

Pedagogy Module of the Instructional Module Development (IMODS) System

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Abstract—IMODS is an open source web application facilitating curriculum design in the field of science, technology, engineering and mathematics (STEM). Based on the principles of Outcome Based Education (OBE), the application provides an improved learning experience for the next generation educators, scaffolding them through a step-by-step process of defining and building a complete curriculum. This report presents an overview of the Pedagogy Module, a review of technologies chosen to implement the Pedagogy Module for IMODS system, a review of instructional techniques chosen to implement the Pedagogy Module for IMODS system, and the subsequent implementation of the Pedagogy Module for IMODS system.

Index terms—Web application, Pedagogy, Instructional Techniques.

I. INTRODUCTION

In today's world most of the (STEM) educators have limited hands on experience in designing and building an Outcome Based Education (OBE), curriculum. Most instructors tend to imitate the learning experience they were exposed to as students. Their approach to learning, instruction and assessment may not be informed by scholarship in the area of how people learn now. The IMODS system currently under development, mainly aims to solve this problem and provide instructors a user friendly interface guiding them in the design of an efficient and complete instructional design.

The five main components of the IMOD are Context, Learning Objective, Contents, Pedagogy and Assessments. The Learning Object forms the core of the IMOD and is built on top of semantic web ontology and defined according to the PC³ model as described below.

- **Performance:** description of what the learner is expected to be able to do,
- **Content:** description of the disciplinary knowledge, skill or behavior to be attained,
- **Condition:** description of the conditions under which the performance is expected to occur
- **Criteria:** description of assessment criteria indicating quality, quantity, speed and accuracy.

The learning objective and the content interface enables user to enter learning objective data and the content data for the instructional module respectively. The assessment interface helps determine how well students are learning. The pedagogy interface suggests relevant instructional techniques based on the type of learning and knowledge specified in the learning objective.

II. PROBLEM STATEMENT

Most educational institutions require faculties to provide a quality learning experience for students enrolled in their courses. This expectation is more eminent in STEM outcome based education systems. To understand a topic or subject is to use knowledge and skill in sophisticated, flexible ways. Knowledge and skills are necessary elements of understanding, but they are not synonymous with understanding. Matters of understanding require more. Students need to make conscious sense and apt use of the knowledge they are learning and the principles underlying it [6]. Currently most of these STEM educators gain practical teaching experience when on the job. They lack formal training and require few years to become proficient, affecting many students. The educators not only require gaining knowledge in teaching methodologies or pedagogical techniques, but also require becoming familiar and proficient with the assessment techniques and the overall curriculum design [1]. Moreover the outcome based approach contrasts the "input-based" model that places emphasis on what is included in the curriculum as opposed to the result of instruction.

The Pedagogy feature of the IMOD system facilitates identifying and mapping the correct use of the instructional strategies based on the learning objectives that have been defined for an IMOD. The key features of the Pedagogy Module as a part of this project are listed below.

A. Display Learning Objectives:

The Learning objectives that have been defined in the Learning objectives tab are displayed here. When no objectives are defined "No Objectives defined" is displayed. The first fifty characters of the learning objectives are

displayed. The entire learning objective is displayed on hovering over each of the displayed objective snippets.

B. Display PC3:

This feature aids in displaying the PC³ parts, performance, content, condition and criteria for the selected Learning Objective.

C. Display Instructional Techniques:

The instructional techniques that map to the learning objective selected are displayed in the ideal match section. The extended match section displays the instructional techniques that map to the learning objective when selected. This section gets updated when filter options are changed to display the instructional techniques that map to the filter options selections. The favorites section displays all the user's favorite instructional techniques.

D. Filter Options:

This feature helps users to explore more instructional techniques by selecting the Domains, Domain categories and Knowledge dimensions of their choice. The instructional techniques that map to the user selections

E. Assign Instructional Techniques to Learning Objectives:

This feature facilitates to assign the instructional techniques displayed in the ideal match, extended match and favorites section to the selected learning objectives.

F. Clone an Instructional Technique:

The clone feature helps users to customize certain pieces of an existing instructional strategy.

G. Instructional Plan:

The instructional plan provides an overview of the learning objectives and the instructional techniques assigned to each of them.

H. Quick Tip:

The quick tip provides useful guide lines for users on hovering over various buttons icons and features.

A detailed description of each of these features can be found under section V for Features of the Pedagogy Interface.

III. BACKGROUND

Pedagogy is the science of the specially organized, goal-oriented, and systematic molding of a human being. It is the science of the content, forms, and methods of upbringing, education, and instruction. Pedagogy is also referred to as the correct use of instructive strategies. These instructions defined as the arrangement of the environment to facilitate this

learning. Learning is the acquisition of new knowledge, skills, or attitudes resulting from an individual's external interaction with his or her environment and/or "internal" interaction between new and previously existing information [4]. Identifying the pertinent instructional techniques to obtain the knowledge plays a key role in object oriented educational systems.

Some existing applications and web sites provide guidelines and help users to design their curriculum. The Avrio Knowledge group is an outcome-based curriculum development, research and consulting group. They are specialized in providing program and course design, content and standards mapping, content development and assessment and reporting solutions [6]. Other websites like the Instructional Strategies online help instructors determine Instructional Strategies that could be used to achieve a learning objective. The techniques are categories based on five categories, Direct, Indirect, Experiential, Independent, and Interactive as listed in Figure: 1. The website lists the structured overview, purpose, how to use the instructional strategies, how they can adopt it and other resources for each instructional technique [5].

