

## **“A la Modes:” The Role of Expressive Modalities in the Teaching and Learning of Design Thinking**

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### **INTRODUCTION**

Language is ubiquitous in teaching and learning. This is as true for engineering as it is for any other area or field. Engineering educators use language to introduce students to disciplinary knowledge and their specific communities of practice. Engineering students use language to gain membership in those communities by engaging in the numerous professional discursive performances typical of the expert engineers they hope to become. That language is not only ubiquitous, but also can play critical roles, for example, in developing an engineering identity seems an obvious and irrefutable experiential truth. And yet, in one of the few studies to examine “students’ knowledge of engineering design language over time, how it comes to shape their design practice, and how students [use language to] make meaning of engineering design situations,” Altman et al., state that much “is not well understood.” [1]

Their study claims three important findings. First, across the four years of an undergraduate engineering curriculum, students increase their “understanding of engineering design as mediated by engineering design language.” [1] Second, students use “engineering design language appropriately,” in relation both to “explaining engineering design” and especially as it increasingly fosters a focus on the “design process.” [1] And third, students use engineering design language to better align themselves with practicing experts thereby allowing for the scrutiny of those experts and the community of practice as a whole. [1] These results are important precisely because they offer empirical evidence for what our experience seems to tell us. However, there is another important result. Altman et al., state “[o]ur findings also show that there remains a gap between what our students ‘know’ and what they ‘do’ with respect to design.” [1] They postulate that the gap is a consequence of “an incomplete internalization of engineering design language ... yet to be addressed in engineering curricula...” [1] I propose an alternative hypothesis. While it is both experientially and empirically true that engineering design language “serves as a mediator in both acquiring conceptual understanding as well as making this understanding visible ... to others;” language may not be the only mediator. [1]

For the last fifteen years at least, many educational researchers as well as educational linguists (ironically enough) have been at the forefront in questioning whether or not language in science education is the only mediator of teaching and learning. They are not challenging the ubiquity of language, nor that language plays a critical role or perhaps a number of roles in science teaching and learning. However, Jay Lemke, asserts that while “the study of language in education is now a mature field .... [such research] “is essentially incomplete without some analysis of how language combines with other semiotic systems.” [2] Similarly, Kress et al., state that “[p]revious educational research has focused primarily on linguistic resources (talk, reading, writing) reflecting the dominant view of learning as primarily a linguistic accomplishment.” [3] “By contrast,” they suggest “we [should] explore the full repertoire of meaning-making resources”.... [in an] “attempt to uncover how these [resources or modes] are organized to make meaning in a multimodal approach to classroom interaction.” [3] Indeed, Gordon Wells, a pioneer in the study of science education, claims that educational researchers, including himself, have suffered under a kind of “logocentrism,” thereby failing to “consider the different ways in which meaning is realized ... in the different semiotic modalities ....” [4]

In response to this logocentrism, those of us interested in studying science teaching and learning, in particular design thinking in engineering, have assumed that “all interactions are multimodal,” [5] and that the appropriate focus ought to be on “humans taking action through their use of communicative modes as resources.” [6] My primary aim in this paper is to gain insight into how the various modalities -- linguistic, visual, aural, spatial, actional -- are used to facilitate teaching and learning, indeed to facilitate the development of a larger professional vision that we might refer to as design thinking. In particular, I describe how one teacher and one student co-produce an understanding of simplicity – an idea relevant to this particular instance of design thinking – through their multimodal (inter)action. I show how “significant pedagogic work is realized through ... [the complimentary use of] a range of [different] modes.” [7] Apropos to my alternative hypothesis, I am interested in “how humans [in this case, a teacher and a student] make meanings, represent and respond to these meanings, and rework the meanings” or, more specifically, how they co-create an experience of design. [3]

## 1 METHOD

If all interactions are multimodal, and teaching and learning are interactions; then we need a methodology for studying teaching and learning as multimodal interactions. Multimodal (inter)actional analysis (MIA) incorporates all the relevant modes by using action as the unit of analysis performed by a social actor or actors within a particular context or site of engagement. It is a methodology that allows the researcher to analyse a situational interaction with a focus “on *what* social actors do (the action that is performed) and *how* the action is performed (the mediational ... tools [also understood as communicative modes] used to perform the action).” [8]

