

Improving learning through smart learning analytics

Kinshuk, PhD

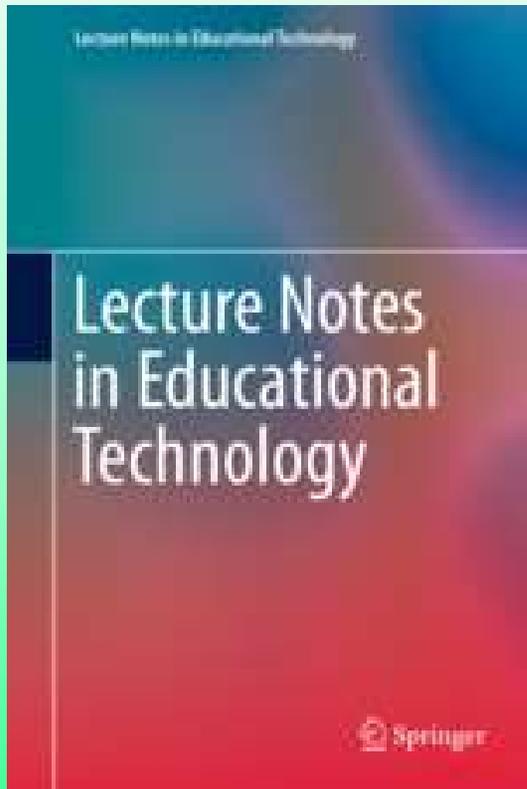
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Springer's Lecture Notes in Educational Technology



<http://www.springer.com/series/11777>

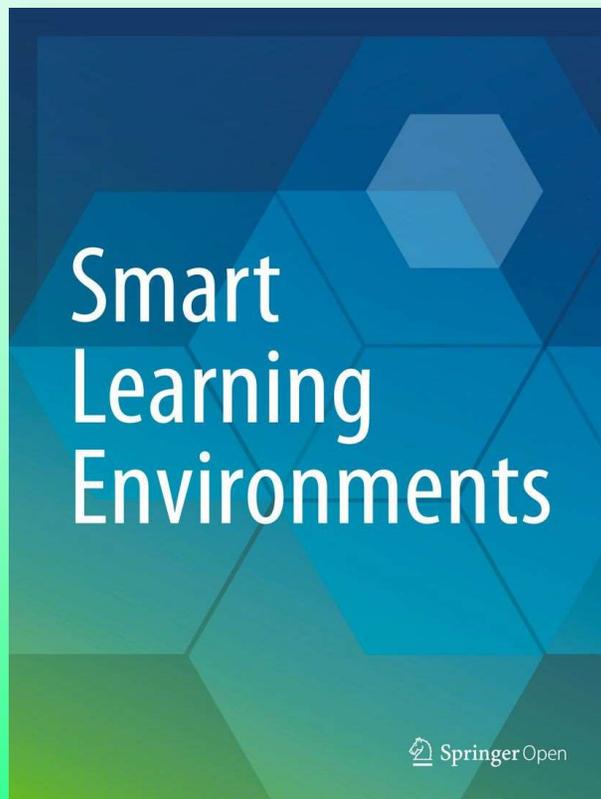
Series Editors

Ronghuai Huang, Kinshuk, Mohamed Jemni,
Nian-Shing Chen and J. Michael Spector

Books
Proceedings
e-books

Springer's Smart Learning Environments

<http://www.springer.com/education+%26+language/journal/40561>



Editors

Ronghuai Huang

Kinshuk

Elliot Soloway

SpringerOpen

International Association of Smart Learning Environments

<http://www.iasle.net/>



The screenshot shows the homepage of the International Association of Smart Learning Environments (IASLE). The header features the IASLE logo on the left, a search bar, and login fields for 'User Name', 'Password', and 'Log in'. A navigation menu includes 'HOME', 'ABOUT', 'HIGHLIGHTS', 'STORIES', 'MEMBER', and 'CONTACT'. The main content area has a dark blue background with the text 'International Association of Smart Learning Environments' and a description: 'A cutting-edge professional forum for researchers, academics, practitioners, and industry professionals interested and/or engaged in the reform of the ways of teaching and learning through advancing current learning environments towards smart learning environments.' To the right is an illustration of a presentation screen showing a bar chart. Below this is a section titled '"International Conference on Smart Learning Environments (ICSLE 2015)"' with details: 'Call For Papers', 'International Conference on Smart Learning Environments (ICSLE 2015)', 'September 23-25, 2015 Sinaia, Romania', and a link to <http://www.ask4research.info/icsle/2015/>. A 'Read more...' button is at the bottom left of this section.

Designing Adaptive and Personalized Learning Environments

Kinshuk

2016
Routledge

ISBN: 978-1138013056



Books Journals eProducts Info & Help

Designing Adaptive and Personalized Learning Environments

By Kinshuk

Routledge – 2016 – 200 pages

Series: [Interdisciplinary Approaches to Educational Technology](#)

Description

Contents

Author Bio

Subjects

Designing Adaptive and Personalized Learning Environments provides a theoretically-based yet practical guide to systematic design processes for learning environments that provide automatic customization of learning and instruction.

The book consists of four main sections: In "Introduction and Overview," the concepts of adaptivity and personalization are introduced and explored in detail. In "Theoretical Perspectives with Example Applications," various theoretical concepts underlying adaptive and personalized learning are discussed, including cognitive profiling, content-based adaptivity, exploration-based adaptivity, and mobile and ubiquitous settings. In "Practical Perspectives with Example Applications," the implementation process for adaptive and personalized learning environments is described, followed by application in various contexts. In "Validation and Future Trends," various evaluation techniques for validating the efficiency and efficacy of adaptive and personalized learning systems are discussed. This final section concludes with a discussion of emerging trends in adaptive and personalized learning research.

Based on cutting-edge research, *Designing Adaptive and Personalized Learning Environments* is appropriate as a primary textbook for both undergraduate and graduate courses focused on the design of learning systems, and as a secondary textbook for a variety of courses in programs such as educational technology, instructional design, learning sciences, digital literacy, computer based systems, and STEM content fields.

Current trends in learning

- Inclusive education
- Focus on individual strengths and needs
- Various learning scenarios – in class and outdoor environments
- Relevance of the learning scenarios with learners' living and work environments
- Authentic learning with physical as well as digital resources
- Result: better learning experience



Vision



~ Learning omnipresent and highly contextual ~

seamless integration of learning into every aspect of life

which implies

immersive, always-on learning

that happens so naturally and in such small chunks

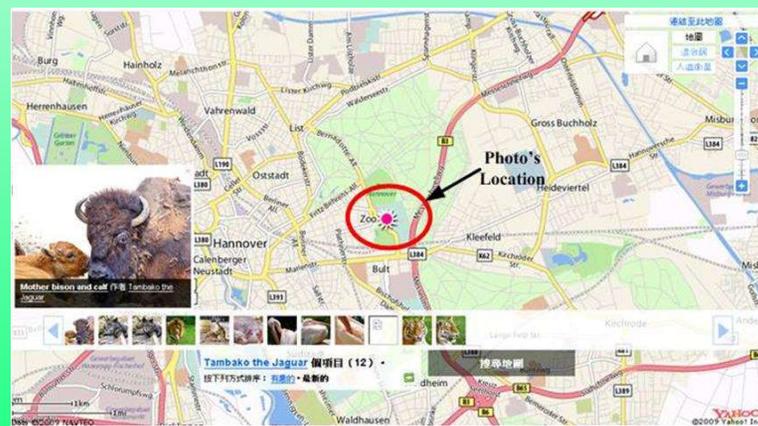
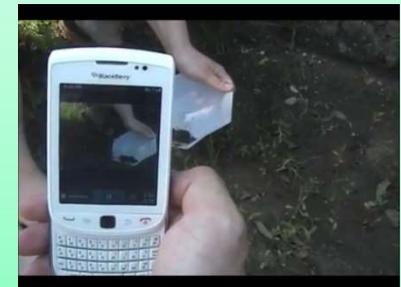
that no conscious effort is needed

to be actively learning while engaged in everyday life

Smart learning analytics



Discover, analyze and make sense of student, instruction and environmental data from multiple sources to identify learning traces in order to facilitate instructional support in authentic learning environments



Discover



Past record and real-time observation of:

Learner's capabilities, preferences and
competencies

Learner's location

Learner's technology use

Technologies surrounding the learner

Changes in learner's situational aspects

Analyze



Learner's actions

Interactions with peers and instructors

Interactions with physical objects

Interactions with digital information

Learner's trends of preferences

Changes in learner's skill & knowledge levels

Making sense: Learning traces



A learning trace comprises of a network of observed study activities that lead to a measurable chunk of learning.

Learning traces are ‘sensed’ and supply data to learning analytics, where data is typically BIG, un/semi-structured, seemingly unrelated, not quite truthful, and fits multiple models and theories.

Why learning traces are important?



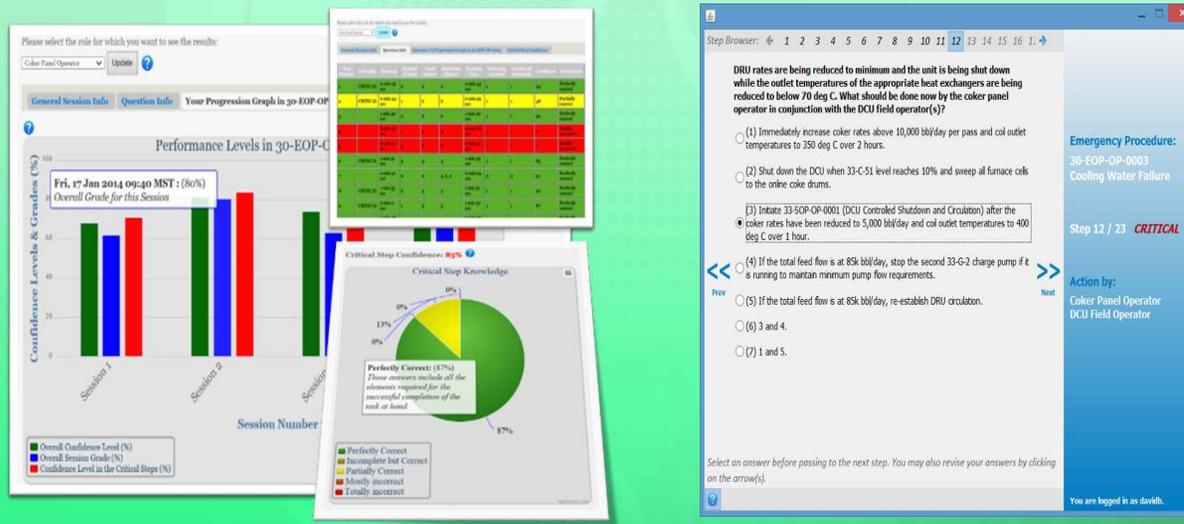
Different students can adopt different learning approaches for the same learning activity!

