



University of Pittsburgh

The Value of Social: Comparing Open Student Modeling and Open Social Student Modeling

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Overview

- The past
 - Why we are doing it?
- The paper
 - Open Social Student Modeling and its evaluation
- Beyond the paper
 - What we have done since submitting the paper?
- The future
 - What are our plans and invitation to collaborate

The Past

- Why?
 - Increase user performance
 - Increase motivation and retention
- How?
 - Adaptive Navigation Support
 - Topic-based Adaptation
 - Open Social Student Modeling

Adaptive Link Annotation: InterBook

4

3

2

1

Netscape: ACT-R Lesson Units

ACT-R Lesson Units

- Unit 0: Interpreting Production Rules
 - Section 0.1: Production Rule Forms
 - 0.1.1 Declarative Units in ACT-R
 - 0.1.2 Production Rules in ACT-R
 - 0.1.3 Production Rule Format
 - 0.1.4 ACT-R's Condition Form
 - 0.1.5 ACT-R's Action Side

0.1.1 Declarative Units in ACT-R

In ACT-R, elements of declarative knowledge are called **chunks** or **WMEs** (for working memory elements).

Content	?
Glossary	?
Help	?
Search	?
Hint	?

Background:

ACT-R

declarative knowledge

1. Concept role

2. Current concept state

3. Current section state

4. Linked sections state

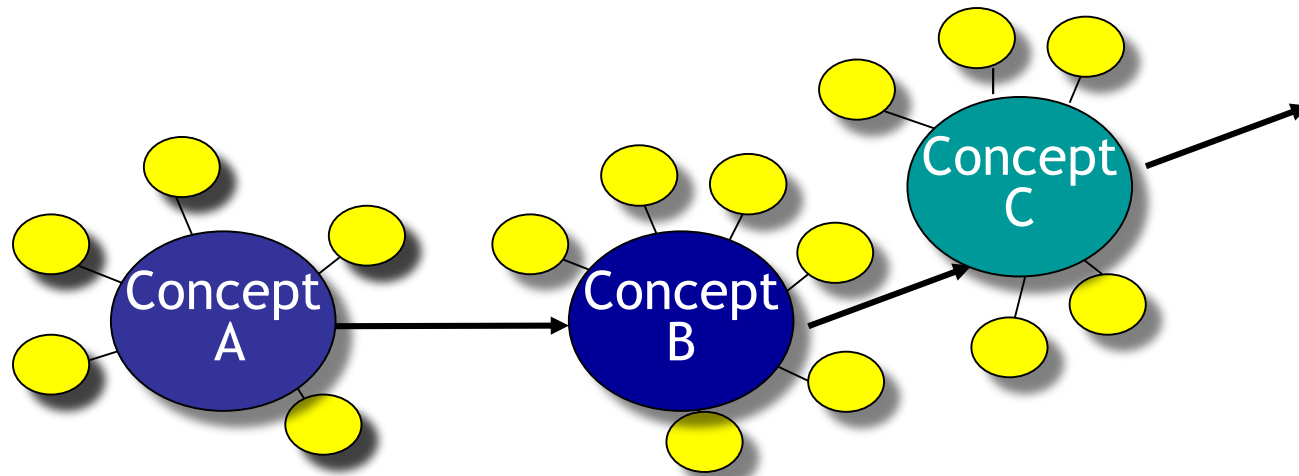
QuizGuide = Topic-Based ANS

Refresh and help icons

List of annotated links to all quizzes available for a student in the current course

Questions of the current quiz, served by QuizPACK

Topic-Based Adaptation



- Each topic is associated with a number of educational activities to learn about this topic
- Each activity classified under 1 topic

QuizGuide: Adaptive Annotations

- Target-arrow abstraction:

- Number of arrows – level of knowledge for the specific topic (from 0 to 3).
Individual, event-based adaptation.



- Color Intensity – learning goal (current, prerequisite for current, not-relevant, not-ready). *Group, time-based adaptation.*



- Topic–quiz organization:

loops (while)
Quiz1
Quiz2

increment decrement

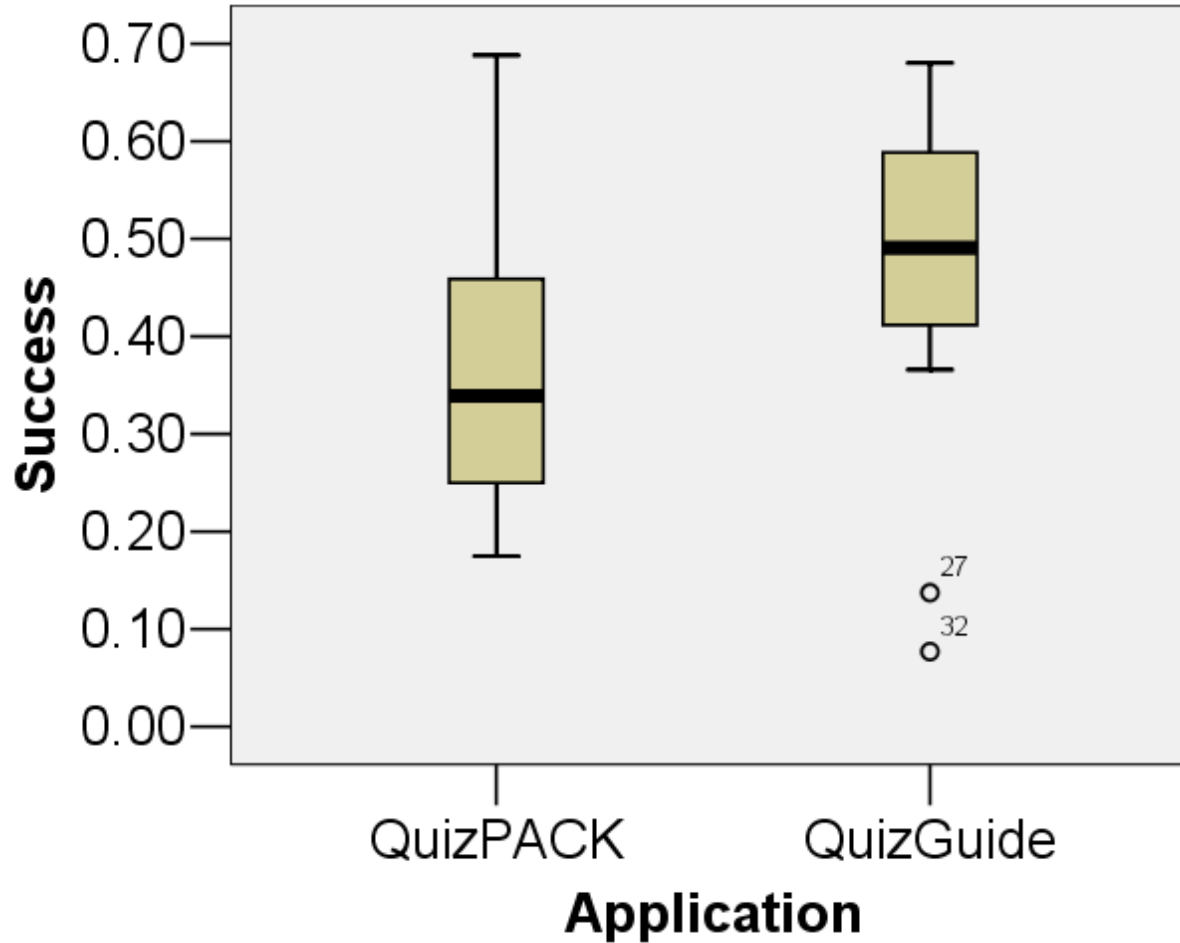
compound assignments
Quiz1

logical expressions
Quiz1

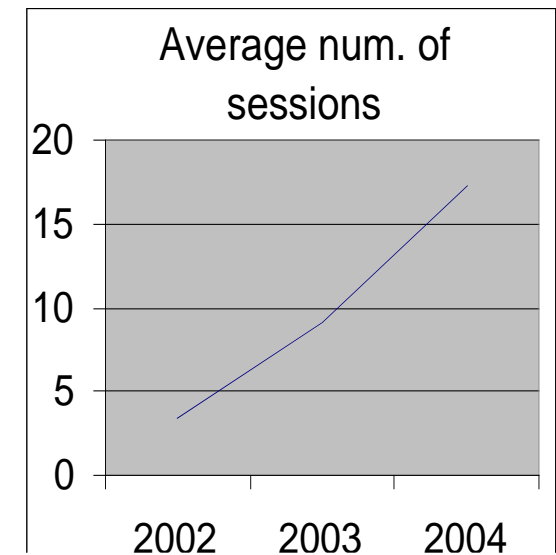
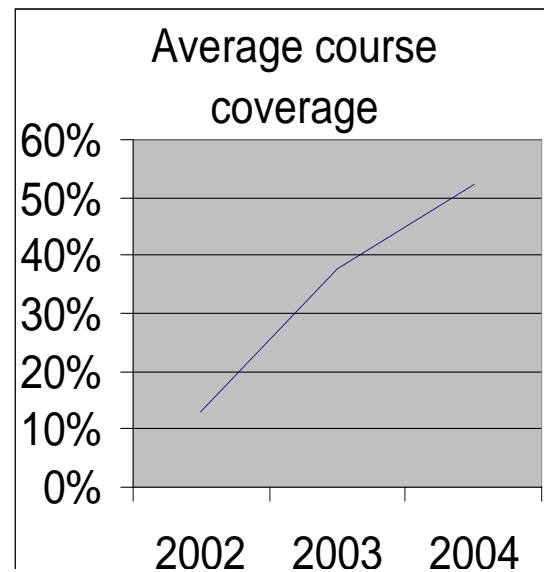
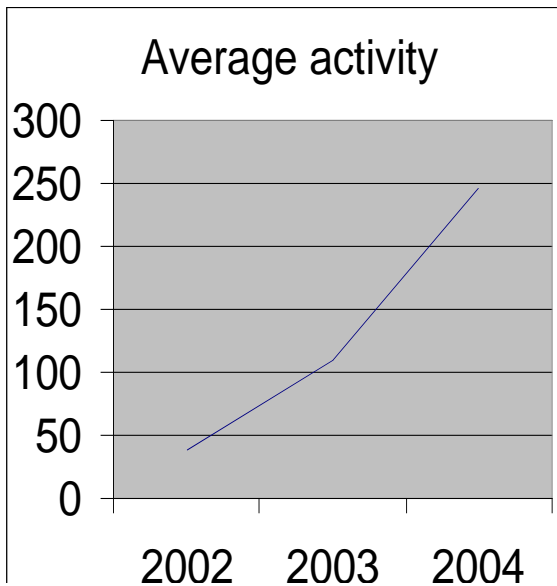
loops (do while)
Quiz1
Quiz2

conditionals (if else)

QuizGuide: Success Rate



QuizGuide: Motivation



- Within the same class QuizGuide session were much longer than QuizPACK sessions: 24 vs. 14 question attempts at average.
- Average Knowledge Gain for the class rose from 5.1 to 6.5



Topic-Based ANS: Success Recipes

- Topic-Based interface organization is familiar, matches the course organization, and provides a compromise between too-much and too-little
- Two-way adaptive navigation support guides to the right topic
- Open student model provides clear overview of the progress



Social Guidance

- Concept-based and topic-based navigation support work well to increase success and motivation
- Knowledge-based approaches require some knowledge engineering – concept/topic models, prerequisites, time schedule
- In our past work we learned that social navigation – “wisdom” extracted from the work of a community of learners – might replace knowledge-based guidance
- Social wisdom vs. knowledge engineering

Knowledge Sea II

- Social Navigation to support course readings

Knowledge Sea v2.0 - TALER - Mozilla Firefox

File Edit View Go Bookmarks Tools Help

http://ir.exp.sis.pitt.edu/ks2/default.jsp?userid=rosta&groupid=3&kt_sid=null

Getting Started Latest Headlines Affogato Coffee Google Music & Lyrics by Zib... http://www.bbc.co... Yahoo! Mail - The be...