MIA is an emerging research methodology that is “squarely situated in practice.” [9] It developed from three mutually influencing fields: interactional sociolinguistics and its focus on real-time interaction and language in use; mediated discourse and nexus analysis and its focus on mediated action; and multimodality and its focus on communicative modes such as those mentioned above. And, there are four assumptions underlying multimodality, multimodal research and therefore multimodal (inter)action analysis. First, “meanings are made, distributed, received, interpreted and remade . . . through many representational and communicative modes.” [7] Second, “each mode in a multimodal ensemble [or in every interaction] is understood

as realizing different communicative work.” [7] Third, “people orchestrate meaning through their selection and configuration of modes.” [7] And finally, the “meanings of signs fashioned from multimodal semiotic resources are . . . social.” [7]

When investigating the teaching and learning of design thinking, MIA allows us to attend to how design thinking is represented and communicated or rather always co-represented and co-communicated in the “give-and-take” of particular actors through particular social actions and their mediational modes within particular sites of engagement. Specifically, we accomplish this through transcription. Transcription

... in multimodal (inter)actional analysis is a large part of the data analysis. The transcription system ... is image based with an overlay of spoken language, arrows, circles, and/or numbers .... These kinds of multimodal transcripts are ideally compiled qualitatively by taking screen grabs and adding them to make up a figure. By doing this, the analyst is leading the transcription-analysis based on the data, allowing for the possibilities of new discoveries .... In the multimodal transcripts researchers embed their research within each screen grab .... [and by] using this ... system, a viewer of the actual data can understand how the researcher arrived at his/her conclusion. [8]

MIA then provides a method of analysis, the above described approach to transcription, that “allows for a new and novel investigation of social interaction” in a way that not only acknowledges and explores, but also allows viewers/readers to evaluate the interconnectedness of context, actors, actions and modes. [8]

My research for this paper focuses on a video of a single design review conversation between an instructor and a student in a semester long **Industrial Design** course for undergraduates in their third (junior) year of a four year program. [10] This single twenty-six minute long video is part of a shared research dataset, a much larger collection of digital video conversations and presentations, “in which design researchers are invited to ... [analyse and then] share their insights” at a **Design Thinking Research Symposium (DTRS)**. [10] These conversations were recorded “in-situ – in natural environments rather than controlled environments” and every effort was made to maximize the richness of the data by including the same students/teams across time as well as multiple students/teams. [10] The particular symposium for which this data was collected and then distributed was the 10<sup>th</sup> in a series of symposiums. It was held in October, 2014 at Purdue University. The symposium was hosted by Robin Adams.

## 2 RESULTS

The particular course project was to design “seating” for an “officescape” setting. The instructor begins this first design review conversation stating the aim: “our job is for you to have five concepts, directions that you think you want to go in” for designing the seating. He also previews the aims for the next two review conversations during subsequent weeks: “discuss and narrow it [the concepts] down to three” and do “line drawings the last week” respectively. These review conversations play an important instructional role in teaching, by actually recreating, and thereby facilitating the student’s learning of the design process. That process culminates in a “visual presentation” given by the student to “the design team from national.”

Shortly after the instructor previews the aims, process, and result for these design review conversations; he, for the first time and with emphasis, introduces the idea of simplicity: “what we’re really working on, too, is just something really simple.” He also introduces a number of other possible ideas – things to consider as they progress

through the design process. The design for the seating ought to take “exciting and new forms” and “different materials” should be considered as well as colour, expense and durability. Finally and together, they should explore “what would the next level be” for such designs. These other ideas are not wholly separate from simplicity. For example, realizing simplicity in the design might actually suggest what that next level could be. Still simplicity is the central idea. Simplicity or simple or another derivation of the word is used 24 times throughout this review conversation.

In MIA, there is a distinction between higher-level actions and lower-level actions. Higher-level actions have a clear opening and closing and are made up of many “chained lower-level actions.” [5] What I have described above is the opening of a higher-level action – a single design review conversation. Foregrounded in this higher-level action is the aim of this first review conversation, the design process leading toward a presentation, and the most important criteria. Lower-level actions are “the actions [... that can involve one or often a number of accompanying and complimentary communicative modes] performed by [...those] in interaction.” [5] In this opening, those lower-level actions were predominately the sequence of spoken language conversational turns performed by the instructor. The student shows her engagement by responding to each turn with a spoken language “Mm-hmm.” And while there was at least one other communicative mode used by the instructor, beat hand gestures typically used for the purpose of emphasis, this mode is low intensity and is clearly intended to complement the instructors spoken language.