Ex: Why a pointed object penetrates better than a blunt object?

- A visual-oriented learner may choose to see this in action and explain the results
- A psychomotor-oriented learner may take a sharp pencil and test it against his/her palm to explain the results
- A cognition-oriented student may workout the mathematics behind pressure to explain the results

Examples of Smart Learning Analytics

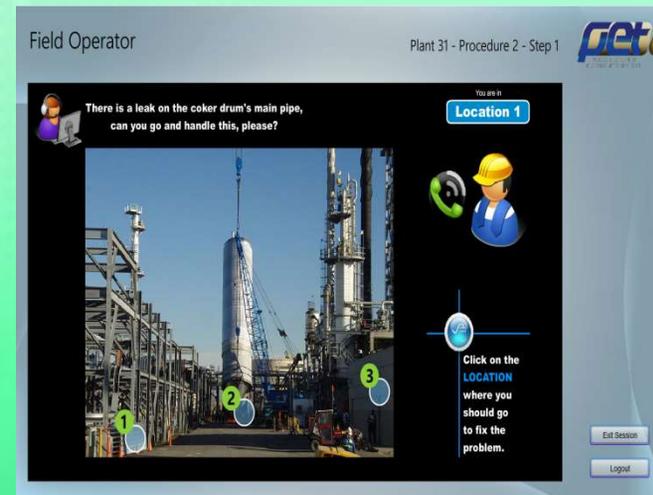
- Empowers organizations in the energy industry to train and recertify their operators in standard and emergency operating procedures.
- Tracks the knowledge and behavior of operators through highly-monitored multiple-choice questionnaires.
- Provides a dashboard to view the operators' proficiency and performance in every step of an operating procedure.
- Gives organizations the ability to manage and optimize knowledge assets and human capital.



ART



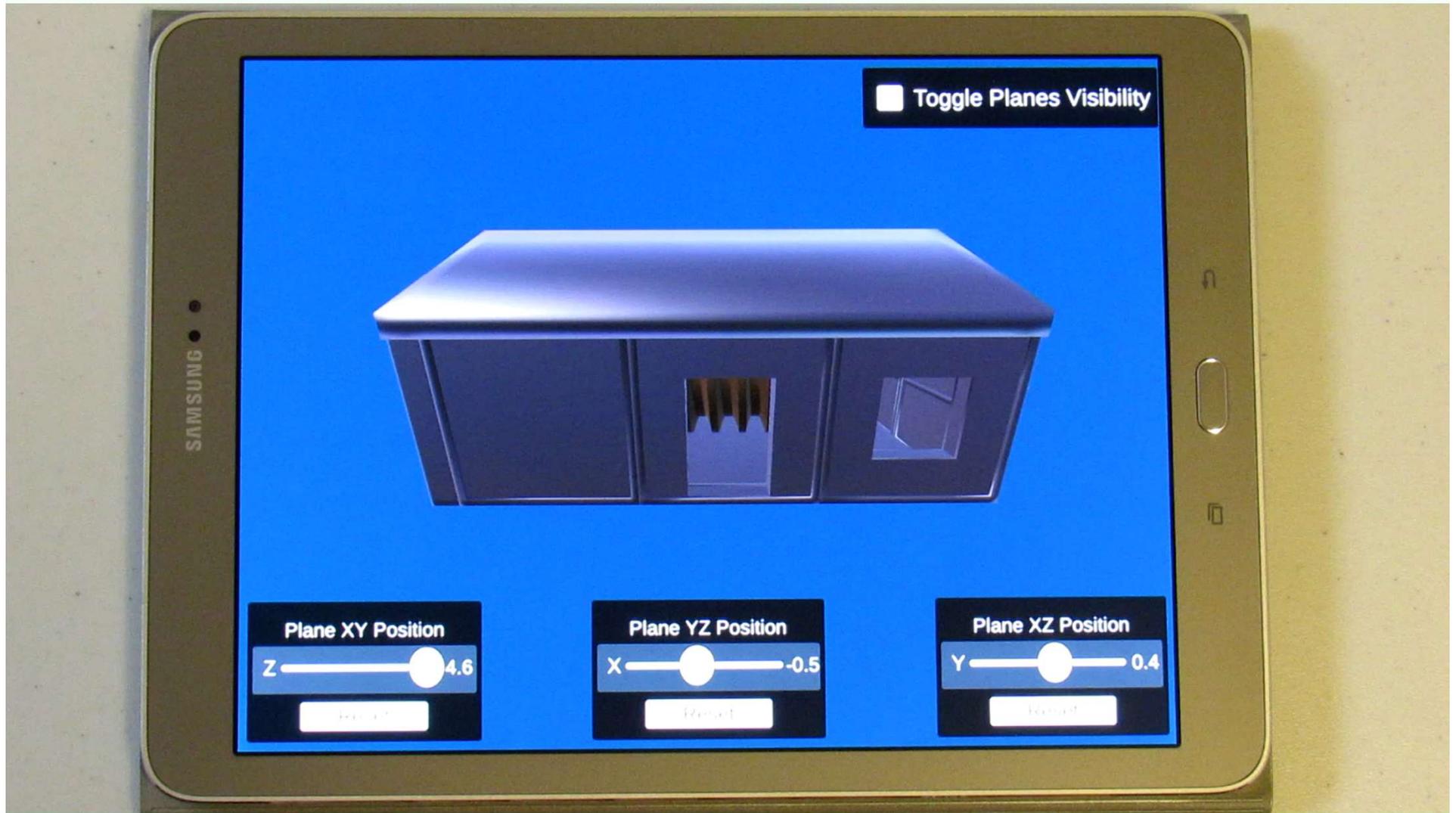
- An immersive training and testing environment using techniques and technologies such as augmented reality and game development environments.
- Provides trainees with multimedia lessons which may include video and audio clips, animations, interactive maps, and customized learning activities.
- Captures all users' interactions with both the physical and virtual worlds and delivers customized feedback to trainees.
- Applies to any domain requiring the application of knowledge in the real world.



Augmented Reality Testing | Training Environment



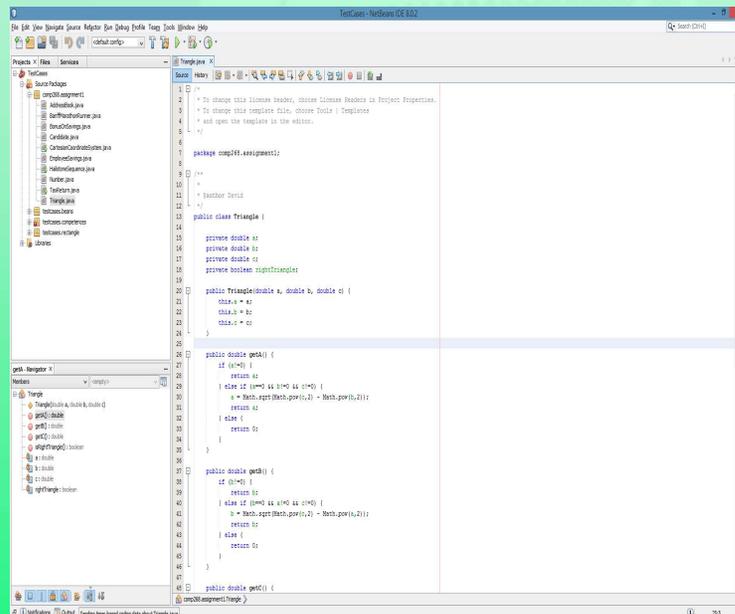






DASHBOARD

- Tracks programmers' interactions with coding tools.
- Records coding habits such as debugging and testing strategies.
- Monitors the problem-solving process underlying the development of a program.
- Analyzes the functionality of a program.
- Recognizes techniques employed by programmers.
- Provides metrics to assess the proficiency and performance of programmers.
- Supports the customization of the techniques assessing programmers.



We now have the capacity to observe study habits of students working on similar problems from around the world, at real time.