KnowledgeSea v2.0

Help

Search in KnowledgeSea

operator, loop, expression L11	operator, loop, expression 	operator, expression, value L14	data, type, variable L8	data, type, variable 	variable, data, type 	variable, function, declaration 	function, variable, declaration
loop, operator, statement 	operator, expression, loop 	language, operator, type 	data, type, variable L9	data, variable, type 	variable, declaration, function 	function, variable, declaration 	function, variable, declaration L18 L23
loop, statement, operator L12 L15	statement, loop, operator L16	language, statement, problem 	language, problem, work 	language, data, problem 	memory, variable, structure 	memory, function, pointer 	function, memory, pointer
statement, compiler, loop 	language, statement, compiler 	language, problem, run 	language, problem, scanf 	memory, scanf, language 	memory, pointer, structure 	pointer, memory, function 	pointer, memory, function
file, compiler, include 	compiler, file, language 	language, compiler, run L7	language, scanf, problem 	scanf, language, memory 	memory, pointer, scanf 	pointer, memory, array 	pointer, memory, array L21
file, compiler, include 	file, compiler, run 	language, printf, scanf 	scanf, string, printf 	scanf, string, character 	pointer, memory, string 	pointer, memory, array 	pointer, array, memory
file, source, include L10	file, output, function 	file, output, printf 	string, character, printf L20	string, character, scanf 	string, character, scanf 	array, pointer, string 	array, pointer, memory
file, output, source 	file, output, input 	file, string, output L13	string, character, printf 	string, character, print 	string, character, array 	array, string, pointer L19	array, pointer, string L17 L22

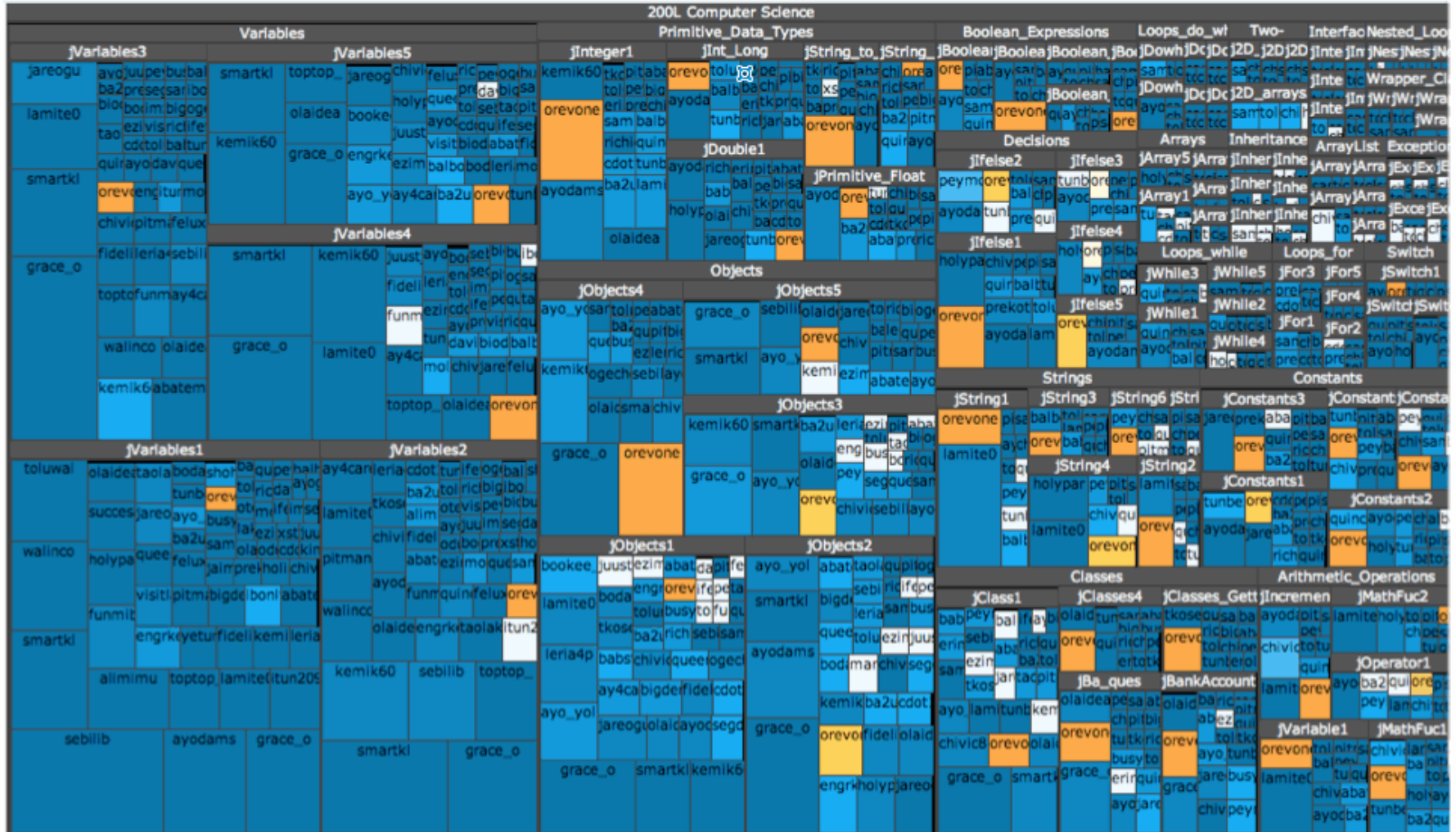


Open Social Student Modeling

- Key ideas
 - Assume simple topic-based design
 - Show topic- and content- level knowledge progress of a student in contrast to the same progress of the class
- Main challenge
 - How to design the interface to show student and class progress over topics?
 - We went through several attempts...