The first image in Figure 1 below shows the opening of the review conversation. Both participants are looking directly at each other and as I have described above spoken language is the predominant communicative mode. However, and barely two minutes into the review conversation, what is foregrounded in the higher-level action changes significantly, along with a change in the predominant as well as the number of communicative modes. The second image shows that the new predominant mode has become the design drawings of the student. Indeed, this change is supported by the fact that whereas before the instructor was the initiator of the interaction, that role has now been taken on by the student.



Fig. 1. Opening of the Design Review Conversation and First Foreground Change.

The student begins this newly foregrounded higher-level action with “OK, Um, I have come up with a lot of ideas.” Notice that in the second image there are at least six separate pages each with at least, but maybe more than one design drawings. What follows is a brief presentation by the student of those various drawings. So, not only are the drawings an added communicative mode, they become the focus of the participants’ attention. As the student presents each of these drawings, she performs actions related to each. Figure 2 below shows a series of actions, in this case gestures, each supporting the student’s spoken description of the particular drawing.

The drawing is of a “lightbulb” shaped seat. In the first image, the student is pointing to the drawing that she wants to present generally describing its distinctive features. In image two, she is pointing to the top of the drawing highlighting the “bulb” shape of the cushion. In image three, she is pointing to the “hard” circular bottom of the seat. As the student points to each feature, she describes them in greater detail. The first three actions are deictic gestures mostly – focusing the instructor’s attention on a particular features or feature of the seat as she speaks. [5] Occasionally and with the marker in her right hand, the student traces the shape again as if to redraw it. Again she is highlighting particular features of the design. In image four, the student is engaging in a different kind of gesture, an iconic gesture, one that “often mimics what is conveyed verbally ... making [... it] more vivid.” [5] She is attempting to show with the movements of her hands how the bulb part of the seat would flatten when someone would sit down.