Peter McCain,
Edmonton, AB,
Canada

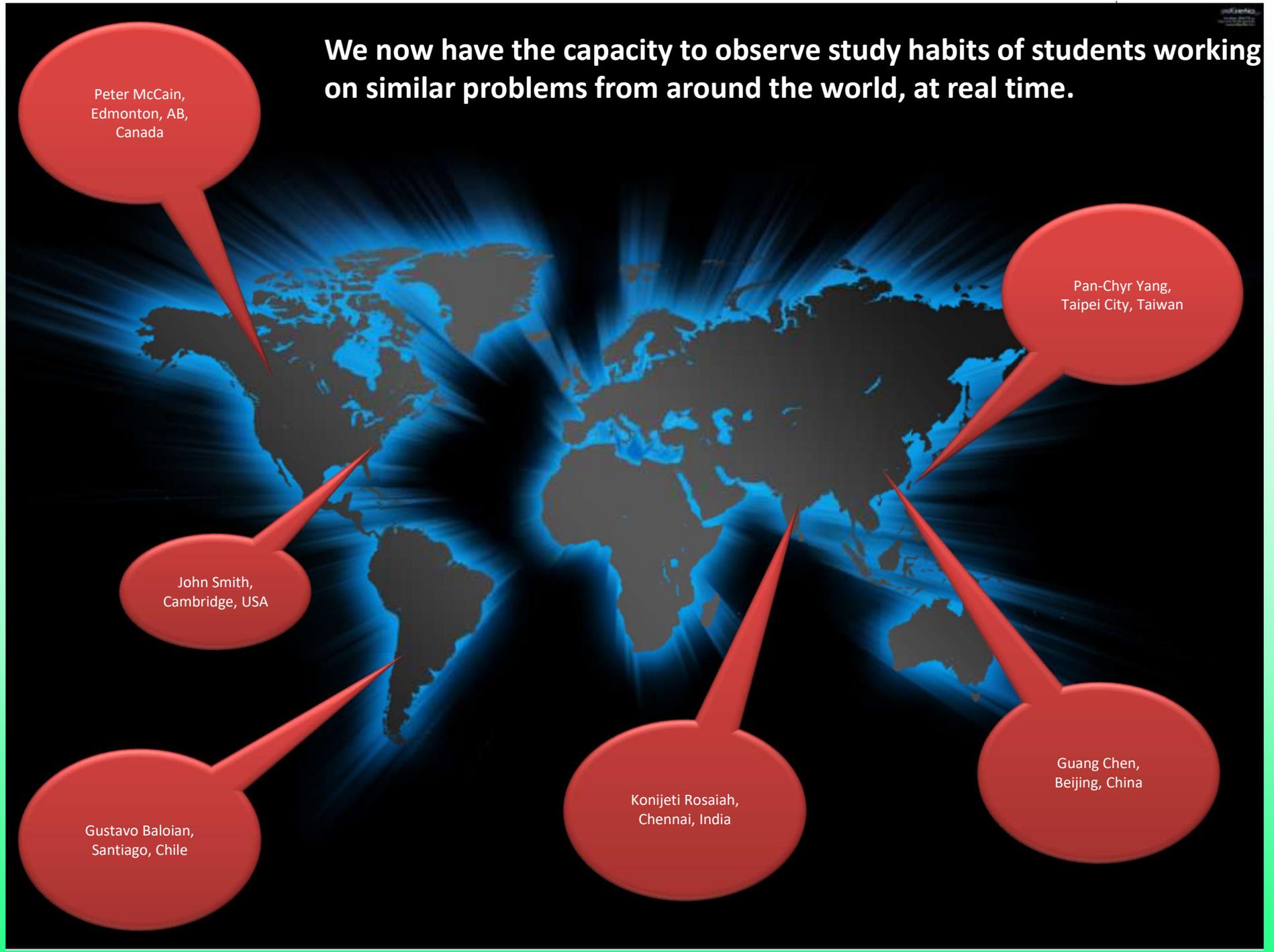
Pan-Chyr Yang,
Taipei City, Taiwan

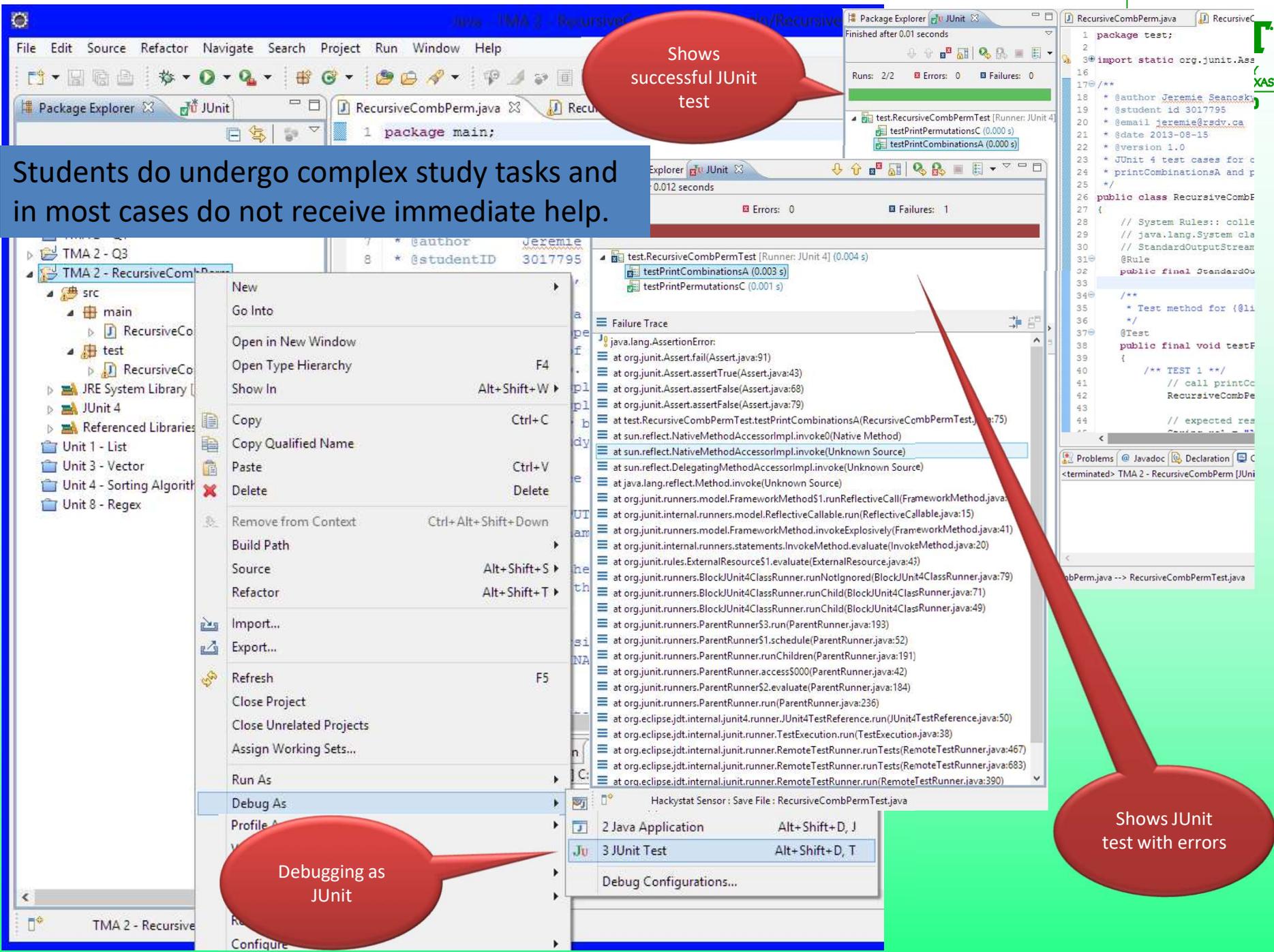
John Smith,
Cambridge, USA

Guang Chen,
Beijing, China

Gustavo Baloian,
Santiago, Chile

Konijeti Rosaiah,
Chennai, India





Shows successful JUnit test

Students do undergo complex study tasks and in most cases do not receive immediate help.

Debugging as JUnit

Shows JUnit test with errors

A student writes code & reviews errors



Teachers do not have the opportunity to see the types of errors students faced while writing code!! We now have the technology to address this issue.

A screenshot of an IDE window showing a Java file named 'RegexTestHarness.java'. The code is a simple program that uses a regular expression to find matches in a string. The code is as follows:

```
127 Matcher matcher = pattern.matcher(console
128     .readLine("Enter input string to search: "));
129
130 // Boolean variable to indicate whether any match was found.
131 boolean found = false;
132
133 // Loop trying to find the next subsequence matching the regex
134 // pattern.
135 while (matcher.find())
136 {
137     // Print out to the console whether or not any matches were
138     // found and if so, list them.
139     console.format("The Matcher engine found the text \"%s\" starting at "
140         + "index %d and ending at index %d.%n",
141         matcher.group());
142     // Return input subsequence matched by previous match.
143     matcher.group();
144
145     // Start index of previous match.
146     matcher.start();
147
148     // Offset (last index) of previous match.
149     matcher.end(2.0);
150
151     // Set found flag to true so loop exits.
152     found = true;
153 }
154
155 }
156
157 }
158 }
```

The IDE shows a 'Problems' window at the bottom with a single error: 'Build Error: RegexTestHarness.java [The method end(int) in the type Matcher is not applicable for the arguments (double)]'. The error is located at line 149, column 13. The status bar at the bottom of the IDE shows '155:13'.

A top student solves a similar problem



Students (or teachers) can show/analyze real-time study habits of students from around the world. Since the initiative comes from students, they get a global perspective on learning, and also engage teachers in similar perspectives.

The screenshot shows an IDE window titled "RegexTestHarness.java". The code is as follows:

```
131 boolean found = false;
132
133 // Loop trying to find the next subsequence matching the regex
134 // pattern.
135 while (matcher.find())
136 {
137     // Print out to the console whether or not any matches were
138     // found and if so, list them.
139     console.format("The Matcher engine found the text \"%s\" starting at "
140         + "index %d and ending at index %d.\n",
141
142         // Return input subsequence matched by previous match.
143         matcher.group());
144
145     // Start index of previous match.
146     matcher.start(0);
147
148     // Offset (last index) of previous match.
149     matcher.end(2.0);
150
151     // Set found flag to true so loop exits.
152     found = true;
153
154 }
155
156 // if not a match is found.
157 if (!found)
158 {
159     // print out to console the proper message
160     console.format(no match found.\n);
161 }
162 }
```

The bottom of the screenshot shows a "Problems" window with 10 errors and 6 warnings. The errors are:

Description	Resource	Path	Location	Type
Errors (10 items)				
console cannot be resolved	RegexTestHarness.java	/Unit 8 - R...	line 159	Java Problem
Syntax error on token "%s", delete this token	RegexTestHarness.java	/Unit 8 - R...	line 159	Java Problem
Syntax error on token "match", (expected	RegexTestHarness.java	/Unit 8 - R...	line 159	Java Problem
Syntax error, insert ";" to complete BlockStatements	RegexTestHarness.java	/Unit 8 - R...	line 159	Java Problem
Syntax error, insert ";" to complete Statement	RegexTestHarness.java	/Unit 8 - R...	line 146	Java Problem
Syntax error, insert ";" to complete Expression	RegexTestHarness.java	/Unit 8 - R...	line 143	Java Problem
Syntax error, insert ";" to complete MethodInvocation	RegexTestHarness.java	/Unit 8 - R...	line 159	Java Problem
The method end(int) in the type Matcher is not applicable for the arguments (double)	RegexTestHarness.java	/Unit 8 - R...	line 149	Java Problem
The primitive type boolean of found does not have a field n	RegexTestHarness.java	/Unit 8 - R...	line 159	Java Problem
Warnings (6 items)				
The import java.io.PrintStream is never used	RecursiveCombPermTest.java	/TMA 2 - R...	line 5	Java Problem
The import org.junit.contrib.java.lang.system.TextFromStandardInputStream is never used	RecursiveCombPermTest.java	/TMA 2 - R...	line 12	Java Problem