QuizMap



Progressor





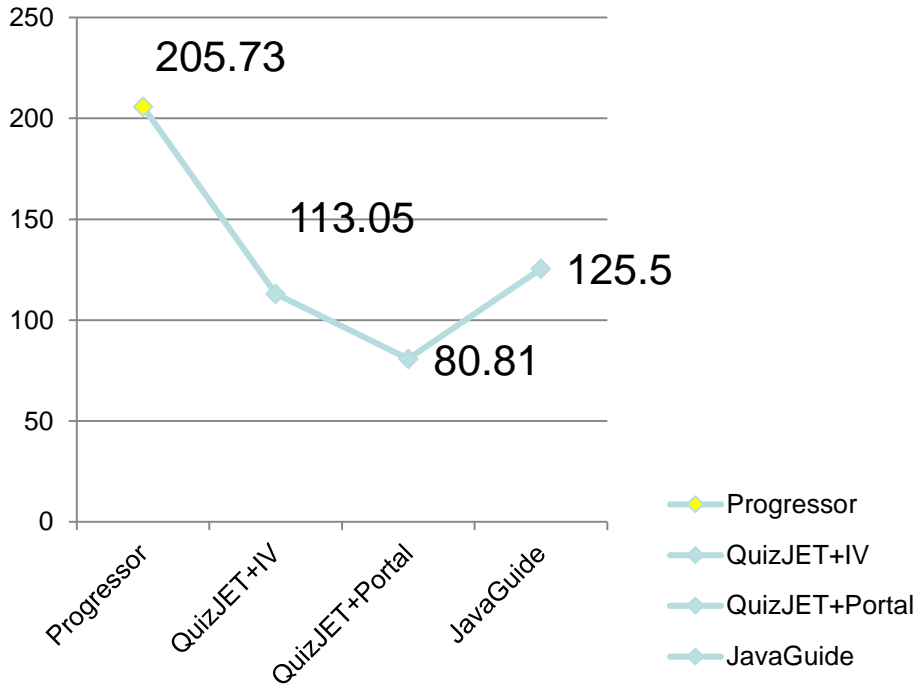
OSLM: Success Recipes

- Topic organization should follow the natural progress or topics in the course
- Clear comparison between “me” and “group”
- Ability to compare with individual peers, not only the group
- Privacy management

