A. Data Collection

Prior to the start of the focus group session, all participants received a consent form. Data (i.e., information from the pre-session surveys and contributions made during the session) was only used from participants who gave signed consent. To kick-off the start of the session, which lasted 90 minutes; the moderator (i.e., a member of the research group) provided a brief overview of the study and discussed the goals of the focus group. Participants were then presented with the scenario shown in Figure 1, and asked to respond.

Figure 1: Scenario presented at Focus Group Session

As participants provided responses, the moderator summarized the contributions aloud. This summary was then verbally confirmed by the participants and in turn, captured by the moderator, using key words, on a large flip chart, in one of three bins, labeled: Input, Processing and Output. Each session was audio recorded; however, most of the data that was processed from the focus groups, came directly from the notes captured by the moderator on the large flip charts. Figure 2 shows an example of the notes recorded on a flip chart in the Input, Processing and Output bins.
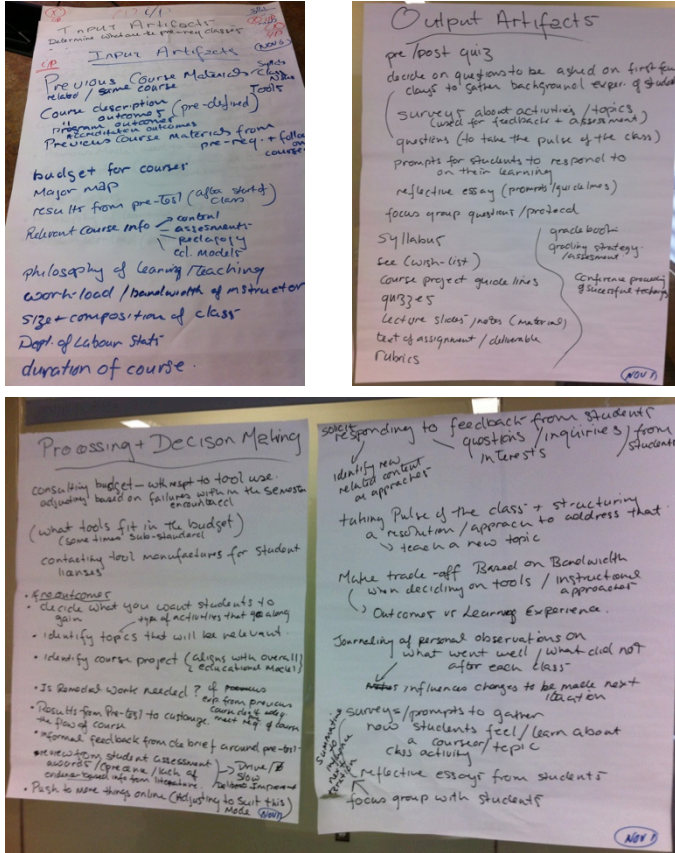
Figure 2 Notes from Focus Group Captured on a Flip-Chart

The primer tracks we identified early on (Input, Processing, and Output bins) remained relevant throughout all the focus group sessions, so we used them as the three main tracks for the final consolidated artifacts. Namely, the consolidated data findings collected from all the sessions included three groups following the original primer tracks. The first consolidation session went through the data captured during the first focus group session (raw data), and after discussions among the three main investigators, a more concise, refined, and relevant set of data (processed data) was produced. For each successive focus group session, a consolidation session followed immediately afterwards to consolidate the new raw data into the existing processed data. In the end, we had one set of consolidated data for each of the three primer tracks that was the collective knowledge accumulated throughout the entire series of focus groups. Figures 3 shows the consolidated data from the Input bin. Figures 4 & 5 show the consolidated data from Processing and Output bins.

Step 8 — Inputs Artifacts

Previous course materials (related/ same course)
- Syllabus
- Class notes

Course Description

Course Outcomes (pre-defined)

Program Outcomes

Previous Course Material from pre-req. and follow on courses

Budget for course

Major map

Results from pre-test (after start of class)

Relevant course info
- Content
- Assessment
- Pedagogy
- Educational Models

Philosophy of Learning/ Teaching

Educational Models

Workload/ bandwidth of instructor

Size and composition of class

Department of Labor Statistics

Duration of Course

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Step 8 — Inputs Artifacts (Contd.)

- Templates
  - Syllabus
  - Course outline
  - Curriculum
  - Alignment map

- Previous Curriculum Design Training
- Curriculum design schedule

- Technical resources
  - Software tools
  - Machinery
  - Materials

- Teacher Characteristics
- Learner characteristics
- Quality metrics
- Peer discussions
- Course usability guidelines/ UX

Key Performance Metrics
- Retention
- Student success
- Employability
- Gestalt principles
- Student collaboration
- Student engagement
- Usability (online)
- Analytics of student use (patterns, duration, etc.)