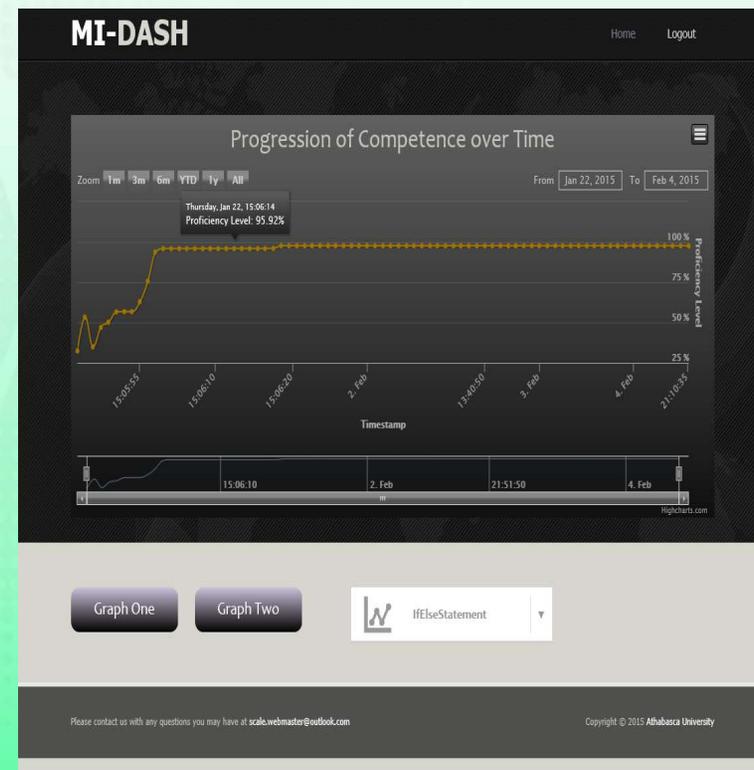


CODEX
CODing EXperiences

MI-DASH



- A learner-centric dashboard with visualizing and reporting capabilities.
- Enables learners to access their learning outcomes in a single place.
- Embeds tools which learners can use to reflect and provide feedback about learning activities they just completed.
- Includes predefined queries, visualizations, and reports such as the development of a student's proficiency and performance.
- Provides tools to select the learning data from which to view personalized results.



Continue to the Sign-In page

Welcome to our Learning Analytics System

▶ CODEX	▶ SCALE	▶ MI-DASH
<h3>Coding Experiences</h3> <p>CODEX is a NetBeans learning analytics plug-in that will enable you to track your coding experiences as you go through your various software engineering activities. CODEX will also capture seamlessly in real-time the development of a particular program's code, the time taken to solve a particular problem, the number of times a particular program has been compiled, and the errors generated at each compilation. CODEX will guarantee through state-of-the-art technologies that the integrity of your learning experiences is preserved during SCALE analysis.</p>	<h3>Smart Competence Analytics on Learning</h3> <p>SCALE is a smart competence analytics technology that analyzes your learning experiences in programming. SCALE basically transforms your learning traces into measurements that will help you assess how proficient you are in the concepts introduced in your programming course. SCALE will also allow you to evaluate how confident you are at solving a particular programming exercise and how confident you are in the overall learning domain. SCALE's mission is to provide you with a scale that will help you see and optimize your learning as it occurs.</p>	<h3>Mixed Initiative Dashboard</h3> <p>MI-DASH is a learning analytics dashboard that will allow you to visualize and monitor your proficiency and confidence levels in programming. MI-DASH will enable you to view your competence portfolio as well as your current level of confidence as you work through each activity in your course. You will also be able to view the progression of your proficiency in a particular competence over time and the progression of your confidence level over time for every learning activity as well as for the overall programming domain. Enjoy!</p>

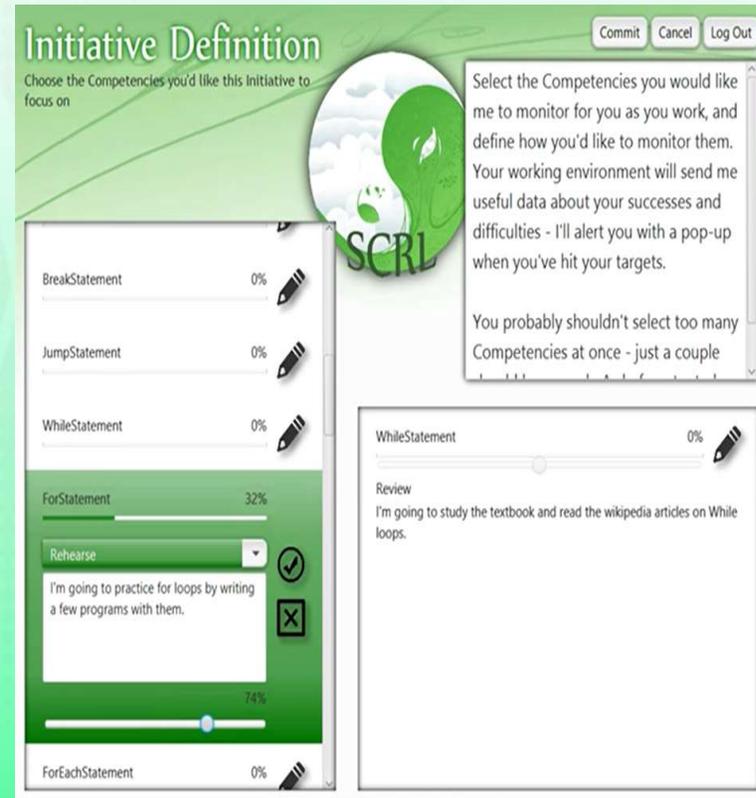


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SCRL

- A tool to help students manage, structure, and engage in coursework in a disciplined way.
- Teaches students effective learning habits by encouraging initiatives and goal-setting among learners.
- Enables students to know more about themselves by identifying strengths and weaknesses in specific skills.
- Identifies students' learning needs and offers solutions by bringing together students in needs with those who previously went through the same challenges.



The screenshot shows the 'Initiative Definition' interface. At the top, it says 'Choose the Competencies you'd like this Initiative to focus on'. Below this, there are several progress bars for different competencies: BreakStatement (0%), JumpStatement (0%), WhileStatement (0%), ForStatement (32%), Rehearse (74%), and ForEachStatement (0%). The 'Rehearse' section is expanded, showing a text box with the goal: 'I'm going to practice for loops by writing a few programs with them.' To the right, a pop-up window provides instructions: 'Select the Competencies you would like me to monitor for you as you work, and define how you'd like to monitor them. Your working environment will send me useful data about your successes and difficulties - I'll alert you with a pop-up when you've hit your targets. You probably shouldn't select too many Competencies at once - just a couple'. At the bottom right, another section for 'WhileStatement' is visible, with a 'Review' section containing the text: 'I'm going to study the textbook and read the wikipedia articles on While loops.'