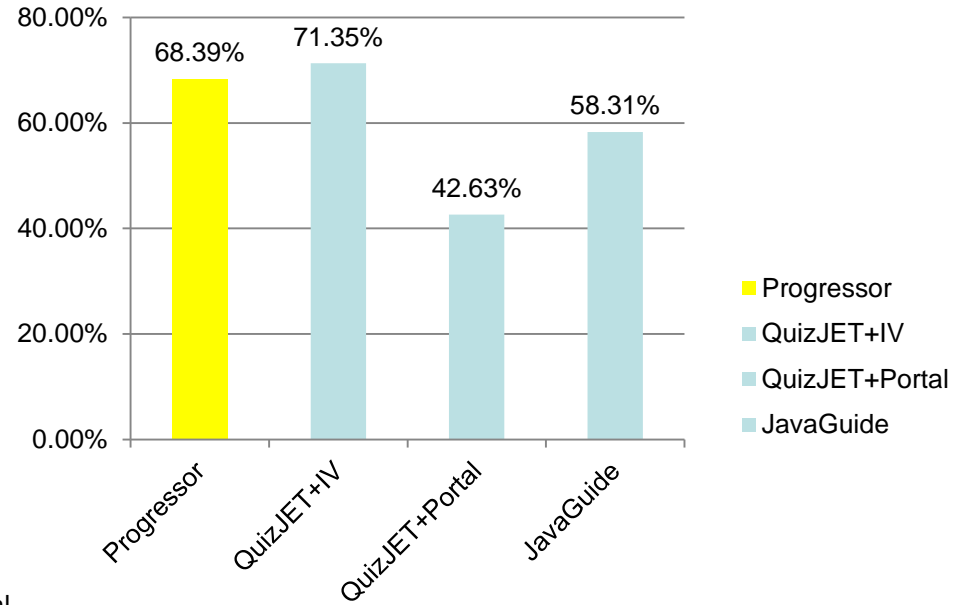


The Value of OSLM

Attempts

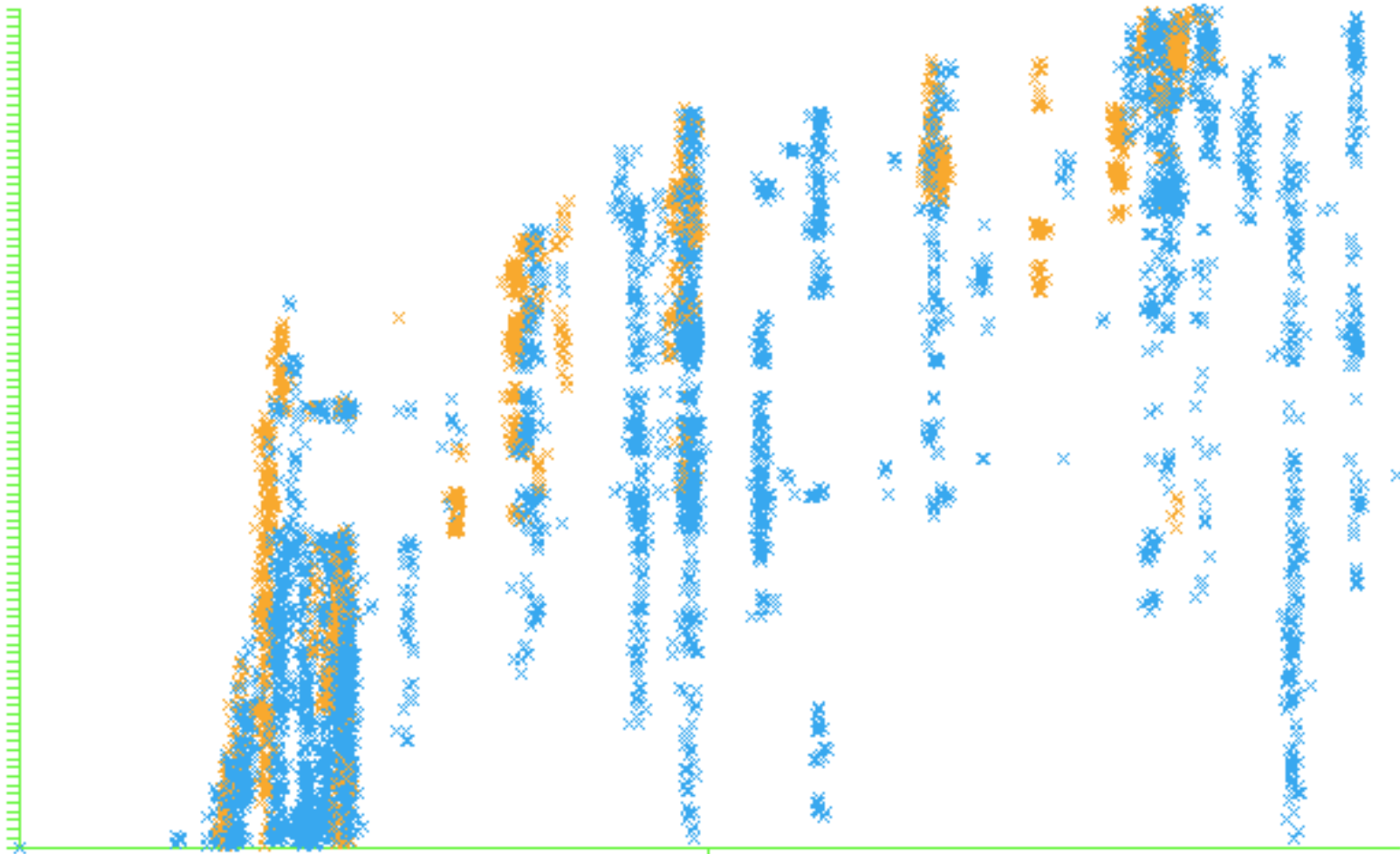


Success Rate



The Secret

Plot: knowledge-guidance





MasteryGrids

- Adaptive Navigation Support
- Topic-based Adaptation
- Open Social Student Modeling
- Social Educational Progress Visualization
- Multiple Content Types
- Open Source
- Concept-Based Recommendation
- Multiple Groups

MasteryGrids OSM Interface

My Progress



exercises and examples are directly accessed

close

Examples

Quizzes

Colors: knowledge progress



Topic: SELECT-FROM-WHERE • Activity: SELECT-FROM-WHERE question3

Question:

Based on the tables below, write the required SQL expression.

Task:
Find the titles of films that rental rate is 4.99 and rating is PG-13.

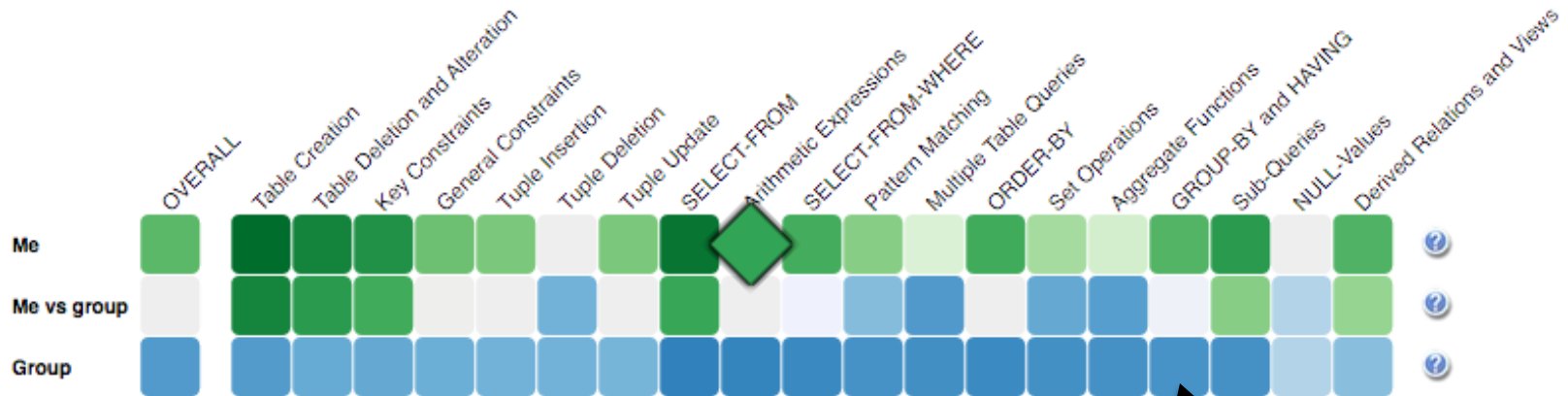
Enter your answer here.

