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# User Research for the Instructional Module Development (IMOD) System

**Dr. Odesma Onika Dalrymple, Arizona State University, Polytechnic campus**

Dr. Odesma Dalrymple is an Assistant Professor in the Dept. of Engineering and Computing Systems at Arizona State University. She conducts research on tools and techniques that can be readily applied in real engineering learning environments to improve student learning and teaching. In this respect her two prominent research contributions are with: 1) artefact-inspired discovery–based pedagogy, i.e., learning activities where students' exploration of STEM knowledge is self-directed and motivated by interactions or manipulations of artefacts; and 2) the development of faculty expertise in outcomes-based course design through the use of the Instructional Module Development (IMOD) system, a self-guided web-based training tool.

**Dr. Srividya Kona Bansal, Arizona State University**

Dr. Srividya Bansal is an Assistant Professor in the Dept. of Engineering and Computing Systems at Arizona State University. Her research focuses on semantics-based approaches for Web service description, discovery & composition, use of semantic technologies to perform effective searches and information processing in various application areas such as handling heterogeneity in Big Data, representation of knowledge around outcome-based instruction design in STEM education, and semantic tagging in a collaborative bookmarking environment.

**Dr. Ashraf Gaffar**

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# User Research for the Instructional Module Development (IMOD$^{TM}$) System


## Abstract

A team of researchers from Arizona State University is engaging in a User-Centered Design (UCD) approach to develop the Instructional Module Development System (IMOD$^{TM}$), i.e., a software program that facilitates course design. The IMOD$^{TM}$ system will be an open-source web-based tool that will guide individual or collaborating STEM educators, step-by-step, through an outcome-based education process as they define learning objectives, select content to be covered, develop an instruction and assessment plan, and define the learning environment and context for their course(s). It will also contain a repository of current best pedagogical and assessment practices, and based on selections the user makes when defining the learning objectives of the course, the IMOD$^{TM}$ system will present options for assessment and instruction that aligns with the type/level of student learning desired. While one of the key deliverables of the project is the software tool, the primary focus of this initiative is to advance the development of faculty expertise in course design for undergraduate STEM education. To this end, the project addresses the following two research goals:

1. Identify deficiencies in user interactions with existing course design tools.
2. Obtain consensus opinion on a representation of the required knowledge (learning taxonomies, help data and pedagogical and assessment strategies) for designing a course or learning environment.

In this paper we present a project update and the data collected so far from user studies that have been conducted.


## 1. Introduction

At many colleges and universities, engagement in scholarly teaching is becoming a minimum expectation of faculty who are held accountable for the quality of the learning experienced by students enrolled in their course(s). These expectations are even greater for STEM faculty given the national demands for a well-trained STEM workforce [1]. Since education training is not typically included in the plan of study of most STEM programs, faculty who graduate with STEM degrees gain their teaching expertise post-appointment and "on-the-job". In the absence of formal training, most faculty can take as much as five years to truly become proficient teachers, and during that period, it is the students who are most affected [2]. There is a growing demand and interest in faculty professional development in areas such as outcome-based education [3], curriculum design, and pedagogical and assessment strategies. In response to this demand, a number of universities have established teaching and learning centers to provide institution-wide, and sometimes program specific support. In this project we are developing the Instructional Module Development (IMOD$^{TM}$) System to further support these ventures and broaden the impact and reach of professional development in the scholarship of teaching and learning, particularly to STEM faculty. The IMOD$^{TM}$ system will be an open-source web-based course design software that:

1. Guides individual or collaborating users, step-by-step, through an outcome-based education process as they define learning objectives, select content to be covered,

develop an instruction and assessment plan, and define the learning environment and context for their course(s).

2. Contains a repository of current best pedagogical and assessment practices, and based on selections the user makes when defining the learning objectives of the course, the system will present options for assessment and instruction that align with the type/level of student learning desired.
3. Generates documentation of course design. In the same manner that an architect's blue-print articulates the plans for a structure, the IMOD™ course design documentation will present an unequivocal statement as to what to expect when the course is delivered.
4. Provides just-in-time help to the user. The system will provide explanations to the user on how to perform course design tasks efficiently and accurately. When the user explores a given functionality, related explanations will be made available.
5. Provides feedback to the user on the fidelity of the course design. This will be assessed in terms of the cohesiveness of the alignment of the course design components (i.e., content, assessment, and pedagogy) around the defined course objectives.

The IMOD™ system is currently being developed using a user-centered, as opposed to technology focused, methodology. This approach is well suited for the project given the high cognitive nature of outcome-based course design tasks, and the high levels of interactions required between the user and the system to not only facilitate the development of course designs, but to help users build an enduring foundation of knowledge, skills and habits of mind about curriculum development.