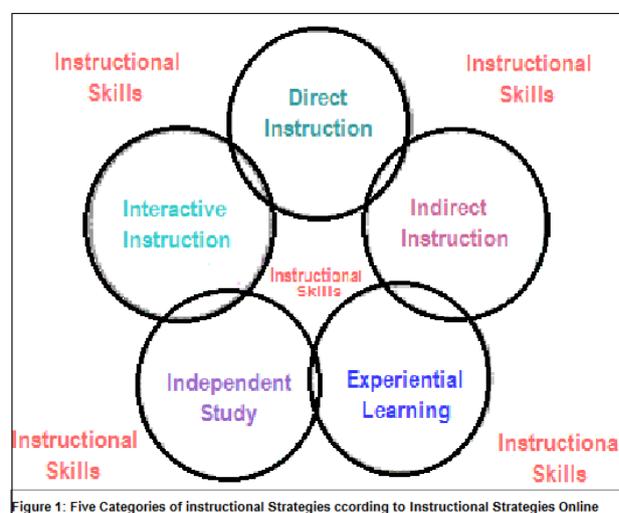


Figure 1: Five Categories of instructional Strategies according to Instructional Strategies Online

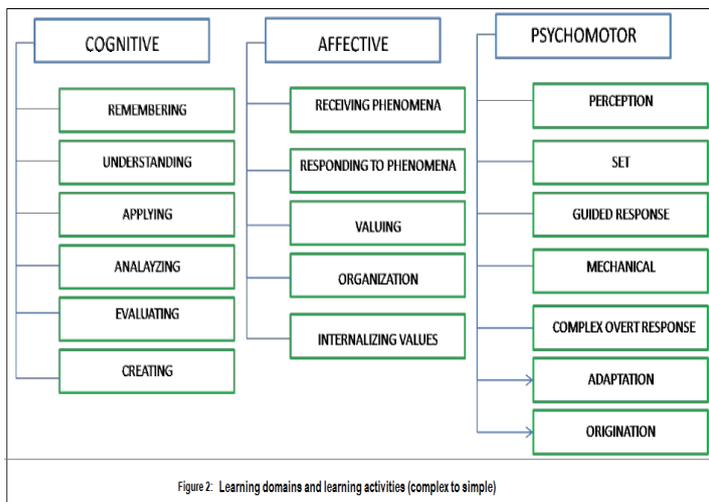
The "Student Engagement Techniques, A Handbook for College Faculty" by Elizabeth F. Barkley discusses a theoretical model defining student engagement in college classroom as the synergetic interaction between motivation and active learning. The book offers practical advice on how to increase motivation and help students learn holistically. There are step-by-step directions for learning activities, categorizing based on learning goals [7]. One other book, "Collaborative Learning Techniques" by Elizabeth F. Barkley, K. Patricia Cross and Claire Howell Major provides insights on pedagogical rationale and effectiveness of collaborative learning [8]. This book also contains pedagogical techniques for creating effective group work. The two books have been a

good source for the instructional techniques that have been used in the development of the pedagogy module.

However, IMODS is an open source application to facilitate outcome based instructional design currently under development. IMODS application provides a step by step navigation through curriculum design, allowing users to be independent. The application provides a rich user interface interconnecting all the individual components providing a seamless experience by masking all the complex integrations. This framework uses Semantic Web technologies to automate aspects of the complex decision making processes that are needed for designing an i-mod [2]. This paper mainly focuses on the Pedagogy Module.

IV. PEDAGOGY FRAMEWORK

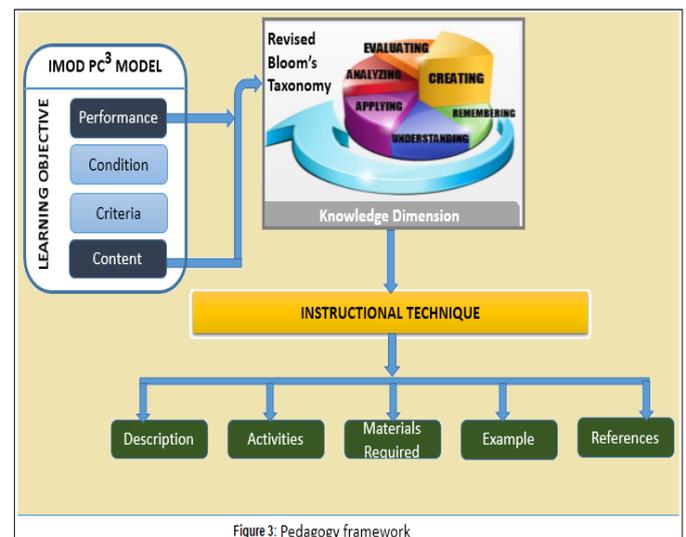
Learning domains according Bloom's revised taxonomy by Anderson and Krathwohl are categorized into Cognitive, Affective, and psychomotor which are further classified under Domain Categories. A detail list of each learning domain and domain category is depicted in Figure 2.



Each Domain Category has performance verbs associated to it. A revision of Bloom's taxonomy has introduced a third dimension for the Cognitive Domain. The subtypes of the knowledge dimension are Factual, Conceptual, Procedural and Metacognitive each representing the knowledge of terminologies, classifications, subject-specific skills and strategic knowledge respectively.

Each learning objective sentence has action verbs and objects. According to the PC³ model the Learning objectives are split into Performance, Content, Condition and Criteria. The Performance and Content refer to the action verbs and the object or nouns of the Learning Objectives. According Bloom's revised taxonomy the performance verbs of the domain categories and the nouns in the knowledge dimension are mapped to the Performance and Content part of the PC³ model.

The Pedagogy feature is built on top of the Performance and Content elements within the PC³ model. The Learning Objective interface helps identify the Domain and Domain categories that are associated with a Learning Object. The Knowledge Dimension categories associated with the contents linked to a learning objective are obtained from the Content interface. Each Instructional technique is mapped to the Domain category and the knowledge dimension of Bloom's taxonomy, thus mapping to the learning objectives. Each learning objective can be associated to instructional techniques enabling an efficient and effective way to identify the relevant techniques to attain the goals in an Outcome Based Education system



The Learning Objective "Apply the concepts of sequence, selection, and iteration by constructing algorithms and formal code to solve problems" belongs to the Cognitive Domain, and Applying Domain Category. The performance and content part of the PC³ are by constructing algorithms and formal code and concepts of sequence, selection, and iteration respectively. The instructional techniques that map to the learning objective are listed in Table 1.

| Instructional Technique | Domain | Domain Category | Knowledge Dimension |
|---------------------------------------|-----------|--|--|
| Partially Guided Programming Exercise | Cognitive | Understanding, Applying, Analyzing, Evaluating | Procedural, Conceptual, Factual, Metacognitive |
| Structured Problem Solving | Cognitive | Understanding, Applying, Analyzing, Evaluating | Procedural, Conceptual, Factual, Metacognitive |
| Think Aloud Pair Problem Solving | Cognitive | Applying, Analyzing, Evaluating | Procedural, Conceptual, Factual, Metacognitive |

The set up instructions and the system architecture of the application can be referred in the documentation provided by Sai Shruthi for “Technology analysis and redesign of the Instructional Module Development (IMODS) System” [3].