Table Name	Schema & Sample Data (click +/- to show/hide sample data)
accident(+)	report_number date location
actor(+)	actor_id first_name last_name last_update
address(+)	address_id address district city_id postal_code phone last_update
car(+)	license model year
category(+)	category_id name last_update

Close window

MasteryGrids OSSM Interface

Me and group (Students in the class)



Load the rest of learners

Examples 

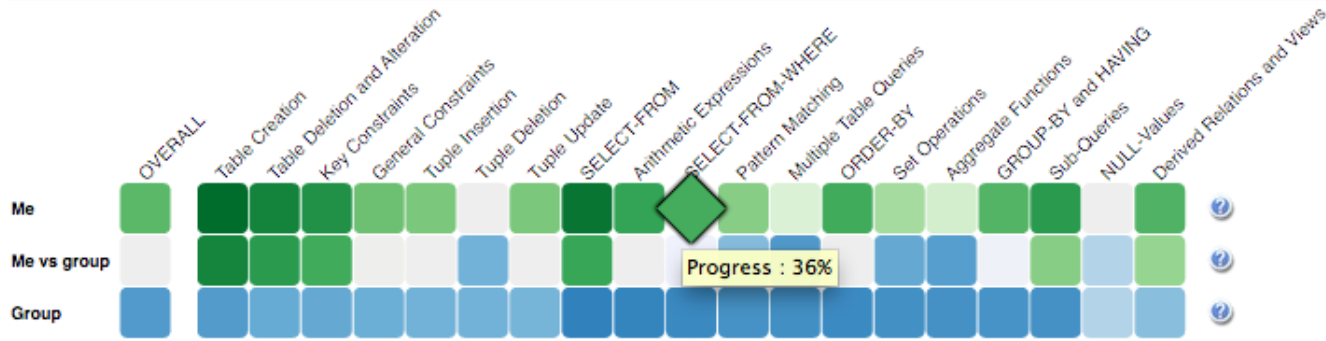
Quizzes 

close

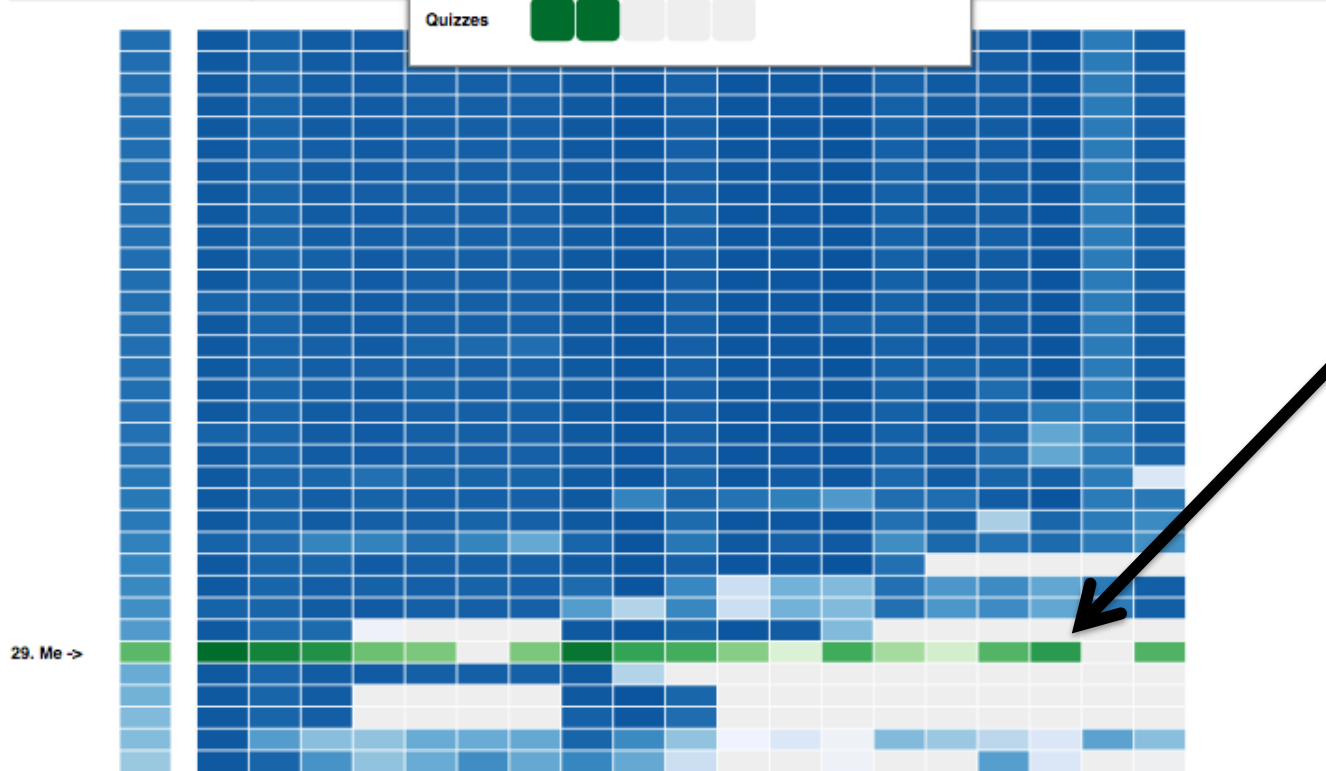
progress of knowledge of the group is represented in blue



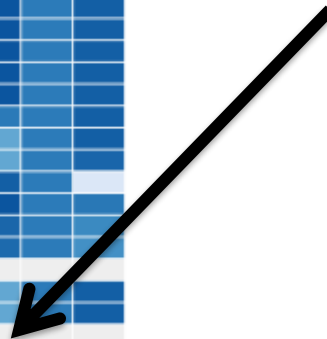
Me and group (Students in the class)