LEARNING INITIATIVE DESIGN



Helps the learner choose goals, decide on strategies

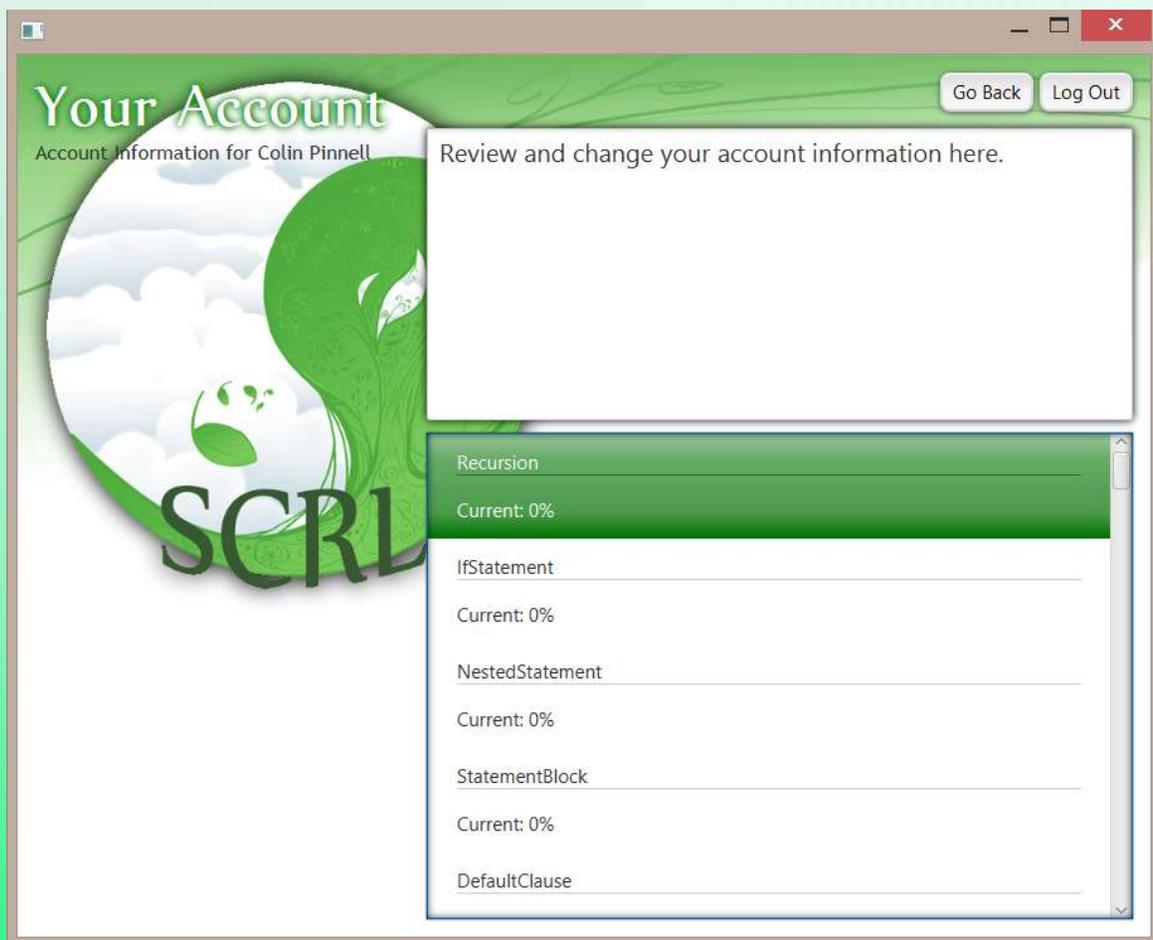
Makes the regulation process explicit

Provides hints and support for indecisive learners

Tutorials are included in both embedded and independent forms

A screenshot of a web browser window titled "New Initiative". The window has a green header with the title "New Initiative" and three buttons: "Next", "Cancel", and "Log Out". Below the title is a sub-header "Make a name for your Initiative and describe your thoughts about it". On the left side of the form is a large green circular graphic with a white cloud-like background and a green leaf-like shape, with the letters "SCRL" in a bold, green, serif font at the bottom. To the right of the graphic is a text box containing instructions: "Initiatives are the actions and plans you take when pursuing a learning goal and completing tasks - at the moment, we're looking at the Java programming language, so let's focus on that. In the top input, give a descriptive name for what you'd like this Initiative to accomplish, and in the lower area, let me know what challenges and problems you expect to face while working on this. If you're unsure of what you should put here, I'd suggest being as specific as possible - 'I'd like to learn how to use...". Below this text box is a text input field containing the text "My New Initiative". Below the input field is a larger text area containing the text "I'm hoping to improve my skill with loops. I'm having trouble getting the booleans right." At the bottom left of the form is a checkbox labeled "Default" with the text "Administrator: Select the check box below if you wish for this initiative to be a default initiative, applied to all students in the course." next to it.

INITIATIVE MONITORING



Real-time monitoring of learner activities

Immediate learner feedback on goal progress

Educators may monitor learner progress with the same mechanisms

Initiative goals may be edited to allow for progressive initiatives

NEW VIRTUAL CLASSROOM DYNAMICS



Chat system allows immediate learner interactions

Educators may form learner groups with shared initiatives

Educators may assign default initiatives for all learners, to provide easy-to-identify goal examples

Students will see their learning as competency progression instead of assigned grades.



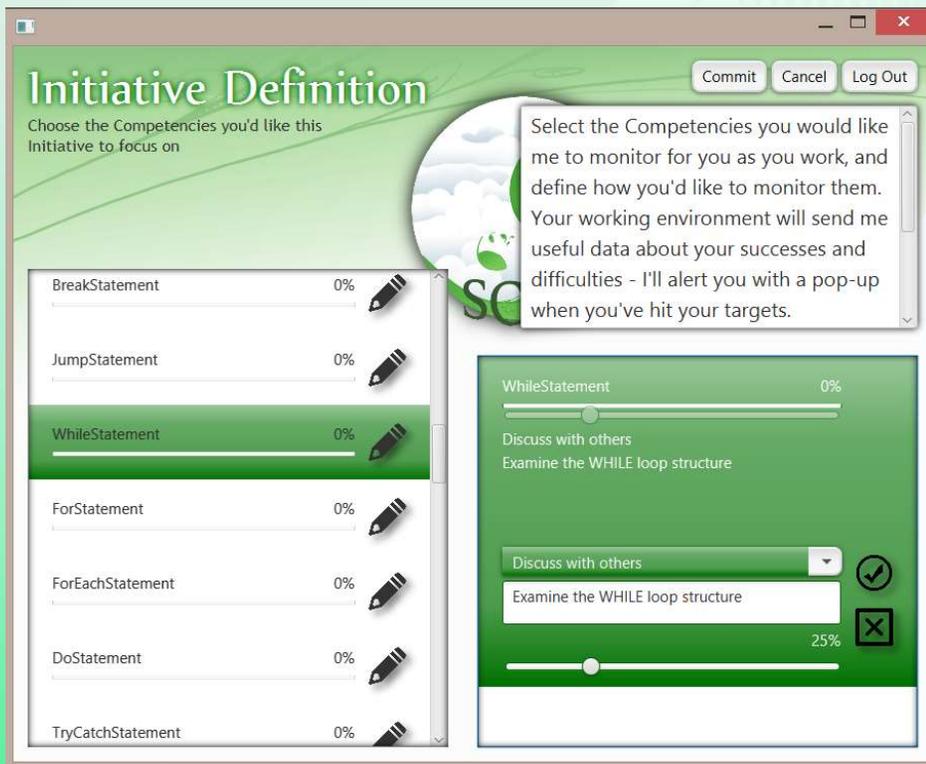
MORE CLASSROOM DYNAMICS



Educators may create shared initiatives for specific learners to address specific deficiencies

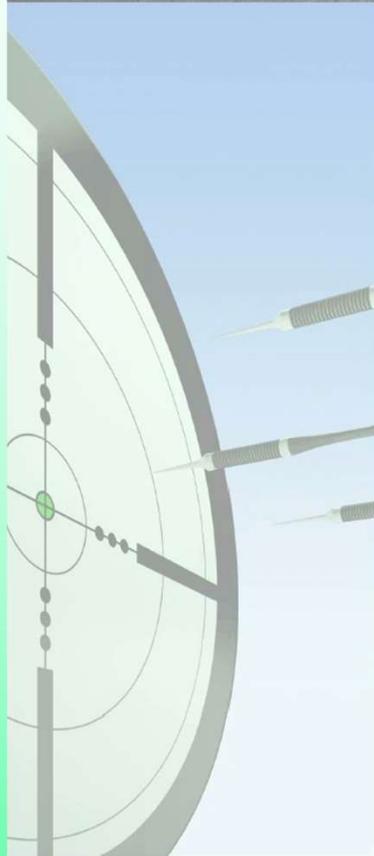
Shared initiatives allow educators to pair needy learners with skillful ones, or to group needy learners together into work teams.

Learners may form these groups independent of educator actions, or may request the help of more skillful learners.





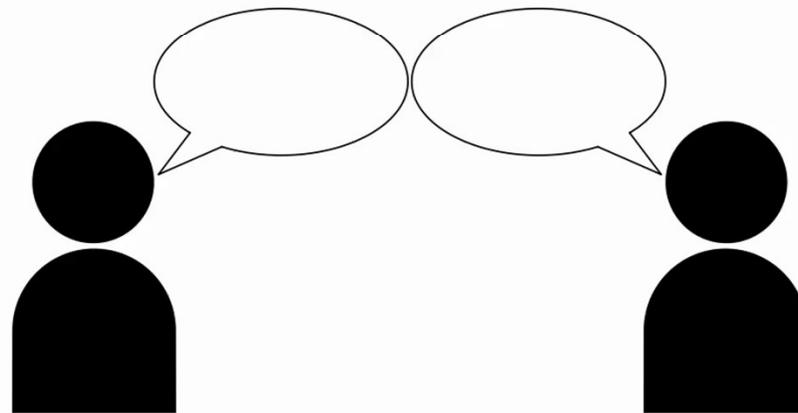
Self- and Co-Regulated Learning
For Students



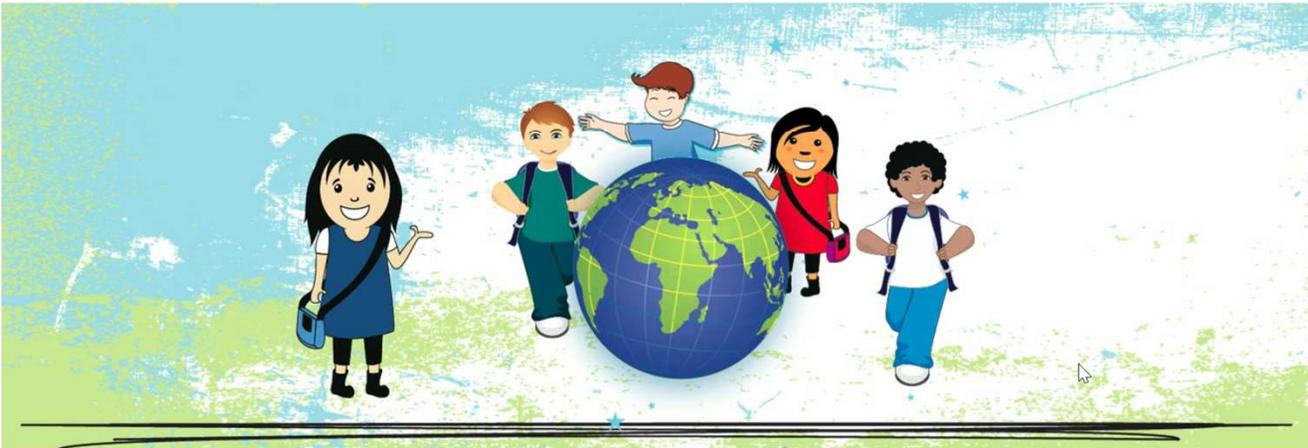


- Assesses the writing skills of its users both at the English level and at the content level.
- Tracks the evolution of a composition at very fine-grained levels.
- Tracks spelling and grammar errors and the corrections made by a student along the way.
- Records the formation and flow of topics within paragraphs.
- Provides feedback on how to improve the quality of a piece of writing and one's efficiency.

The screenshot displays the MI-WRITER interface for an essay titled "The new order of things proposed". The page includes a navigation menu on the right with options like "Home", "Site pages", "My profile", and "Current course". The main content area shows the essay text and a "Sentence Analysis" section. The analysis identifies two paragraphs and provides feedback on sentence structure, spelling, and grammar. For example, it notes "Words: 21" and lists "Spelling Errors: 0" and "Grammatical Errors: 0". The interface also includes a "Make a Suggested Correction" link and a "Leave Sentence Feedback" option.



2WRITE



LEARNING ACTIVITY
Learn by doing activities!



DASHBOARD
See your performances and grades!



GOALS
Set your own learning goals!



MOTIVATION
Get motivated!

MUSIX



- MUSIX stands for MUSIc eXperiences.
- MUSIX enables learners and teachers to reflect and regulate on music-oriented data and instruction.



MusiX Prototype

“The Music Analytics pedagogy prototype that targets a single competency will allow the administrator and the music pedagogue to estimate the value of information obtained from the music analytics system. The prototype will develop a pedagogue dashboard with which music teachers can plan their instruction based on the Wirth method.”