In addition to the development of the IMOD™ system, the scope of this project will also include the evaluation of its novel approach to self-guided web-based professional training in terms of: 1) user satisfaction with the documentation of course designs generated; and 2) impact on users' knowledge of the outcome-based course design process. The insights gained from the evaluation study will contribute to the knowledge on approaches for effective instructional development, and potentially provide a new validated framework for building faculty expertise in outcome-based instructional design, and pedagogical and assessment strategies that can be applied to STEM courses.

## 2. User-Centered Design Methodology

User-Centered Design (UCD) approach is an effective methodology to address the fundamental challenge in software development, i.e., "Defining the right application scope is essential for the success or failure of an application" [4]. UCD approach starts by understanding the actual user needs first hand before focusing on any development environment or selecting any specific technology or even defining a specific -constricting solution. Due to the subjectivity of most human domains, the high expectations of humans towards any software as well as the inherent complexity of most applications, the goal of identifying "actual user needs" is easier said than done [5, p. 63]. UCD follows an iterative approach of identifying user needs and validating them though careful conceptual analysis, synthesis, and design as well as multiple and extensive prototyping, testing and reevaluation. In this project, our analysis has identified two main aspects that raise the need for user-centered design process:

- ***High Cognitive Barrier*:** We are dealing with the learning process in an academic setting. Successful pedagogical activities are far from being systematic, deterministic, or even predictable. On the contrary, a good teacher has a high degree of adaptability to varying students' needs and progress. This aspect places our project at the other extreme from a deterministic approach. Our software tool must also be flexible and highly adaptable to different instructors' and students' mutual collaboration, and the software is expected to enhance this highly cognitive nature.
- ***High Interactive Nature*:** The main objective of the IMOD™ system is to exploit and enhance interactivity and adaptability towards individual users' learning abilities and needs. Therefore, the tool will have many interactive interfaces and adaptable features that drive the need for UCD process.

***UCD Phases for the IMOD™ System:*** User Centered Design is a systematic approach that is typically divided into 5 main phases.

- Phase 1 **–** User Research
- Phase 2 **–** High-level design
- Phase 3 **–** Detailed design
- Phase 4 **–** Development and development support
- Phase 5 **–** Testing and Installation support

We are currently in Phase 1 of the project that involves user research. UCD approach starts by understanding the actual user needs first-hand before focusing on any development environment, selecting any specific technology or even defining a specific-constricting solution. Due to the subjectivity of most human domains, the high expectations of humans towards any software, as well as the inherent complexity of most applications, the goal of identifying "actual user needs" is an iterative process of capturing the perspective of potential users and validating them through careful conceptual analysis and synthesis. The user research phase of the project is described in the following section.

## 3. Project Phase 1 - User research

This is the first and key phase of UCD, in which designers focus on meeting users and understanding what they actually do today and need in the future. Several tools have been used in UCD and education domains to effectively execute this phase. We have identified 3 tools that will be most suitable for this project in this phase. To facilitate this process the following tools and strategies were used:

a) **Brainstorming/Focus Groups** allows us to extract many ideas and identify the main features expected by experts in this domain, both teachers and students. We anticipate that we will need 5 brainstorming sessions, each lasting about 3 hours and each session will include up to 5 domain experts (a mix of students and teachers) as well as the moderator (UCD expert) and some of the PIs of the project. Typically, the first 1-2 sessions are moderated with an agenda but are unstructured and are very broad in nature. After analysis of each session, and as we progress towards the last sessions, they become more specific, more focused and more structured. We plan to divide each session into 2 equal parts, 45 minutes each with a 30 minutes lunch break. Lunch will be provided as an incentive/compensation for participants.

b) **Interviews** often provide a targeted feedback and are guided by different types of interviewing techniques and questions. We plan to divide our interviews into an ethnographic-style observation of an interviewee doing their own activities while we observing them, then we follow that by close-ended questionnaire for statistical processing and seek feedback through open-ended questions for opinions and comments. We estimate the need for 10 interviews, each will have a minimum of 3 persons: the interviewer, the interviewee (the domain expert) and a note taker. Participants will receive gift cards as an incentive/compensation for their feedback.

c) **Surveys** are also effective in quickly collecting large amounts of simple data. We intend to design and implement an online survey to further validate out initial findings from the brainstorming sessions and interviews. A mid-term online survey would therefore be more effective than an early survey when no specific questions have been identified yet. Therefore, we will use the initial analysis of our brainstorming sessions and interviews to formulate the survey questions to validate or invalidate them to the broader domain audience. We plan to post the call for participation on various listservs, special interest groups of ASEE, IEEE, & ACM to increase the visibility of the survey and the number of participants.