V. FEATURES OF PEDAGOGY INTERFACE

The new implementation of the IMOD system had to overcome the disadvantages of the previous system. The purpose of analyzing various technologies was to ensure rapid development with the latest technologies in the field of software development and use open source technologies wherever feasible. Towards this end, an analysis of web application frameworks, version control systems, server side technologies and client side technologies was performed. The sections below provide a detailed description of the selected technologies.

A screen shot of the pedagogy interface mockup is in Figure 4.



Figure 4: Pedagogy Interface

A. Display Learning Objectives

The learning objective interface facilitates the instructors to define the objectives that align with the PC³ model. The learning objective consists of four parts, Performance, Content, Criteria and the Condition. The Performance parts can be mapped to the Learning Domain and Domain Category of Bloom’s Taxonomy. Each of the Domain categories has action verbs associated with it. These action verbs form the Performance part of the Learning Objective.

The Revised Bloom’s Taxonomy provides a third knowledge dimension, mapping to the Content part of the Learning Objective, and describing the disciplinary knowledge, skill or behavior to be attained. The Condition and the Criteria are performance-based and is explicitly provided by the user.

The Pedagogy interface displays the Learning objective that had been previously defined as a list. There is a limit of forty character set on the display of the learning objective description displayed in the list. Hovering over the objective displays the entire description of the objective in a pop up as in Figure 5.

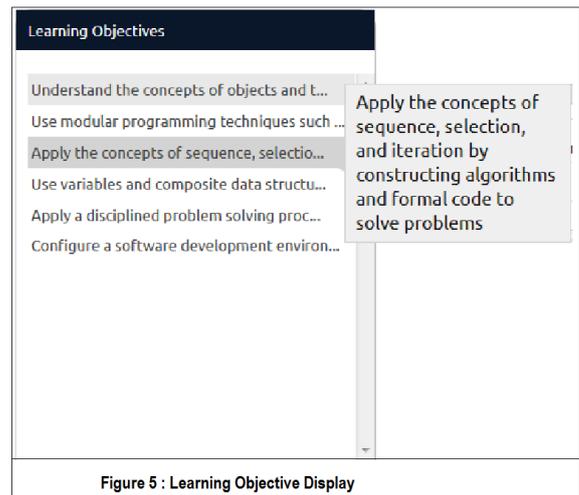


Figure 5 : Learning Objective Display

Incase no objective have been defined the “No learning objective available” message is displayed.

B. Display PC³

The PC³ represents the Performance, Content, Condition and Criteria parts of the Learning Objectives. The Pedagogy interface enables users to identify each part of the Learning Objective by hovering over the PC³ parts on the interface. The display provides the PC³ parts for the selected Learning Objective. Figure 6 provides a screen shot of the display of performance piece of the learning objective.



Figure 6: PC³ - Performance

Let us consider the learning Objective definition, “Apply a disciplined problem solving process to the constructing algorithms and formal code to solve problems”. In the above objective the

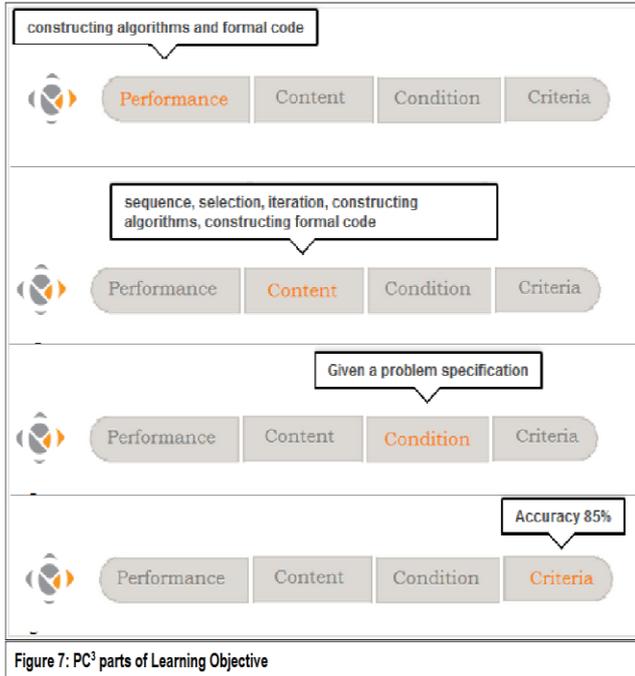
Performance piece is constructing algorithms and formal code

Content is Sequence, Selection, Iteration, Constructing algorithms and constructing formal code. The content is based on the topic titles that the user inputs for the Learning Objective in the Content Interface.

Condition is given a specific problem

Criteria are 85% Accuracy.

Figure 7 represents the PC³ parts in the Pedagogy interface.



C. Display Instructional Techniques

a) Ideal Match

The Ideal match tab displays all the Instructional Techniques whose Domain, Domain Category and Knowledge Dimension types match those of the Learning Objective selected. For example the Learning Objective

“Given a problem specification, use variables and composite data structures to store and manipulate data by constructing algorithms and formal code to solve problems with 85% accuracy “

belongs to the Cognitive Domain, Applying Domain Category and the Knowledge Dimension Conceptual, Metacognitive or Factual.

| Instructional Technique | Domain | Domain Category | Knowledge Dimension |
|---------------------------------------|-----------|--|--|
| In-Class Portfolio [7]. | Cognitive | Applying Analyzing | Factual Conceptual Procedural Metacognitive |
| Partially Guided Programming Exercise | Cognitive | Understanding Applying Analyzing Evaluating | Conceptual Procedural |
| Think Aloud Pair Problem Solving [7]. | Cognitive | Understanding Applying Analyzing Evaluating | Factual Conceptual Procedural Metacognitive |
| Structured Problem Solving [8]. | Cognitive | Understanding Applying Analyzing Evaluating | Metacognitive |

The Instructional Techniques In-Class Portfolio, Partially Guided Programming Exercise, Structured Problem Solving and Think Aloud Pair Problem Solving. The Domain, Domain Category and Knowledge Dimension types are listed in Table 2 above.