Students in the class (you are 29th out of 30)



Peer students ranked by progress





The Study

- A classroom study in a graduate Database Course
- Two sections of the same class. Same teacher, same lectures, etc.
- The students were able to access non-mandatory database practice content (exercises, examples) through Mastery Grids
- 47 students worked with OSM interface and 42 students worked with OSSM interface

Participants

Systems/gender	OSSM		OSM	
	f	%	f	%
Female	26	55.3	21	50
Male	21	44.7	21	50
Total	47	100	42	100



Data Collection

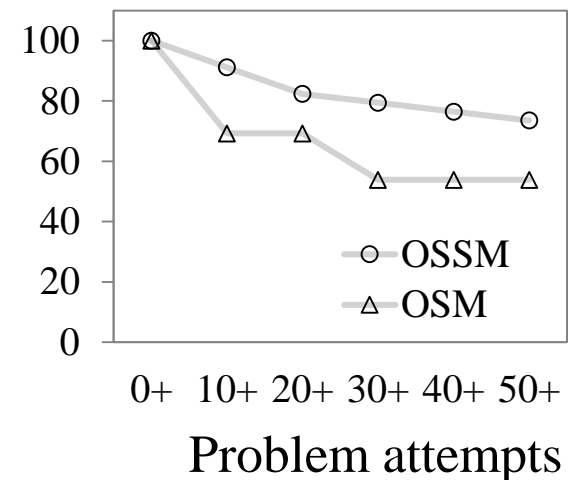
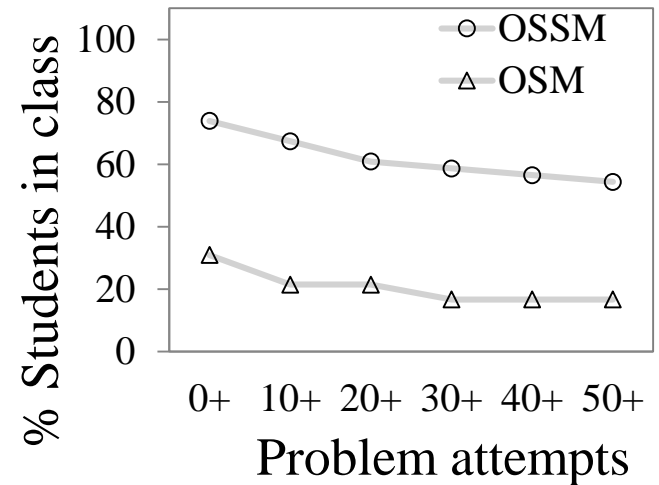
- Pre- and post-test
- Student activities with the system
 - every attempt to solve problems,
 - every example line viewed
 - ...
- The Iowa-Netherlands Comparison Orientation Measure
 - how often students compare themselves with other people
 - Likert-type questionnaire, 11 items
- End of semester questionnaire

Impact on Learning

- Student knowledge significantly increased in both groups
- Number of attempted problems significantly predicts the final grade ($SE=0.04, p=.017$).
- We obtained the coefficient of 0.09 for *number of attempts on problems*, meaning attempting 100 problems increases the final grade by 9
- The mean learning gain was higher for both weak and strong students in OSSM group
- The difference was significant for weak students ($n=033$)

Does OSSM increase student engagement

- OSSM group had much higher student usage
- Looking much more interesting to students at the start (compare #students after the first login)
- At the level of 30+, serious engagement with the system, the OSSM group still retained more than 50% of its original users while OSM engagement was below 20%.



Does OSSM increases system usage?

Variable	OSM	OSSM	U
	Mean	Mean	
Sessions	3.93	6.26	685.500*
Topics coverage	19.0%	56.4%	567.500**
Total attempts to problems	25.86	97.62	548.500**
Correct attempts to problems	14.62	60.28	548.000**
Distinct problems attempted	7.71	23.51	549.000**
Distinct problems attempted correctly	7.52	23.11	545.000**
Distinct examples viewed	18.19	38.55	611.500**
Views to example lines	91.60	209.40	609.000**
MG loads	5.05	9.83	618.500**
MG clicks on topic cells	24.17	61.36	638.500**
MG click on content cells	46.17	119.19	577.500**
MG difficulty feedback answers	6.83	14.68	599.500**
Total time in the system	5145.34	9276.58	667.000**
Time in problems	911.86	2727.38	582.000**
Time in MG (navigation)	2260.10	4085.31	625.000**

Does OSSM increase Efficiency?

- Time per line, time per example and time per activity scores of students in OSSM group are significantly lower than in the other group.
- Students who used **OSSM interface** worked **more efficiently**.

Variable	OSM	OSSM	U
	Mean	Mean	
Time per line	22.93	11.61	570.000**
Time example per	97.74	58.54	508.000*
Time problem per	37.96	29.72	242.000
Time activity per	47.92	34.33	277.000*

Usability and Usefulness Questionnaire Analysis

- 53 students (81 – 28 usage < 300 seconds)
 - 32 in OSM+Social (18 f, 14 m)
 - 21 in OSM (10 f, 11 m)
- Questions in 5-Likert scale (1 low -> 5 high)
- 3 parts:
 - **Part 1** (all students) about common OSM features
 - **Part 2** (only OSM group) about the prospective of using OSSM features
 - **Part 3** (only OSM+Social group): about social comparison features