**Expected Outcomes:** The expected outcomes of the user research phase is a scientific and objective analysis of unbiased user needs; identification of deficiencies in user interactions with current course design tools; and a consensus opinion on the representation of the required knowledge for course design.

**Table 1: Curriculum-design tools**

| Tools | % of Participants |
|---|---|
| **Blackboard** | 89% |
| **Word** | 78% |
| **PowerPoint** | 67% |
| **Excel** | 56% |
| **Whiteboard** | 44% |
| **Email** | 33% |
| **Webpages (with content related to course or other related education topics)** | 33% |
| **Learning Studio** | 22% |
| **CATME** | 22% |
| **Camtasia** | 22% |

## 4. Data Collected from User Research

We conducted 3 focus groups during the past semester with 5 engineering and computing systems faculty members in each session. The aim of these sessions was to understand the course design process used by the participants. At the beginning of each session all participants were asked to fill an electronic background survey that collected demographic information, primary areas of interest in teaching and research, time spent on teaching, number of courses taught per year (at both undergraduate and graduate levels), and number of new courses developed (both at undergraduate and graduate levels). Participants were also asked to fill an electronic questionnaire about curriculum design tools that they currently use to create and manage their courses (e.g. preparing syllabi; communicating with students; developing teaching materials; preparing, assigning, and delivering grades, etc.). Table 1 shows the list of the 10 most identified tools. Figure 1 shows samples of the raw data collected from one of our focus group sessions. Data about course design process was categorized into inputs, processing and decision-making, and output artifacts. Figure 2 shows the consolidated data from the 3 focus groups that were conducted.