The code snippet for the logic behind retrieving the Ideal match is below in table 3.

| |
|---|
| <pre> if(kdomain.size() > 0) pedaTechList = PedagogyTechnique.executeQuery ('select p from PedagogyTechnique as p inner join p.domain as dm join p.category as ct join p.knowledge kn where dm.name in (:dc) AND (ct.name in (:ld) AND kn.description in (:kd)) order by p.pedagogyTitle', [dc: domain,ld: domainCategory,kd: kdomain]) else pedaTechList = PedagogyTechnique.executeQuery ('select p from PedagogyTechnique as p inner join p.domain as dm join p.category as ct where dm.name in (:dc) AND (ct.name in (:ld)) order by p.pedagogyTitle', [dc: domain,ld: domainCategory]) </pre> |
|---|

The screen shot of Ideal Match interface on the Pedagogy Tab is in Figure 8.

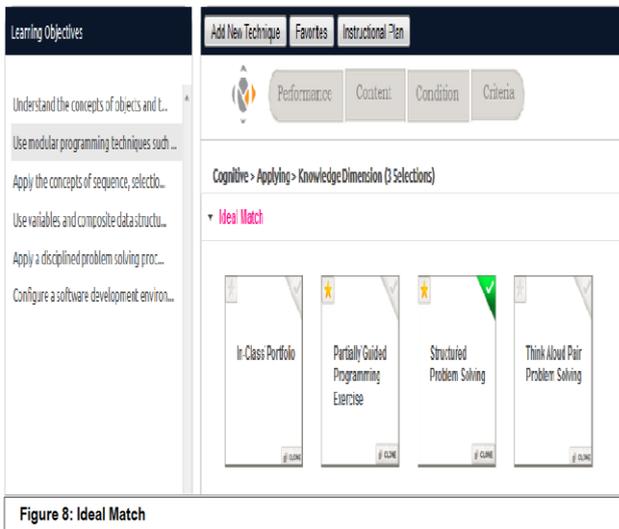


Figure 8: Ideal Match

b) Extended Match

The Extended Match tab displays the Instructional Techniques based on the selections made in the Filter Options. By default the ideal matches are displayed in the extended match tab when no filter options have been applied. The Figure 9 shows a snapshot of the extended match in the pedagogy interface.

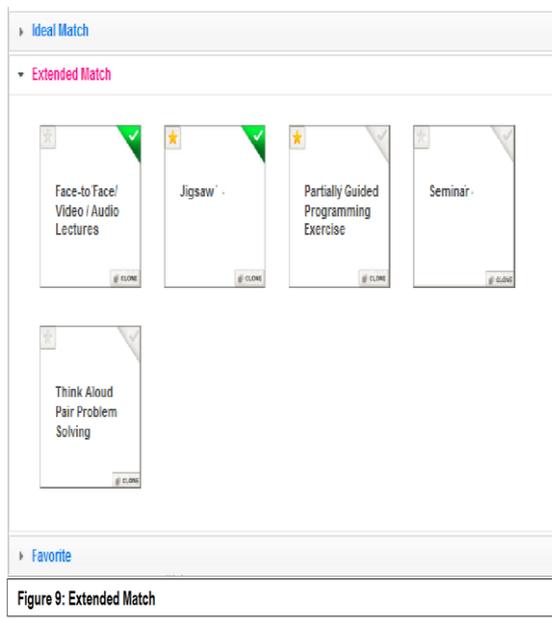


Figure 9: Extended Match

c) Favorite Techniques

The Instructional Techniques can be made favorite for the user on one click. Clicking on the un-favorite  icon adds the technique to the favorite list of the user and clicking on the favorite  icon removes the technique from the favorite list of the user. Figure 10 shows a snapshot of favorites in the pedagogy interface.

There are two ways to view the techniques that have been made favorite.

- The Favorite tab displays the Instructions Techniques that have been made a Favorite.
- Clicking on the Favorite Button expands the Favorite tab.

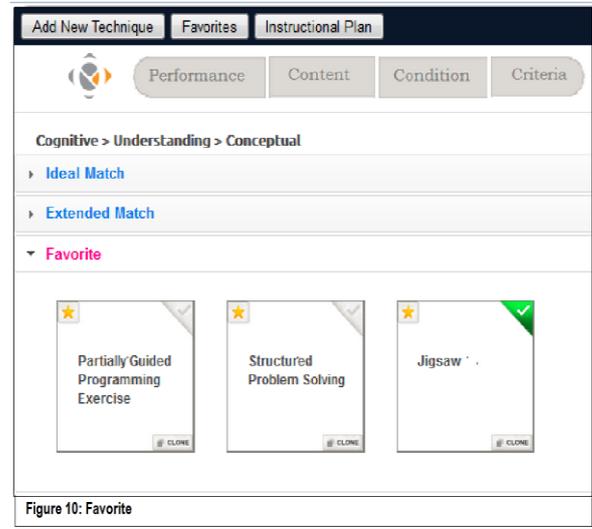


Figure 10: Favorite

D. Filter Options

The Pedagogy interface provides Filter Options assists users to view Instructional Techniques based on Domain, Domain Category and Knowledge Dimension selections in the Extend Match. Figure 11 gives a snapshot of the Filter Options feature.