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Figure 3: Consolidated Input data

Step 8 — Processing

Determine Scope and Depth (topics and details)

Determine available resources
- Relevance of resources
- Classroom resources
- Instructional resources

Define/ Refine Objectives

Define assessment (methods/ policy/ evaluation rubrics)

Course Pulse (collecting and processing/ responding to post-mortem feedback)

Fill Schedule

Prepare course materials

Adapt educational model

Annotate the course design with Feedback (post-mortem data)

Ongoing development of syllabus

Familiarize with new tools

Continuous improvement

Generate feedback (postmortem)

Generate tags on resources

Rating or peer reviewing other courses

Interfacing with social media

Compliance with course usability guidelines/ UX

Compliance with key performance metrics

Tracking course development progress and deadlines

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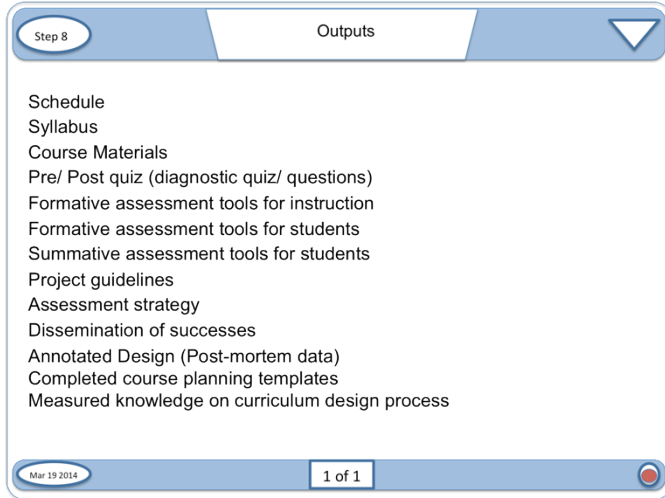**Figure 4: Consolidated Processing data**

Step 8	Outputs	▽

Schedule
Syllabus
Course Materials
Pre/ Post quiz (diagnostic quiz/ questions)
Formative assessment tools for instruction
Formative assessment tools for students
Summative assessment tools for students
Project guidelines
Assessment strategy
Dissemination of successes
Annotated Design (Post-mortem data)
Completed course planning templates
Measured knowledge on curriculum design process

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Figure 5: Consolidated Output data

Resulting Artifacts

Additional artifacts were also identified to help support the project like an ontology, which defines the relevant terms of the domain and identifies their specific meaning as well as the potential relationships between them; and mental model, which is a tool to improve understanding of the user needs and activities.

1) Ontological Model
The IMOD software system will use Semantic Web technologies to provide intelligent interactions with the users, dictate a course design process in conformance with the underlying framework, check for omissions and inconsistencies in the design, provide feedback to the user on their course design, and recommend relevant assessment and pedagogical approaches along with help on how they are implemented. The IMOD framework will be translated into a rich meaningful knowledge structure in the form of an ontology, i.e., an explicit and formal specification of a conceptualization [8]. During the course design elicitation process, logical inference algorithms will test the course design for consistency and adherence with the ontological model.

The results from the focus group helped identify important terminology that will server as ontological concepts and relationships between concepts. Figure 6 shows the hierarchy of concepts.
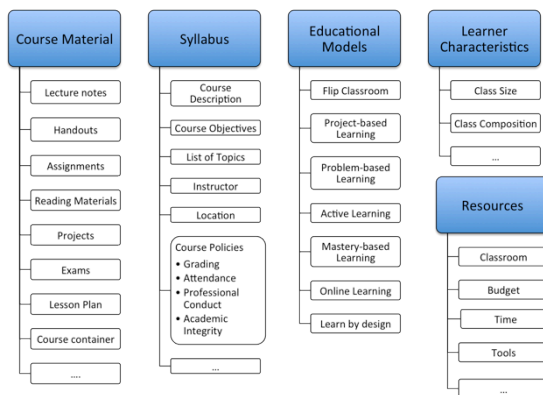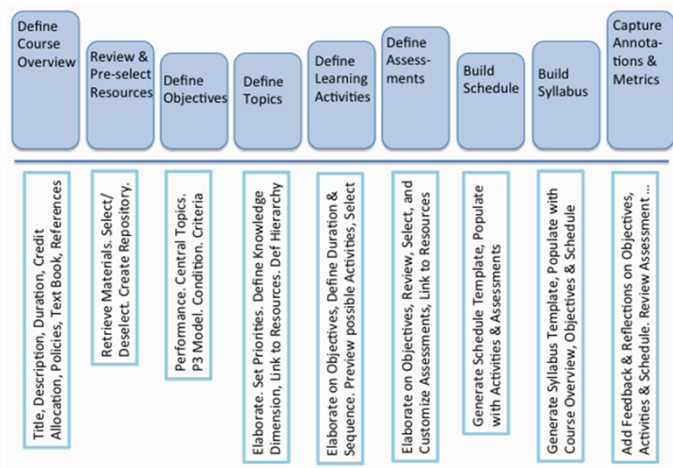

Figure 6: Ontological concepts and relationships

2) Mental Model:
We used mental modeling as a supplemental tool to improve our understanding of the user needs and activities. The process started with a high-level identification of the "User Mental Space", which is a graphical representation of the users' view of the application in terms of their motivation (why they

need/want to use the tool for), Goals (What they need to achieve), tasks (Steps), and activities (detailed actions). After discussions, we look for patterns of repeated and common activities. We decided to limit the process of building a mental model to one session due to resource limitations, but we were able to get good results and build a representative model. We grouped them by building an affinity diagram of similar activities, and organized them sequentially into 9 towers as shown in Figure 7, upper half. The lower half included the detailed and relevant activities that would roughly correspond to application features and functions.

Figure 7: Mental Model