OTHER PROJECTS



- **MeMoo** is Mechanical Moods, a multiple-media sentiment analytics engine.
- **JFlapEx** is for analyzing learner interactions on Formal Languages.
- **xDesign** is for analyzing learner interactions on Experimental Designs.
- **SDLeX** is for analyzing learner interactions on Self-Directed Learning environments.
- **MHADS** is for analyzing learner interactions in Healthcare Analytics in the domain of Attention Deficiency Syndrome.
- Synthetic Biology Analytics is an educational and training tool for synthetic biology in genome sequence assembly, bioinformatic analysis, biochemical pathways, and gene expression analysis. Uses techniques similar to the ones used in learners' text interactions.
- **P-PSO** is a parallel particle swarm optimization algorithm adopted in LAMBDA.
- **GIOIA** is for analyzing semantics on algorithms to cluster and classify large volumes of datasets.
- **RPA** is a tool to analyze research publications.
- **TADA** is a tool for Traffic Analytics with Data Accretion, a brand new tool/technique being proposed that allows learners to contextualize sensor data from physical objects with sensor data from personal data.

OTHER PROJECTS (CONTINUED)



- Interview Mastery Analytics is a system that simulates an online interview environment, conducts a simulated interview, observes the response of the candidate, offers feedback, and allows reflection/regulation opportunities to the candidate.
- **ListenEx** is an environment where learners can listen to utterances and respond to follow-up questions to measure their level of listening comprehension. Moreover, the system measures the time intervals between the question and the answer, as well as, the quality of responses.
- **MUSIX** is a tool to explore and research ways to enhance the experiences of musicians by means of technology.
- **ReadEx** is a reading analytics tool tracking the ability of the learner to read and understand the content, the speed with which reading comprehension happens, and the relation between reading comprehension and working memory.
- **SpeakEx** is a speaking analytics tool that parses translated written material arising from speech utterances and presents a scaffolded dashboard to provide feedback, reflection, and regulation opportunities to learners. The types of feedback include grammar-based feedback, feedback on the pacing of the speech, feedback on the breaks in speech, and identification of misspoken words.

Learner awareness



Personalization of learning experience through dynamic learner modeling

- Performance
- Meta-cognitive skills
- Cognitive skills
- Learning styles
- Affective state
- Physiological symptoms

Technology awareness

Personalization of learning experience through the identification of technological functionality

- Identifying various device functionality
- Dynamically optimize the content to suit the functionality

Display capability, Audio and video capability, Multi-language capability, Memory, Bandwidth, Operation platform

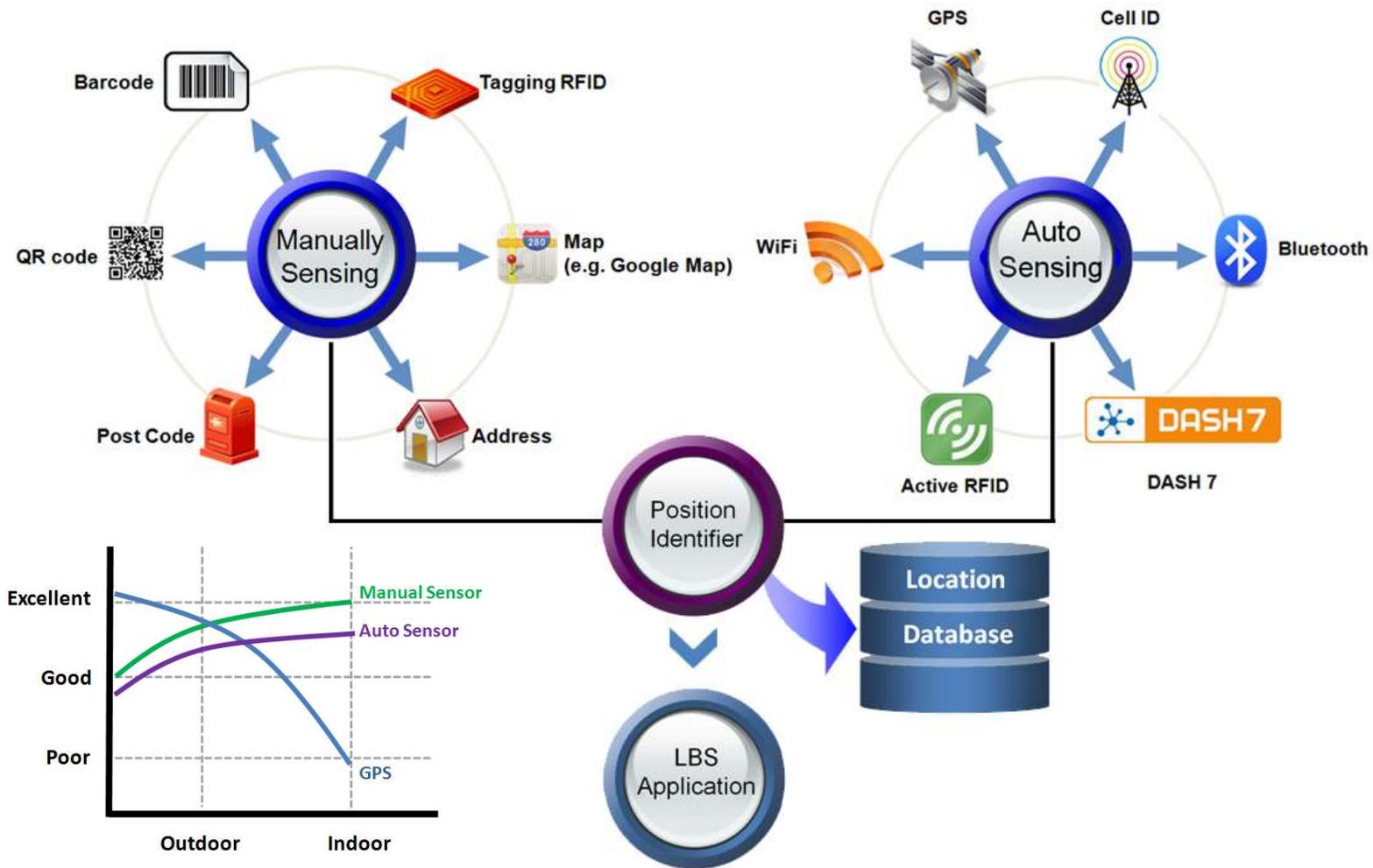
Location awareness



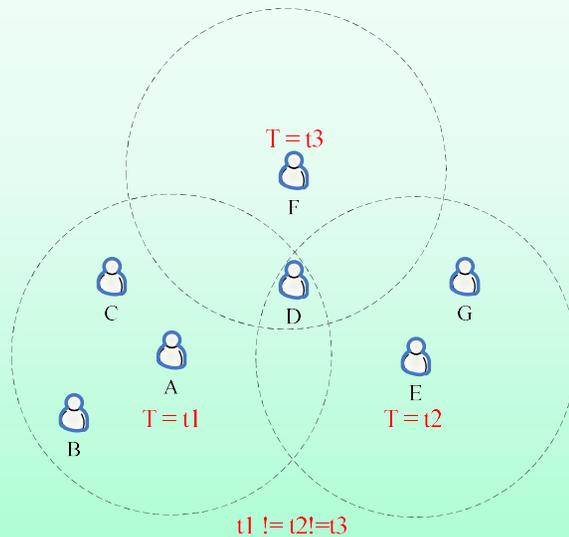
Personalization of learning experience through the use of location modeling

- Location based optimal grouping
- Location based adaptation of learning content

Location based technologies



Location aware dynamic grouping

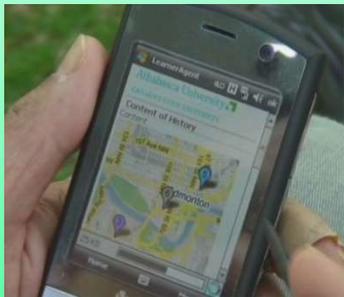


Location Grouping

- Mobile Learner's Address
- Mobile Learner's Cellular Data
- Mobile Learner's GPS Coordinates
- Mobile Learner's Other Location Info

Mobile Virtual Campus

- Mobile Learner's Learning Profile
- Mobile Learner's Learning Style
- Mobile Learner's Learning Interests



Real-life physical objects



Personalization of learning experience as per surrounding environment

Public databases of POIs

QR Codes

Wi-Fi & Bluetooth Access Point identification

Active and Passive RFIDs

Surrounding awareness



Personalization of learning experience through the use of surrounding context

- Identifying specific context-aware knowledge structure among different domains
- Identify the learning objective(s) that the learner is really interested in
- Propose learning activities to the learner
- Lead the learner around the learning environment

Skills and knowledge level detection

Competency level

Confidence level

Mapping learning outcomes to specific skills

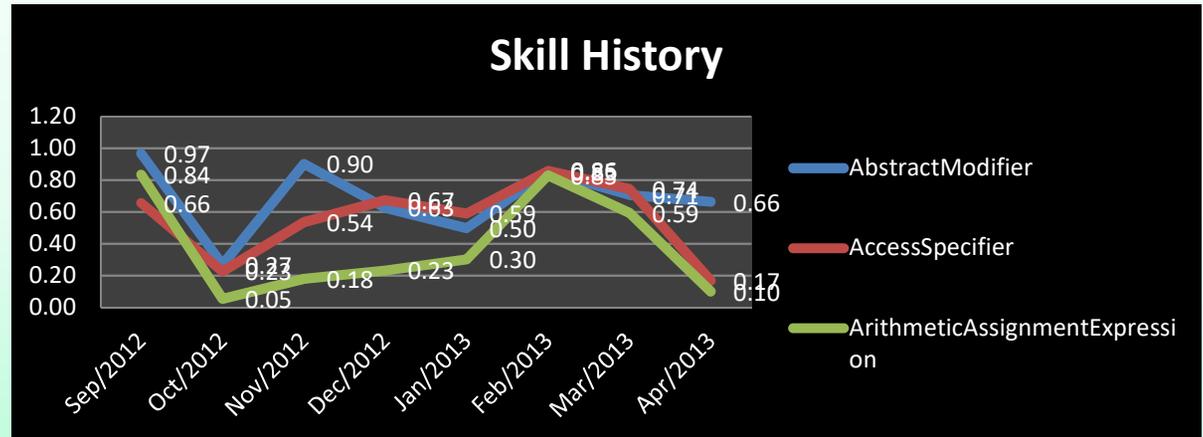


A screenshot of a Java IDE interface. The left pane, titled "Class hierarchy", shows a tree view of Java classes. The root is "Thing", followed by "Java", "JavaLanguage", "Data", "DataType", and "Value". Under "Value", several classes are listed, including "ArrayInitializer", "ArrayLength", "ObjectReference", "ReturnedValue", "SimpleDataTypeValue", "StringLiteral", "Variable", "ArrayElement", "Constant", "Field", and "FormalMethodParameter". The right pane, titled "Individuals: StaticMethodInvocation", displays a list of 25 Java-related terms, each preceded by a diamond icon. The term "StaticMethodInvocation" is highlighted with a blue background. The list includes: PolymorphicObjectCreationStatement, Polymorphism, PrivateAccessSpecifier, PublicAccessSpecifier, ReturnedType, ReturnedValue, ReturnStatement, ShortDataType, ShortValue, SimpleAssignmentExpression, SimpleDataType, SimpleDataTypeValue, SimpleVariable, Statement, StatementBlock, StaticMethod, StaticMethodDefinition, StaticMethodInvocation, StaticModifier, StringAddition, StringDataType, StringInitializationStatement, StringLiteral, StringLiteralMethodInvocation, and StringVariable.