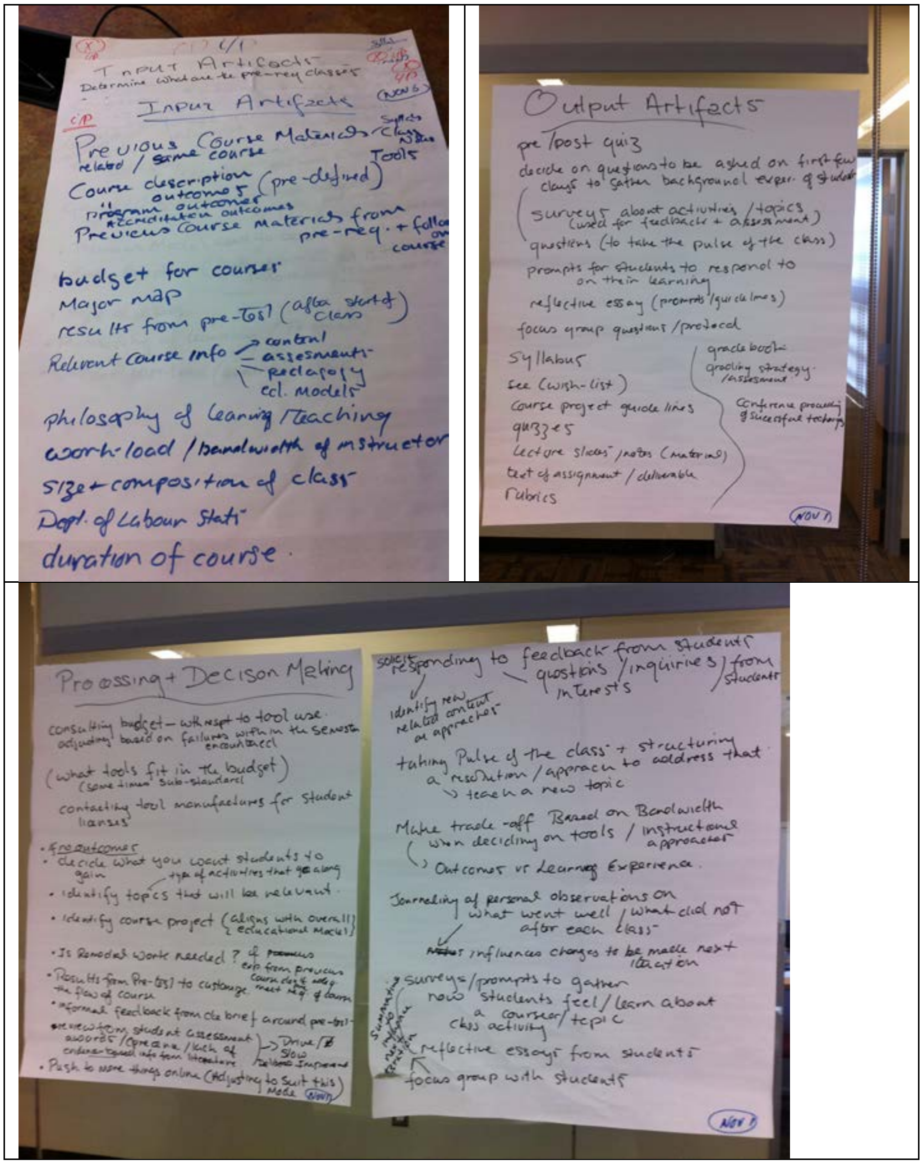


**Figure 1: Raw data from a Focus group**

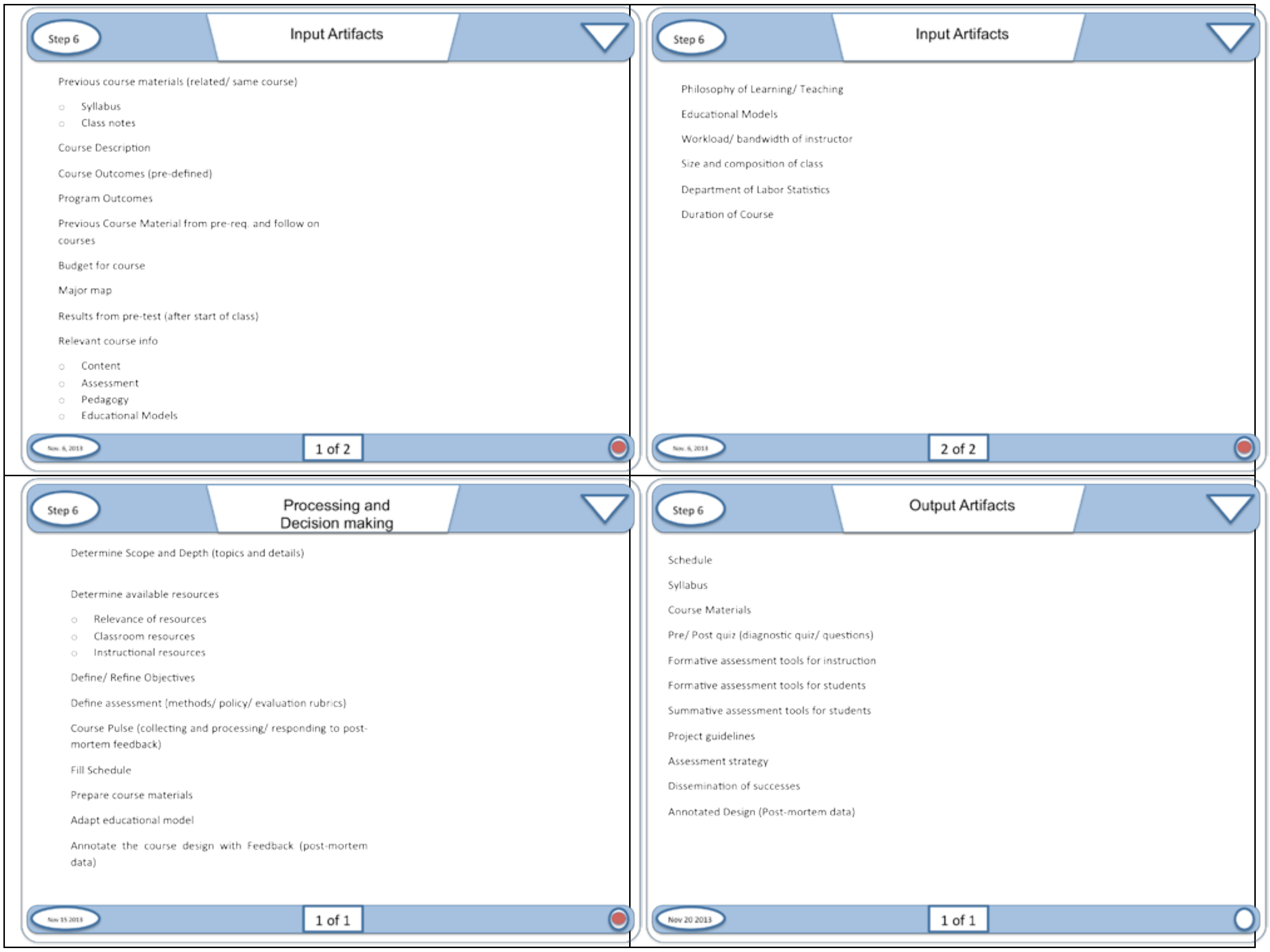


**Figure 2: Consolidated data from 3 focus group sessions**

## 5. Future Work

User studies and the design of the IMOD$^{TM}$ system is still ongoing, and will be further described in future publications. The next steps will include more focus groups and further analysis of the data collected. We will also conduct user interviews which will consist of: a) an ethnographic-style observation of an interviewee doing his or her own curriculum design activities while we observe him or her; and b) follow-up with open and close-ended questions for further clarification of the observations.

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