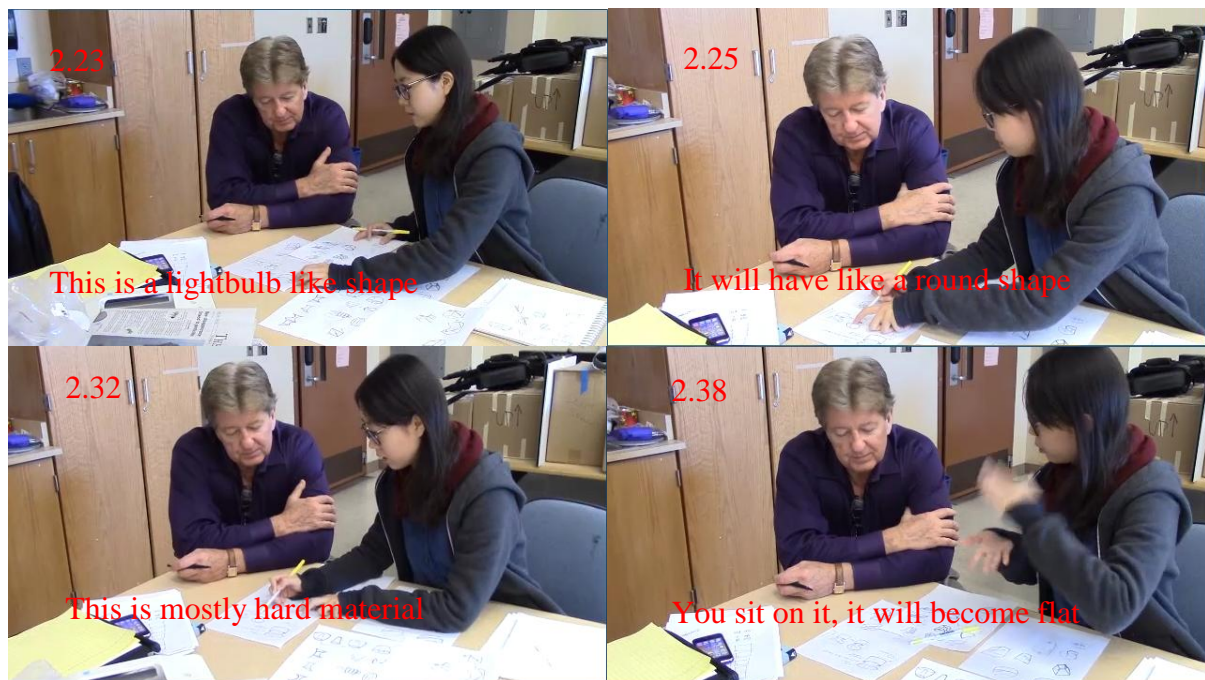


Fig. 2. Student Presentation of Design Drawings

The student proceeds through the rest of her drawings in a very similar fashion. It is important to note that each presentation is multimodal with the predominant mode being the actual design drawings. Spoken language and gestures are the accompanying and complimentary modalities. As the presentations proceed, the instructor offers a range of responses: backchannel comments like “Mm-hmm,” and/or evaluative comments like “this is a really good one to develop” or “that’s great” and “that’s exciting” or “excellent,” and/or questions like “the function of the foam then here – what does it do?” and “could [you] hang these on some arm comes of the wall or something?” Also and more than occasionally, he uses deictic gestures as well to focus the student’s attention on a particular feature, a positive possibility for the design that she has not considered or perhaps a problem. Each presentation is followed by a brief discussion with the instructor focusing on the different affordances and constraints of seating design.

It is after the student’s presentations of the various seating designs that she and instructor begin to consider which of the designs should be chosen for further development. This represents again another change in what is foregrounded in the higher-level action. What was initially foregrounded was the aim, process and result;

then the presentation of the various designs. Now, because “just something really simple” has been established as the desired criterion, that criterion is foregrounded and it is during this final discussion of the various designs that the idea of simplicity is taught and learned. In order to focus on the teaching and learning of simplicity and its relation to design thinking, I will attend somewhat exclusively to those parts of the remainder of design review conversation in which the qualities that make up simplicity is the principal topic.

## 2.1 “Just Something Really Simple”

So, how are the various communicative modalities used to facilitate teaching and learning of design thinking or, specifically, how do one teacher and one student co-produce an understanding of simplicity and its qualities? Recall the original aim for the review conversation as stated earlier by the instructor: “our job is for you to have five concepts.” His contribution to realizing that aim is to help her select from a number of drawings those five that merit further development. Since the established criterion for this selection is simplicity, that selection process should reveal something about what simplicity is.

Both images in Figure 3 below show the instructor selecting (and by selecting then suggesting to the student) drawings that he thought fulfilled that criterion. As in the previously foregrounded higher-level action, the drawings remained the predominate communicative modality while spoken language and gestures (mostly deictic) were the accompanying and complimentary modalities.



Fig. 3. Instructor Selection of Promising Design Drawings

Both the instructor and the student are looking at the drawings. However as the instructor is selecting those drawings, he is at the same time describing the qualities that comprise simplicity. There are three: “pure geometry,” “pure form,” and “functional.” All of these are terms used by the instructor in reference to specific design drawings. Indeed, without the drawings these qualities have very little meaning. Pure geometry represents a design that is scalable to its actual size. The instructor describes two ways to determine scalability: modelling in clay or using a grid with a set width, height and depth. So, if a drawing is scalable, it is simple. Pure form is a “one piece design.” That pure form may be something that is “organic,” that “you find in nature.” All of the designs not selected by the instructor included more than a single piece and are described in one way or another as being “maybe too complex for this ... project.” Finally, the third quality is that each design be “functional.” The instructor reminds the student during this selection process that while being “innovative” and “visionary” is important, the design has to “accommodate the human anatomy.” It “has to be a certain height” and “be comfortable.” Since the particular project is to design seating for an officescape setting, people need to be able to sit.

By selecting certain design drawings and describing their particular features, the instructor is giving meaning to these qualities. Perhaps the teaching of simplicity is best illustrated in a return to the interaction surrounding one of the designs – the “Hershey Kisses.”