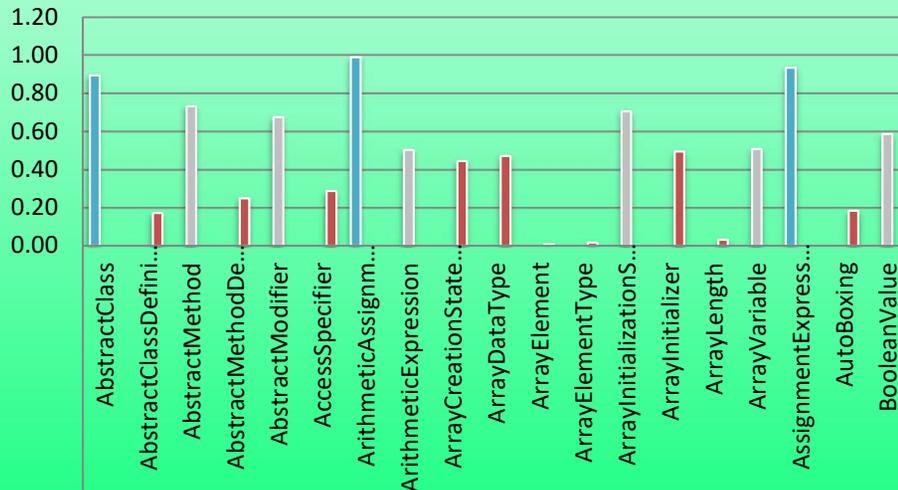
Teacher's dashboard



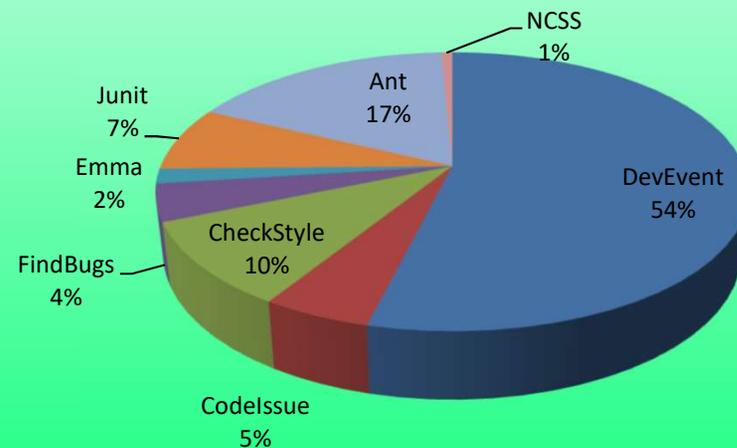
Teacher's dashboard shows individual and group progress. Teachers receive triangulated data that explains issues faced by students.



Student Profile



Student skills using tools



Parents checking-in



localhost/moodle/grade/report/user/index.php?userid=3&id=2

Welcome to Gmail Google Drive Athabasca University EasyWeb W3Schools YouTube Java 7 API The Clay Box AU Other bookmarks

English 20: View: User report

You are logged in as Jennifer Schreiber (Logout)

Home → ENG20 → Grade administration → User report

User report

User report - Johnny Scheiber

Select all or one user: Johnny Scheiber

Grade item	Grade	Range	Percentage	Feedback
English 20				
✓ Essay Writing	95.00	0-100	95.00 %	
✓ Essay - Book Report	81.00	0-100	81.00 %	
✓ Paragraphs Assignment	75.00	0-100	75.00 %	
Course total	83.67	0-100	83.67 %	

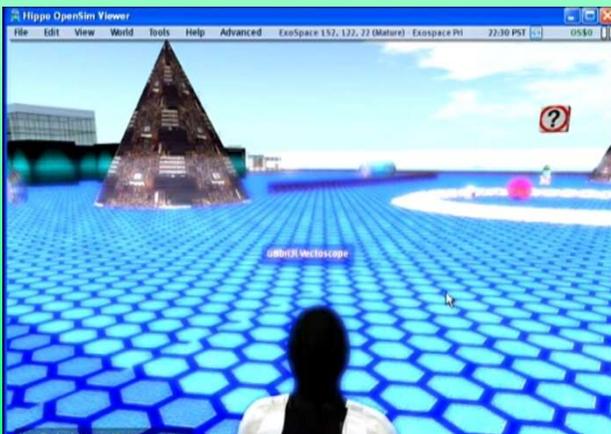
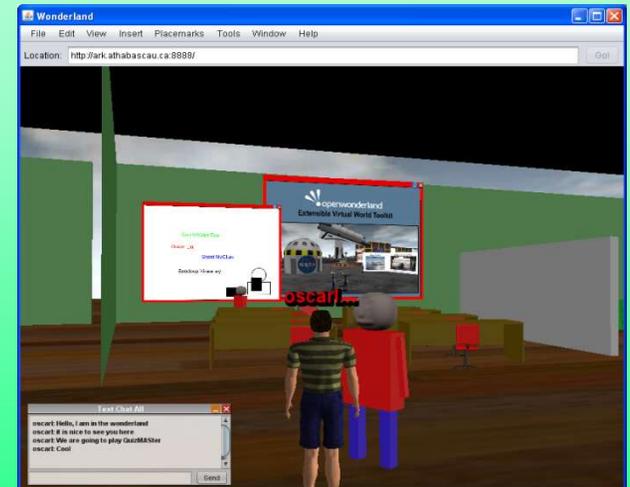
NAVIGATION

- Home
 - My home
 - Site pages
 - My profile
 - Current course
 - ENG20
 - Participants
 - Reports
 - General
 - Romeo and Juliet
 - Sentence Structure
 - Effective Paragraphs
 - The Writing Process
 - Essays
 - To Kill a Mockingbird
 - My courses

SETTINGS

- Grade administration
 - Grader report
 - Outcomes report
 - User report
 - Import
 - Export
 - Course grade settings
 - My report preferences
 - Letters
 - Scales

