning, presentation, and discusion of their own items.

Intro (7 mins) Introduce the idea of a Concept Inventory, the quiz show format, and audience participation op-

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[1]Instead, we only ask people to *personally* embarrass themselves by participating in a quiz show with the moral equivalent of chicken hats as prizes.

A binary search tree contains the keys 1, 2, 3, 4, 5, 6, and 7 (not necessarily inserted in this order). What shape **must** the tree be?

(a) This shape:

(b) This shape:

(c) This shape:

(d) This shape with either 1 or 7 at the root and the other keys arranged appropriately:

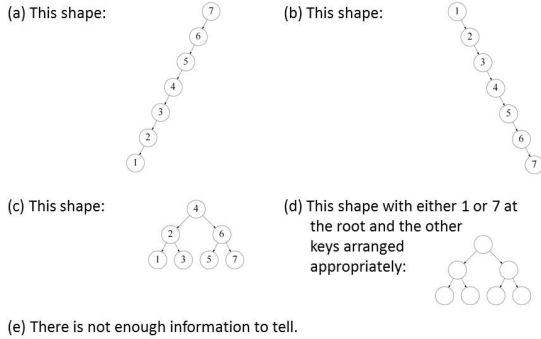(e) There is not enough information to tell.

Figure 1: Sample concept inventory question for the quiz show, adapted from Karpierz and Wolfman [4].

tions (e.g., provided clickers). Collect consent from audience members to use data in future research.

Contestants (3 mins) Solicit volunteer contestants for the quiz show. (Prearranging interesting SIGCSE regulars as "plants" in case few people volunteer.)

Quiz Rounds (2 × 25 mins each)

Questions (3–5 × 4 mins each)

Context Course and background information.

Display Question & Audience Response

Challenge Contestants E.g., "Predict the most popular distractor for students."

Reveal Responses of audience, students, and contestants.

Reflection on how the question, data, and responses will impact the audience's teaching.

Discussion (10 mins) about the full round.

Conclusion (5 mins) Tie discussion back to what a concept inventory is and what role CIs can play in practitioners' courses. Hand out summary of questions, references, concept inventories, and next steps.

(We leave 10 minutes for scheduling flexibility.)

4. SAMPLE QUESTION

As an example of a CI item we might use, Figure 1 shows a question adapted from Karpierz and Wolfman [4], which exposes interesting student misconceptions surrounding binary search trees, balance, and heaps.

For this question, we might: (1) skip contextual information since the area of CS is well known, (2) show the question and ask everyone to respond to it on their clickers, (3) challenge the contestants to predict the most popular answer besides (e)[2], (4) reveal in succession the audience's response, the responses from student data, and then the contestants' answers, (5) award a point to successful contestants, and (6) give audience members time to reflect on the question.

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[2]In our experience, experts often suspect a different "most popular distractor" from the one students chose.

5. EXPECTATIONS

Our primary audience is computing educators, particularly those who teach first- and second-year university-level CS courses, as most CI work focuses on these courses. We do **not** aim to give a complete overview of CI work; instead, we want to show high-impact examples that may make a difference in audience members' teaching approach directly and also encourage them to look further into the available research.

At the start of the session, we will distribute a handout to facilitate audience members' note-taking and reflection about the CI items we discuss. At the end of the session, we will distribute a handout with all the CI items and data presented in the session and literature references to the CI development work. Together, these handouts will make excellent starting points for audience members' further exploration.

6. SUITABILITY

A session like this would be difficult or impossible to accomplish in the other available formats. In particular, a paper or panel could summarize results on concept inventory work at this time but would not dramatize the misalignment of expert and novice perspectives as well as our direct, live format. (And would be rather dull in comparison.)

Conversely, getting substantial feedback from an audience of experts is a persistent problem in concept inventory development, and this session offers a mutually beneficial format giving researchers access to experts.

If successful, this format will also lend itself well to future presentations as concept inventory work in CS matures.

7. REFERENCES

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