Figure 4 shows a sequence of images in which the instructor returns to a particularly interesting drawing. Image one shows the instructor pointing to the drawing and saying “... these Hershey Kisses is very nice, very nice and extremely simple.” Image two shows the instructor suggesting that the student might create a clay moulding to test its scalability. He uses another iconic gesture in order to represent what such a moulding might look like. In image three, the instructor does a drawing of the design himself from a frontal rather than a side perspective. He is attempting to emphasize features that show how a Hershey Kiss design is “such a wonderfully pure form.” And in image four, he returns to the student’s drawing suggesting changes by redrawing or altering her original. Those suggested changes are the instructors attempts to make the design more function or to respond to the student’s concern “it’s kind of not a flat part, so how to sit on it?”

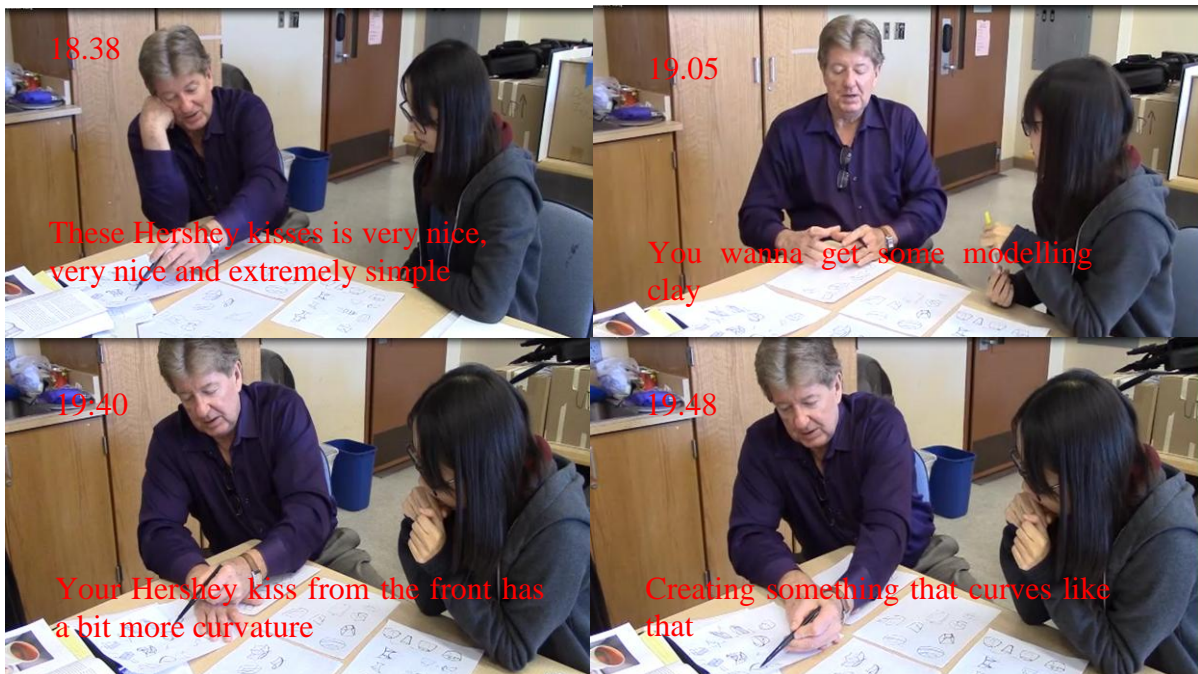


Fig. 4. Instructor Enactment of Design Thinking

We know from the instructor’s statement above that the design is “simple,” indeed “extremely simple.” So what the sequence of images reveals is how he uses various communication modalities to draw the student’s attention to the three important qualities of simplicity.

Perhaps the learning of simplicity is best illustrated in the student’s final selection of her “five concepts.” I stated earlier that higher-level actions, in this case, the design review conversation, have a clear opening and closing. After a brief discussion of one final drawing the instructor initiates a closing: “Well ... okay, of, of these if you had to pick five today – which would be your favorites?” Figure 5 below shows four images. In image one, the student is selecting one of her drawings to be among those surviving five concepts. In image two and like the instructor in Figure 4, she is using her marker to point to the functional quality of the design: “... this one can be put so I can sit on this part.” In image three, the student is using an iconic gesture to show

how the design can fold in upon itself thereby making it a “simpler shape” or a more pure form. And finally in image four and immediately after having selected the previous drawing, the student is pointing to a design drawing that she rejects. Her reasons for rejection are that it is neither functional nor an example of pure form. Consequently, it is not “just something really simple.”