Findings: Part 1

Part 1		OSM		OSM+Social	
		M	SE	M	SE
1	In general, it was useful to see my progress in Mastery Grids (MG)	3.76	.228	4.03	.145
2	In general, I liked the interface of MG	3.86	.221	3.84	.163
3	Seeing my progress in the tool motivated me to work on quizzes and examples	3.52	.214	4.09	.130
4	The interface helped me to understand how the class content is organized	3.62	.223	3.81	.176
5	The interface helped me to identify my weak points	3.52	.190	3.84	.186
6	The interface helped me to plan my class work	3.33	.211	3.22	.160
7	It was clear how to access questions and examples	3.81	.264	3.56	.190
8	It was useful to see my knowledge progress for each topic [in MG]	3.71	.171	4.03	.135
9	It was useful to see how I am doing with individual quizzes and examples	3.71	.197	4.16	.128
10	Using green colors in different intensity to show my progress was easy to understand	3.90	.217	4.09	.151

(3) OSSM group value OSM features more than OSSM

(Mann-Whitney U=225, p=.026 two-tailed)

(all) Tendency OSM+Social > OSM

(all responses higher, but not significant diff)

Findings

		OSM		OSM+Social	
		M	SE	M	SE
Part 1					
1	In general, it was useful to see my progress in Mastery Grids (MG)	3.76	.228	4.03	.145
2	In general, I liked the interface of MG	3.86	.221	3.84	.163
3	Seeing my progress in the tool motivated me to work on quizzes and examples	3.52	.214	4.09	.130

$p = .031$
(Wilcoxon Signed Rank test)



Part 3, question 10

10	Viewing my classmates' progress motivated me to work more in quizzes and examples	3.88	.193
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Findings

- OSSM group is more excited about OSM part
- OSSM group value OSM features more than OSM group (Mann-Whitney $U=225$, $p=.026$ two-tailed)
- OSSM group is more positive about social features that OSM
 - **the actual experience is better than they think it would be.**



What we are doing now?

- Gender analysis
- Easy authoring to define “your course”
- Exploring more advanced guidance and modeling approaches based on large volume of social data
- Interface and cultural studies in a wide variety of classes from US to Nigeria
 - Interested to be a pilot site? Write to peterb@pitt.edu



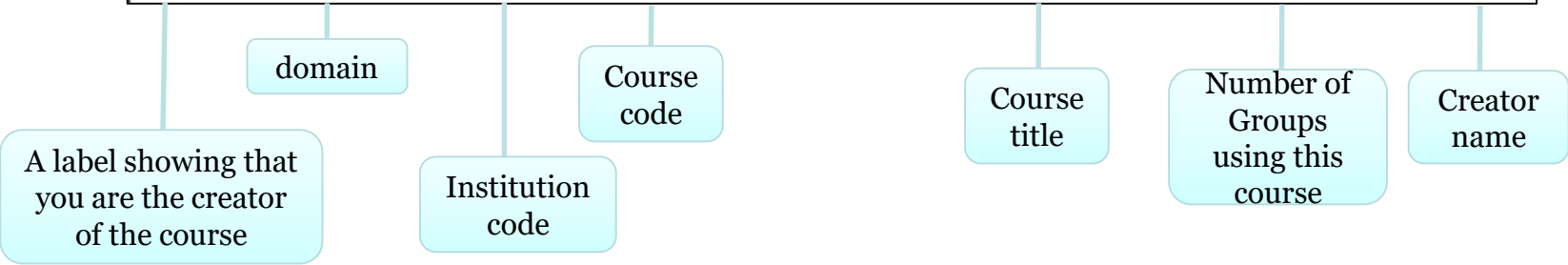
Course Authoring Interface

My courses only Clone the selected course Show the course URL

Courses (3)						Resources (0)	Providers
M	Java Programming	PITT	INFSCI 0017	Introduction to Java Programming	Group:11	Administrator	
M	SQL	PITT	IS 1022/2710	Database Management	Group:4	Administrator	
M	Java Programming	PITT	STUDY2013	Lab Study 2013 - 2014	Group:3	Administrator	

Units (0)	Resources (0)	Unit Activities (0)	Available Activities (0)	Activity Details
			Author: <input type="text"/> Name and tags: <input type="text"/>	

M Java Programming PITT INFSCI 0017 Introduction to Java Programming Group:11 Administrator





Acknowledgements

- Past work on ANS and OSLM
 - Sergey Sosnovsky
 - Michael Yudelson
 - Sharon Hsiao
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- NSF Grants
 - EHR 0310576
 - IIS 0426021
 - CAREER 0447083
- ADL “PAL” grant to build MasteryGrids



Read About It! Try It!

- GitHub link
 - <https://github.com/PAWSLabUniversityOfPittsburgh/MasteryGrids>
- **Brusilovsky, P., Sosnovsky, S., and Yudelson, M.** (2009) Addictive links: The motivational value of adaptive link annotation. *New Review of Hypermedia and Multimedia* **15** (1), 97-118.
- **Hsiao, I.-H., Sosnovsky, S., and Brusilovsky, P.** (2010) Guiding students to the right questions: adaptive navigation support in an E-Learning system for Java programming. *Journal of Computer Assisted Learning* **26** (4), 270-283.
- **Hsiao, I.-H., Bakalov, F., Brusilovsky, P., and König-Ries, B.** (2013) Progressor: social navigation support through open social student modeling. *New Review of Hypermedia and Multimedia*
- **Brusilovsky, P., Somyurek, S., Guerra, J., Hosseini, R., and Zadorozhny, V.** (2015) The Value of Social: Comparing Open Student Modeling and Open Social Student Modeling. In: F. Ricci, K. Bontcheva, O. Conlan and S. Lawless (eds.) Proceedings of 23rd Conference on User Modeling, Adaptation and Personalization (UMAP 2015), Dublin, Ireland, , June 29 - July 3, 2015, Springer Verlag, pp. 44-55, also available at http://link.springer.com/chapter/10.1007/978-3-319-20267-9_4.