Analytics data from a variety of sources



How to do effective learning analytics



Learning Analytics is a *soup* of

content

learning theories

styles

pedagogies

instructional designs

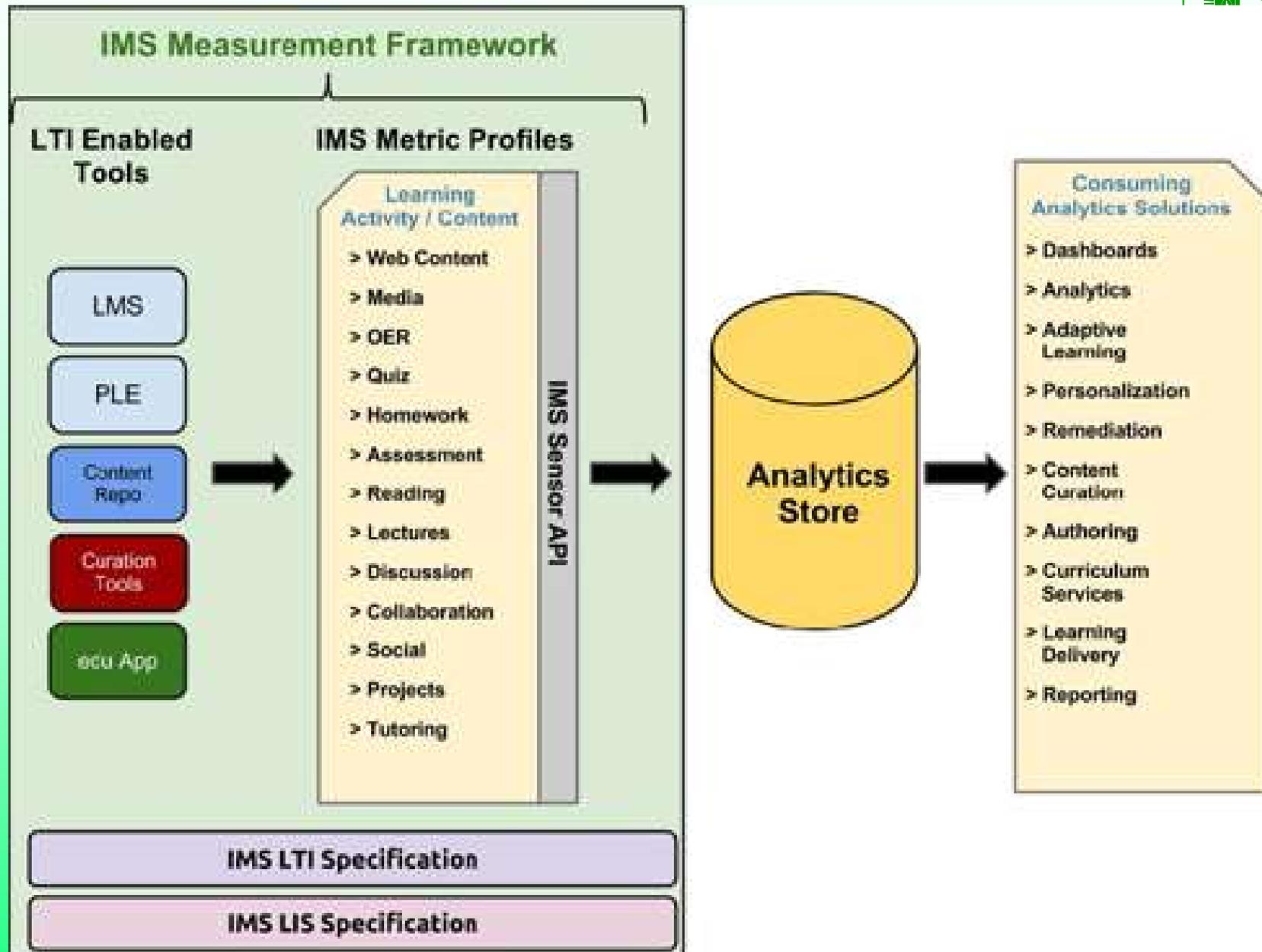
learner capacities

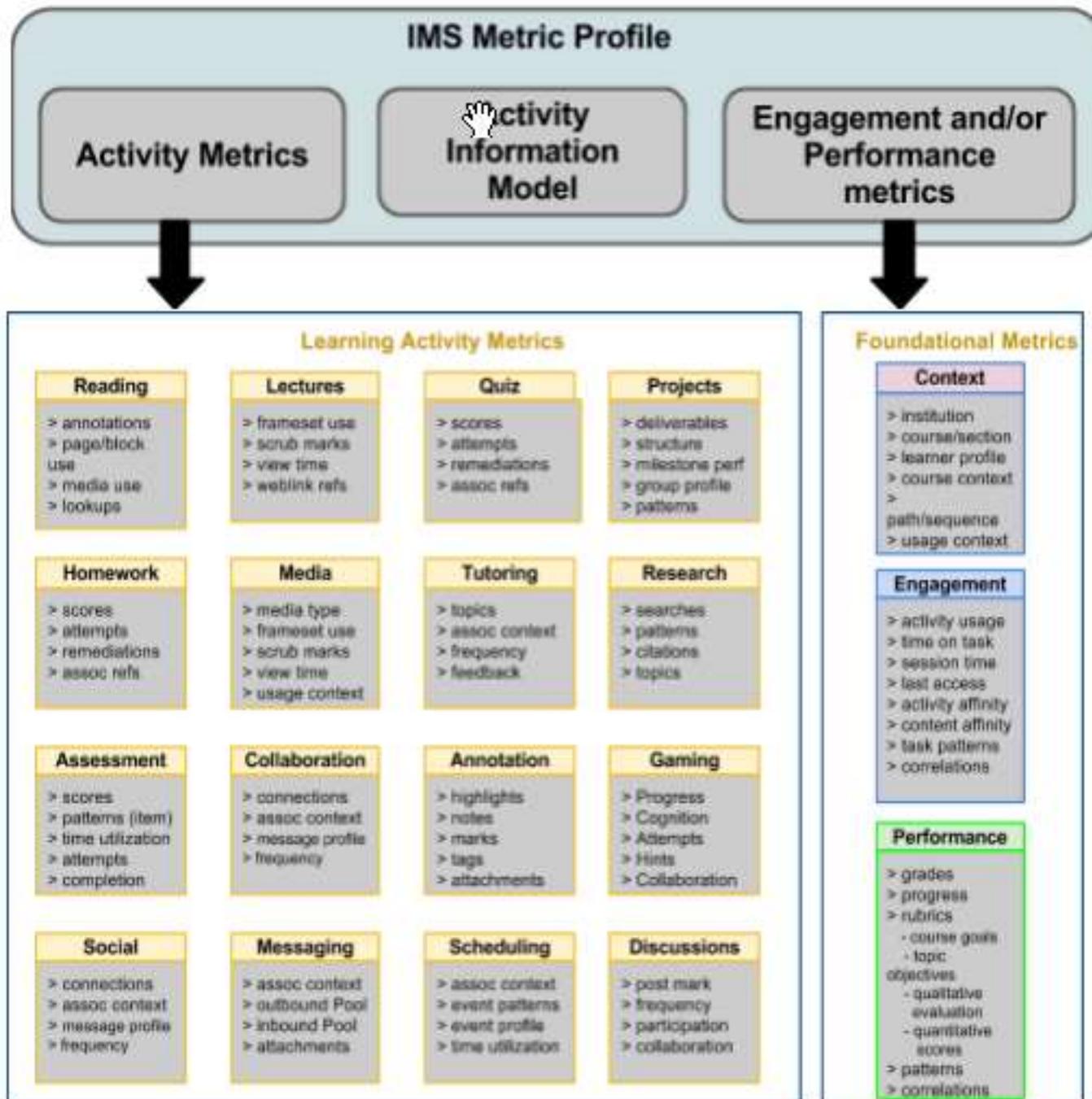
institutional reputation ...

How to prepare a *cup of soup* to the liking of each student/ teacher/ administrator/ industry with custom flavour, taste, consistency, ...?

This is where learning analytics specifications, emerging standards, come into play.

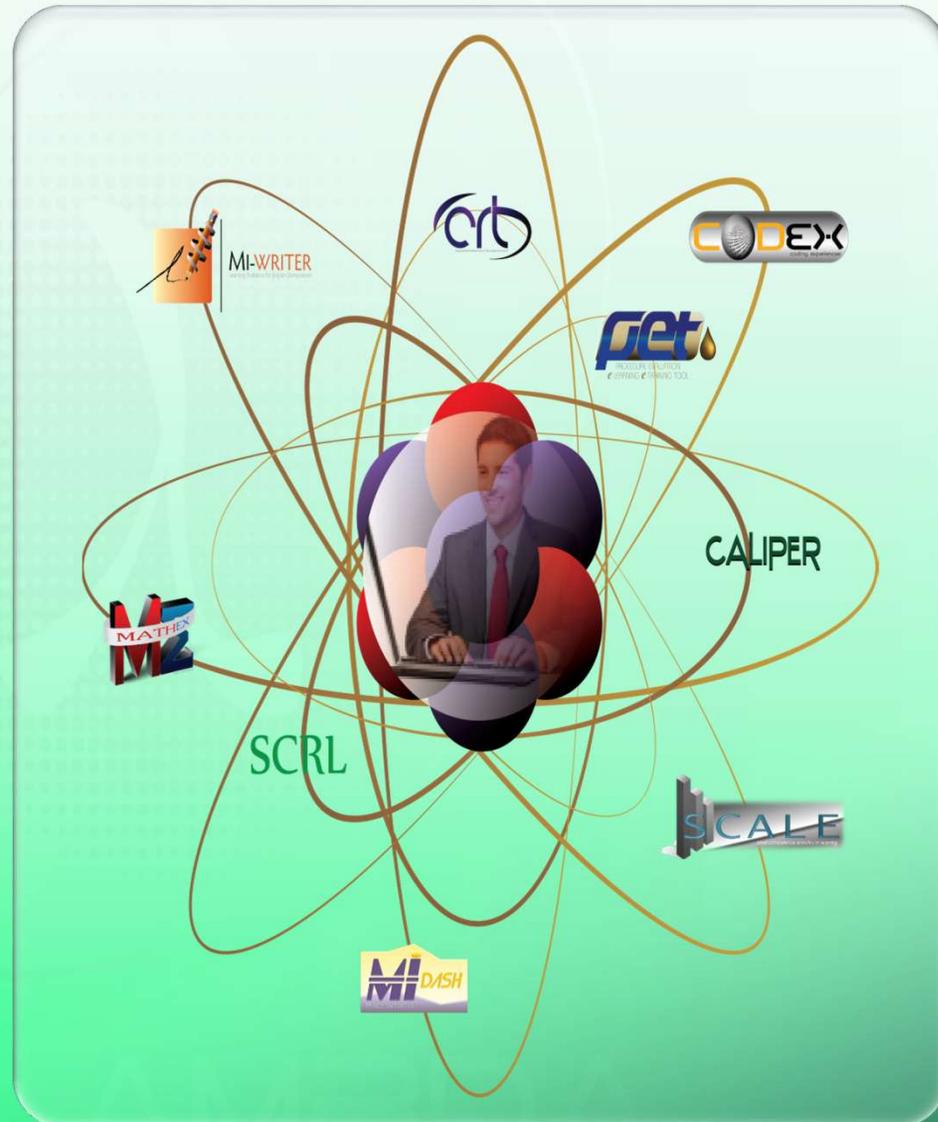
Caliper Framework Architecture





LAMBDA – LEARNING ANALYTICS PLATFORM

- Provides a unified learning analytics platform in which learning experiences can be sensed, analyzed, and reported.
- Standardizes the generation, transmission, and interpretation of learning events.
- A suite of tools empowering students to manage not only what they learn but also why they learn and how they learn.
- Links isolated datasets together to form a clearer and broader picture of the learner and his/her context.
- Reports data from a wide range of learning domains including programming, math, writing, etc.



SCALE



UNT
UNIVERSITY
OF NORTH TEXAS
EST. 1890

- Analyzes students' learning artifacts (such as a composition, a piece of software, mathematical calculations, etc.) and lists the skills displayed by the student and how proficient the student is in each skill.
- Assesses students' behavior in problem-solving processes and reports student's performance and confidence.
- Identifies and classifies students as good, average, and at risk.
- Enables students to compare themselves against classroom's average and anonymized top students.
- Customizable for any learning domain and any course.



References



- Learning Measurement for Analytics
(<http://www.imslobal.org/IMSLearningAnalyticsWP.pdf>)
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- What is a Learning Record Store (LRS)?
(<http://tincanapi.com/learning-record-store/>)
- Layers of the Tin Can Onion (<http://tincanapi.com/the-layers-of-tin-can/>)
- Learning Tools Interoperability™
(<http://www.imslobal.org/toolsinteroperability2.cfm>)
- IMS Question & Test Interoperability Overview
([http://www.imslobal.org/question/qtiv2p1/imsqti_ overview2p1.html](http://www.imslobal.org/question/qtiv2p1/imsqti_overview2p1.html))
- IMS Global Learning Information Services Specification Primer
(<http://www.imslobal.org/lis/lisv2p0p1/LISSpecPrimerv2p0p1.html>)

Thank you!

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