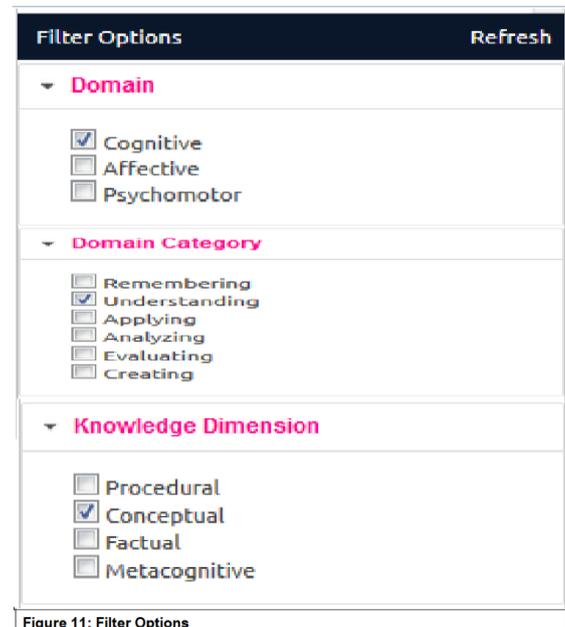


Figure 11: Filter Options

The feature provides an accordion interface allowing users to select the types of Domains, Domain Categories and Knowledge Dimensions by marking the check boxes corresponding to the types that need to be selected. Clicking on Refresh, makes modifications to the below

- Display of the choices. When more than two choices are made the count of the choices are displayed. In other cases the selections made are displayed. For example from the image Filter Options the Cognitive and Affective Domains are selected. The Analyzing and Evaluating Domain Categories are selected and all the four Knowledge Dimensions are selected. On click Refresh, the display of choices updates as below in Figure 12.



Since more than two Knowledge Dimension types are selected the count of selections made is displayed, in this case “4 Selections”.

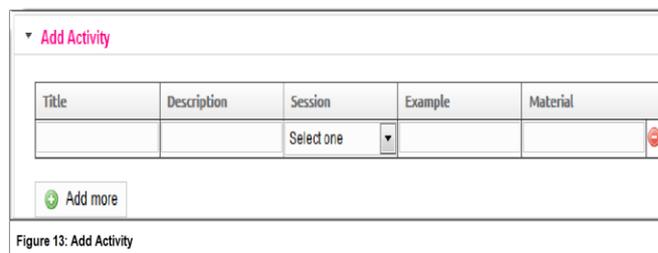
- Refresh the Extended Match. On clicking Refresh in Filter Options the Extended Match tab gets updated with the Instructional techniques which map the selections made in the Filter options as in Figure 9.

E. Assign Instructional Techniques to Learning Objectives

Assigning an Instructional Technique to a Learning Objective is one of the core features of the IMOD and the Pedagogy Interface. The interface provides a rich UI, unique to the IMOD, allowing users to map the Instructional Techniques to the selected Learning Objective in a single click. The Instructional Techniques from the Ideal Match, Extended Match and the Favorite tabs can be assigned to the selected Learning Objective. Multiple Techniques can be assigned to the objectives and vice versa. The Instructional Technique icon has an assign icon. Clicking on the unassigned  icon assigns the technique to the objective and clicking on the assigned  icon un-assigns the technique from the objective. Add New Technique

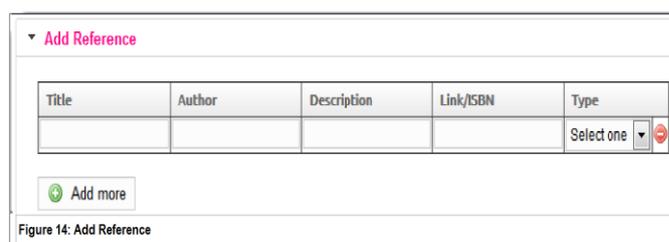
The Add New Technique feature assists users in creating new Instructional Techniques. The below steps should be followed to create an Instructional Technique.

- Click on the “Add New Technique” button . The Add New Form pops up.
- The mandatory fields in the form are indicated with the  symbol. Title, Mode, Domain, Domain Category and Knowledge Dimensions are the mandatory fields.
- The title can be up to 255 characters.
- The Mode can be in-person, online or hybrid. Hybrid can be used in cases where the technique can be applied to both online and in-person. There cannot be multiple selections.
- Multiple selections can be made on Domain, Domain Category, Knowledge Dimension and Focus.
- Focus indicates they type of activities which can be one or more of Reading, Writing, Discussing or Presenting.
- Add Activity:
The Add Activity allows users to add activities involved in a technique. Multiple activities can be added by clicking on the  button. Click  button to remove an activity. Session can be Single, Multiple or Both. Both can be used when the activity can be completed in either a single session or in multiple sessions. Figure 13 shows the Add Activity accordion tab.



viii. Add Reference

The reference accordion assists users to include reference that have been used in creating the technique. The reference type can be book or a link from the web. The fields in the add reference table are the title, Author, Description, Link/ISBN and type. The Author field indicates the author of the reference. The description allows the user to include notes about the reference. The Link/ISBN field indicated the web link or book ISBN. Figure 14 below provides a snapshot of the reference accordion.



- ix. Clicking the Save Button creates a new technique, closing the form and redirects to the pedagogy interface.
- x. Clicking the Cancel button terminates from the form and redirects to the pedagogy interface.

F. Clone an Instructional Technique

Users are provided an option to modify an existing technique with making changes to the key attributes of the existing technique. Clicking on the **CLONE** button on an instructional technique icon helps create a modified version of the technique. The fields that cannot be changed are the Domain, Domain Category and Knowledge Dimension. The Title must be changed along with modification to one other field in the clone technique form to make a successful clone. The Clone Technique form populates the fields with the values corresponding to the fields of the technique to be cloned. This facilitates the user to know the existing title, description, Mode, Focus, Activity and Reference for the technique to be cloned.

G. Quick Tip

The Quick Tip provides a quick help tip for the users to ease the usage of the application. Hovering over buttons, displays the purpose of the button on the quick tip. Hovering over the Instructional Techniques displays the description of the Technique on the Quick Tip helping the User to get a snapshot of what the techniques tend to accomplish. A screenshot of the Quick Tip is below in Figure 17.

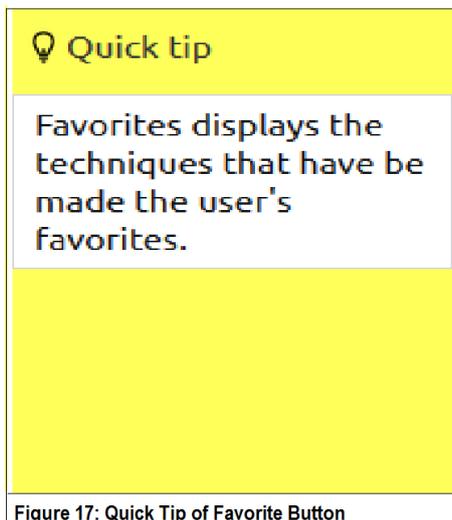


Figure 17: Quick Tip of Favorite Button

H. Instructional Plan

The Instructional Plan shows the Learning Objective, their assigned Instructional techniques and the description of the instructional techniques. The **☰** bullet indicates a Learning

Objective and **🎓** bullet indicates the assigned Instructional Techniques. Clicking on **✕** closes the Instructional Plan and redirects to the Pedagogy interface. This is for read only purpose and is still being considered for future enhancements. A screen shot of the Instructional Plan is in Figure 15.