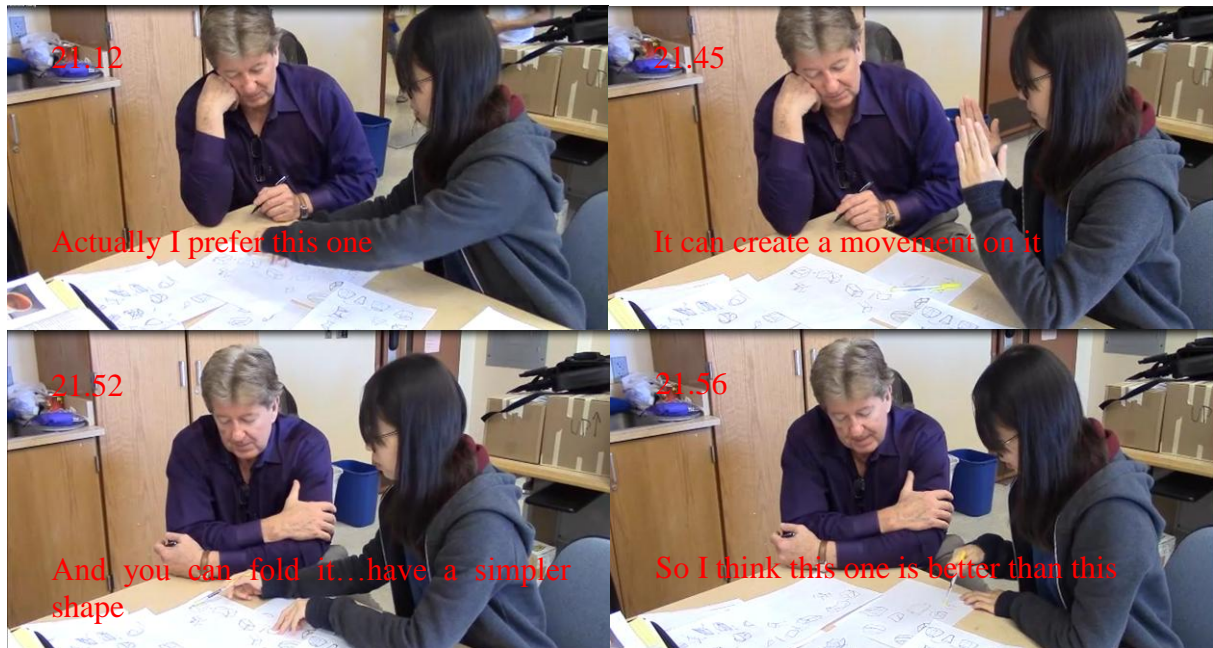


Fig. 5. Student Enactment of Design Thinking through Design Selection

Through her selections of specific drawings and her reasons for those selections, the student is revealing her understanding of at least two of the qualities of simplicity and how simplicity is represented and communicated in the various communicative modalities. But she is revealing more. Through her use of the communicative modalities, she is showing design think in practice – how in the “give-and-take” of particular actors through particular social actions and their mediational modes within particular sites of engagement recreate design thinking.

### 3 DISCUSSION

In this particular design review conversation, it is clear that teaching and learning are multimodal interactions. For example, both the instructor and the student employ a number of communicative modalities to develop and to share an understanding of simplicity. It is also clear that both the instructor and student use these modalities strategically, to perform a particular kind of communicative and, of course, pedagogical work, and complementarily, to augment the work of the other modalities. For example, as the foregroundings throughout the review conversation change so do the predominate modalities. And finally it is clear that the use of these communicative modalities is a collaborative social achievement. In other words, design thinking as it is realized through these modalities and in this particular context certainly is a co-production. For example in the discussion of the Hershey Kiss design, the instructor performs design thinking. And, the student in her selection of design drawings for further development models that performance, and through modelling demonstrates that she too can perform design thinking. Indeed, both the instructor and the student albeit in a preliminary way in this design review conversation co-create an experience of design.



#### 4 ACKNOWLEDGMENTS

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