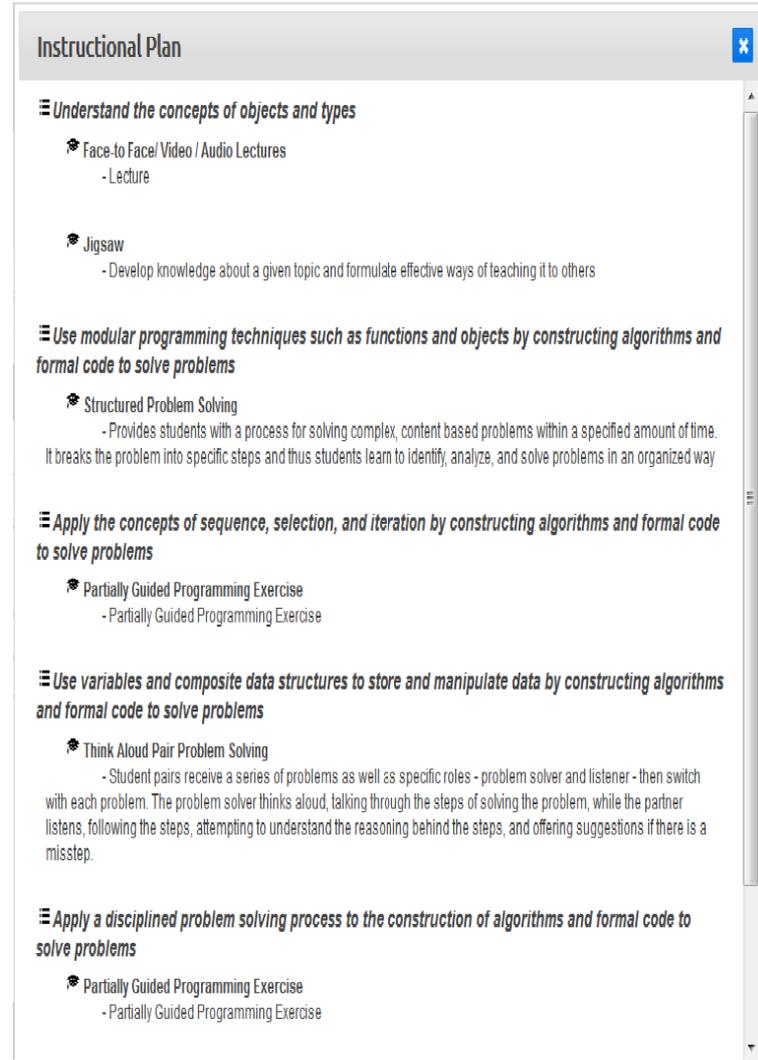


Figure 15: Instructional Plan

VI. DATABASE DESIGN:

PostgreSQL has been used as the backend. The pedagogy techniques, the activities related to the techniques, the references, and the focus of the technique are the of the pedagogy module. Each activity has a description, an example scenario, the duration and the materials required to perform the activity, The Pedagogy technique and Activity tables and the fields are described in the below tables.

1. Pedagogy Technique

The ERD of the pedagogy technique is in Figure 18 and Table 4 has a description of the fields related to the pedagogy technique.

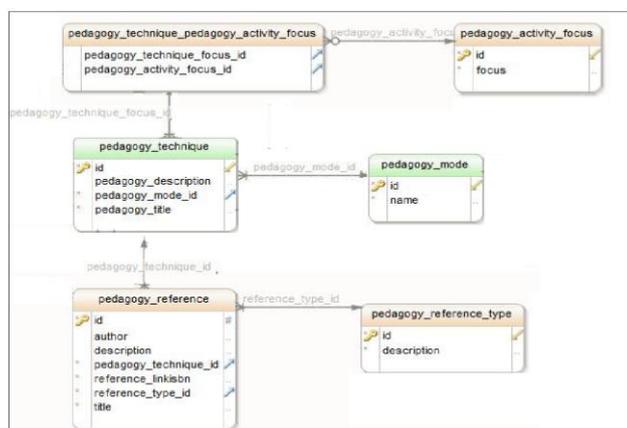


Figure 18: Pedagogy Technique ERD

Table 4: Pedagogy Technique Fields

| Column | Description |
|----------------------------|---|
| Id | An auto generated Pedagogy Id |
| Title | Name of the Pedagogy Technique |
| description | The description of the Technique. |
| Pedagogy_mode_id | Indicates if the pedagogy technique can be online, in-person or hybrid. |
| Pedagogy_focus_id | Indicates if the technique focuses on Presenting, Discussing, Writing or Reading |
| Pedagogy_reference_type_id | Indicates if the pedagogy technique was referenced by a web link or a book by the author. |

2. Pedagogy Activity

The ERD of the pedagogy technique is in Figure 18 and Table 5 has a description of the fields related to the pedagogy activity.

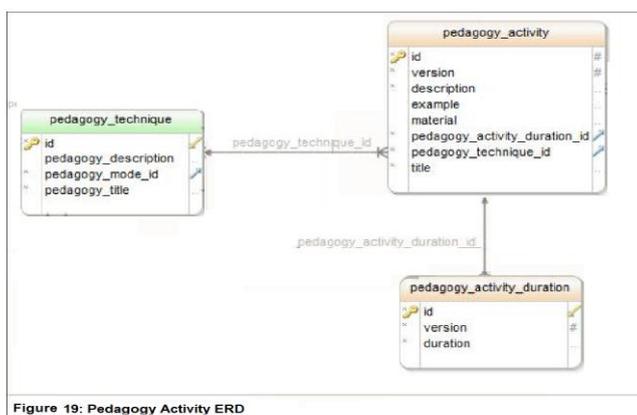


Figure 19: Pedagogy Activity ERD

| Table 5: Pedagogy Activity Fields | |
|-----------------------------------|---|
| Column | Description |
| Id | An auto generated Activity Id |
| Title | Name of the activity |
| description | The description of the activity. |
| Pedagogy_technique_id | Id of the instructional technique |
| Pedagogy_activity_duration_id | Indicates if the activity involves a single session or multiple session . |
| example | A sample scenario show how the activity can be implemented |
| material | Any materials that could be need to perform the activity |

The Pedagogy Mode, Pedagogy Reference Type, Pedagogy Activity Focus, and few Pedagogy Techniques are included in the Bootstrap of the application. Below Table 6, Table 7, Table 8 and Table 9 are the code snippets of the Bootstrap.

Table 6: PedagogyMode

```
if(PedagogyMode.count() == 0){
  new PedagogyMode (name:"online").save(flush:true)
  new PedagogyMode
(name:"in-person").save(flush:true)
  new PedagogyMode (name:"hybrid").save(flush:true)
}
```

Table 7: Pedagogy Reference Type

```
if(PedagogyReferenceType.count() == 0){
  new PedagogyReferenceType
(description:"Book").save(flush:true)
  new PedagogyReferenceType
(description:"Web").save(flush:true) }
```

Table 8: Pedagogy Activity Duration

```
if(PedagogyActivityDuration.count() == 0)
{
  new PedagogyActivityDuration
(duration:"Single Session").save(flush:true)
  new PedagogyActivityDuration
(duration:"Multiple Session").save(flush:true)
  new PedagogyActivityDuration
(duration:"Both Session").save(flush:true) }
```

Table 9: Pedagogy Activity Focus

```
if(PedagogyActivityFocus.count() == 0){
  new PedagogyActivityFocus
(focus:"Reading").save(flush:true)
  new PedagogyActivityFocus
(focus:"Writing").save(flush:true)
  new PedagogyActivityFocus
(focus:"Discussing").save(flush:true)
  new PedagogyActivityFocus
(focus:"Presenting").save(flush:true) }
```


VII. TESTING

Grails automatically generates unit testing to high level functional tests under the test/unit directory in the applications whenever a controller or view is generated in Grails. These tests are executed by running the 'test-app' grails command. Further user interface testing was performed by using Chrome's developer tools and console.

1. Test case for verifying the UI of the Pedagogy tab

| | STEPS | EXPECTED RESULTS |
|----|--|--|
| 1. | Click on the Pedagogy tab | Pedagogy tab should open |
| 2. | Verify buttons | Pedagogy tab should show Add New Technique, Favorite and Instructional Plan buttons |
| 3. | Expand the Ideal Match accordion. | The Ideal Match panel should open. No other panel in the accordion should be open. The panel should contain a text area. |
| 4. | Expand the Extended Match accordion. | The Extended Match panel should open. No other panel in the accordion should be open. The panel should contain a text area. |
| 5. | Expand the Favorite accordion. | The Favorite panel should open. No other panel in the accordion should be open. The panel should contain a text area. |
| 6. | Expand the Domain accordion in the filter options | The Domain panel should open. No other panel in the accordion should be open. The panel should contain a text area. |
| 7. | Expand the Domain Category accordion in the filter options | The Domain Category panel should open. No other panel in the accordion should be open. The panel should contain a text area. |
| 8. | Expand the Knowledge Dimension accordion in the filter options | The Knowledge Dimension panel should open. No other panel in the accordion should be open. The panel should contain a text area. |
| 9. | Click on Add New Technique Button | The Add New Technique form should open. |

| | | |
|-----|---|---|
| 10. | Click on the Favorite Button | The Favorite panel should open. No other panel in the accordion should be open. The panel should contain a text area. |
| 11. | Click on the Instructional Plan Button | The Instructional Plan should open. No other panel in the accordion should be open. The panel should contain a text area. |
| 12. | Click on the Refresh Button on the Filter Options | The Refresh should update the display of the filter options. |

2. Test case for verifying Learning Objective panel

| | STEPS | EXPECTED RESULTS |
|----|----------------------------------|---|
| 1. | Hover over a Learning Objective. | The full description on the Learning Objective should pop up. |
| 2. | Click on a Learning Objective. | The Learning Objective gets highlighted. The instructional techniques that map to the learning objective should be displayed in the ideal match and the extended match. The Domain, Domain Category and Knowledge Dimension accordions in the Filter options panel should get updated with the respective values. |

3. Test case for verifying Filter Options

| | STEPS | EXPECTED RESULTS |
|----|--|---|
| 1. | Click on Refresh after selecting the Check-box corresponding to the Domain, Domain Category and Knowledge types. | Updates the Expanded Match accordion with the instructional techniques that map to the selections in the Filter Options. No other panel should open or get updated. |

4. Test Case For Favorite

| | STEPS | EXPECTED RESULTS |
|----|--|---|
| 1. | Click on Favorite Button. | Expands the Favorite accordion and shows the instructional techniques that have been marked by the user. |
| 2. | Click on the  icon on the instructional technique desired to be the favorite. | The instructional technique is made the favorite and gets displayed in the favorite accordion. The disabled icon,  is changed to favorite icon,  . |
| 3. | Click on the  icon on the instructional technique desired to be the favorite. | The instructional technique is removed from the favorite list and does not get displayed in the favorite accordion. The favorite icon,  is changed to disabled icon,  . |

5. Test case for assign

| | STEPS | EXPECTED RESULTS |
|----|---|---|
| 1. | Click on the  icon on the instructional technique. | The instructional technique is assigned to the learning objective selected and the unassigned icon,  is changed to assign icon,  . |
| 2. | Click on the  icon on the instructional technique. | The instructional technique is unassigned to the learning objective selected and the unassigned icon,  replaces the assign icon,  . |

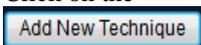
6. Test Case for clone

| | STEPS | EXPECTED RESULTS |
|----|--------------|---|
| 1. | Click on the | The instructional technique clone form pops up. The |

| | | |
|-----|---|--|
| |  button on the instructional technique. | background is disabled. The Domain, Domain Category and Knowledge Dimension is disabled. |
| 2. | Click on the Save button without making any changes to the existing instructional technique. | Error message pops up indicating "Please change the Title name and atleast one other field to create a clone". |
| 3. | Click on the Save button without making any changes to the title of the instructional technique. | Error message pops up indicating "Please change the Title name and atleast one other field to create a clone". |
| 4. | Click on the Save button making changes only to the title of the instructional technique. | Error message pops up indicating "Please change the Title name and atleast one other field to create a clone". |
| 5. | Click on the Save button making changes to the title and atleast one field of the instructional technique. | The form closes and a clone of the instructional Techniques is created. The UI is redirected to the pedagogy tab. |
| 6. | Choose "Select One" from the drop down of the mode. | Error message pops up indicating "Please select Mode". |
| 7. | Expand the "Add Activity" accordion. | The add activity accordion should open. The add reference accordion should not be open. The panel should contain add new inner form showing any activities that were added to the existing parent instructional technique. |
| 8. | Click on the  icon corresponding to the activity under the add activity accordion. | The activity is removed. |
| 9. | Click on  Button under the add activity accordion. | A new column showing opens enabling to enter a new activity. |
| 10. | Expand the "Add Reference" accordion. | The add Reference accordion should open. The add activity accordion should not be open. The panel should contain add new inner form showing any Reference that were added to the existing parent instructional technique. |

| | | |
|-----|---|---|
| 11. | Click on the  icon corresponding to the Reference under the add Reference accordion. | The Reference is removed. |
| 12. | Click on  Button under the add Reference accordion. | A new column showing opens enabling to enter a new Reference. |
| 13 | Click on the Cancel button. | The form closes without saving the clone. The UI is redirected to the pedagogy tab. |

7. Test case to add new technique

| | STEPS | EXPECTED RESULTS |
|----|---|---|
| 1. | Click on the  . | The add new technique form pops up. The background is disabled. |
| 2. | Click on the Save button without adding values to any of the fields in the form. | Error message pops up indicating "Please provide title". |
| 3. | Click on the Save button without adding values indicating to add the values for mandatory fields in the form. | Error message pops up indicating to add the values for mandatory fields. |
| 4. | Click on the Save button after adding the title and the mandatory fields. | A new technique is added. |
| 5. | Click on the Cancel button. | The form closes without saving the new technique. The UI is redirected to the pedagogy tab. |

7. Test case for Instructional Plan

| | STEPS | EXPECTED RESULTS |
|----|--|---|
| 1. | Click on the  . | The instructional plan form pops up. The background is disabled. The Learning Objectives, the instructional techniques assigned to it and the description of the instructional technique are displayed. |
| 2. | Click on the  button. | The form closes and the UI is redirected to the pedagogy tab. |

8. Test case on Quick Tip

| | STEPS | EXPECTED RESULTS |
|----|--|---|
| 1. | Hover over any button. | The Quick Tip panel should display the text associated with the button description. |
| 2. | Hover over the instructional technique icon. | The Quick Tip panel should display the text associated with the description of the instructional technique. |
| 3. | Hover over the accordion. | The Quick Tip panel should display the text associated with the accordion description. |
| 4. | Hover over Refresh on the Filter Options. | The Quick Tip panel should display the text associated with the description of Refresh. |

9. Test case to verify PC³

| | STEPS | EXPECTED RESULTS |
|----|-------------------------------|--|
| 1. | Hover over Performance of PC3 | A pop up displays the performance piece of the Learning Objective selected. |
| 2. | Hover over Content of PC3 | A pop up displays the Content piece of the Learning Objective selected. Each content is separated with ; |
| 3. | Hover over Condition of PC3 | A pop up displays the Condition piece of the Learning Objective selected. |
| 4. | Hover over Criteria of PC3 | A pop up displays the Criteria piece of the Learning Objective selected. |

VIII. FUTURE SCOPE

In the future development of the application, the Instructional Plan can be improved based on usage. Instructional techniques currently included in the bootstrap of the application belong to the Cognitive Domain. More Techniques belonging to the Affective and Psychomotor Domains can be included to the Bootstrap. Semantic ontology can be implemented on the instructional techniques to align with the learning Objectives. This will help provide a more efficient and accurate mapping of the instructional techniques to the learning objectives. The action verbs and objects in the instructional technique descriptions can be used in the implementation of the ontology, thus eliminating the need for users to provide the Domain, Domain Category and the Knowledge Dimensions of Blooms Taxonomy while trying to add a new technique.

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REFERENCE

- [1]. Odesma Dalrymple, Srividya Bansal, Ashraf Gaffar, Randi Taylor. "*Instructional Module Development (IMOD) System: A User Study on Curriculum Design Process*". In Proceedings of Frontiers in Education Conference (FIE), October 2014, Madrid, Spain.
- [2]. Ketaki Andhare, Odesma Dalrymple, Srividya Bansal; "*Learning Objectives Feature for the Instructional Module Development System*", in the Proceedings of the 2012 ASEE PSW Section Conference Cal Poly - San Luis Obispo.
- [3]. Sai Shruthi, Odesma Dalrymple, Srividya Bansal; "*Technology analysis and redesign of the Instructional Module Development (IMODS) System*". Master's Applied Project Report, May 2013.
- [4]. Instructional Technology Master of Arts IMTA at Virginia Tech. Internet: <http://www.itma.vt.edu/modules/spring03/instrdes/introduction.html>, [Aug.29, 2013].
- [5]. Dr. Dave Perry. Instructional Strategies Online. Internet: <http://olc.spsd.sk.ca/DE/PD/instr/index.html>, [Aug.29, 2013].
- [6]. Avrio Knowledge Group. Internet: <http://avrioknowledge.com>, [Feb.02, 2013].
- [7]. Elizabeth F. Barkley. "*Student engagement techniques*", 1st ed. James Rhem. California: Jossey-Bass, 2010, pp 259-345
- [8]. Elizabeth F. Barkley, K.Patricia Cross and Claire Howell Major. "*Collaborative Learning Techniques*", 1st ed. James Rhem. California: Jossey-Bass, 2005, pp 169-192.