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A Semantic ISD Model for Distance Learning

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Abstract

Designing instructional systems for asynchronous Distance Learning in higher education is inherently different than face-to-face learning. This is because of the intervention of temporal, psychological and geographical distance between teacher and learner via a Web-based interface. We address this challenge by utilizing Communications, Cognitive and graphic design theories to describe the Distance Learning environment as a communications system. The Semantic ISD Model attempts to operationalize these theories by offering a logic model and heuristic development products to achieve optimal clarity for instructors and learners in Distance Learning instructional systems.

A Semantic ISD Model for Distance Learning

The face-to-face learning environment offers instructors a variety of options to gauge student receptivity, comprehension and response integrity through interactive verbal and non-verbal signaling patterns. The unbroken continuum of this form of interpersonal communication offers both the student and instructor opportunities to instantly resolve incomplete or ambiguous information transfer in realtime by rephrasing a concept in an alternate visual form, drawing an analogy from a more relevant example, or asking the teacher for further elaboration.

The asynchronous Distance Learning (DL) environment, however, places both the instructor and learner at a disadvantage because of the temporal, logistical and psychological gap between them, referred to in theory as Transactional Distance (Giossos et al, 2008). Despite this challenge, higher education institutions and students have embraced DL for its ability to efficiently facilitate instructional services worldwide to serve needs not otherwise met.

The challenge for the instructional systems developer, therefore, is to create a system of instruction for DL that can exploit both the advantages of asynchronous DL while supporting instructor's and learner's needs to reliably comprehend asynchronous online information using information and communication technologies (ICT).

Background

Context

The Semantic ISD model is to be used in the context of Distance Learning in the higher education environment where the learning content and activities are Web-based

and asynchronous. An applicable course structure for using this model includes:

- Higher education, undergraduate or graduate curriculum
- Students operating in a prescribed online environment to read, process and respond to lesson material
- Learning material uploaded to and retrieved for use by means of an Internet-based application via ICT

Role of the Developer

This model is intended for use by an advanced team of ISD and media design specialists whose assignment is to develop both a course of instruction and to utilize or prescribe a means for its online implementation. The ISD development team is responsible for prescribing strategies for instructor and student needs analysis, instructional analysis, design strategies, instructional development, and evaluation. The media design specialist is responsible for analyzing, selecting or modifying the online implementation system upon which the learning content will reside, and for informing the development team about optimal methods to customize learning material for use in the online environment.

The model offers the development team a design plan and a series of checklists in certain principle stages of ISD. These checklists inform the development of the following instructional components:

- Front-end assessment of instructor skills and knowledge needed to operate the online learning system, and to manage an online course.
- Front-end assessment of student Digital Literacy for the level of skills and knowledge needed to operate in the prescribed DL environment.
- Front-end assessment of the resources available for implementation.
- Development of learning material that can function effectively in an asynchronous network environment.
- Selection or modification of applications and interfaces for use on an asynchronous network medium.
- Pilot testing of the course.

- Methods for feedback and formative evaluation to determine possible causal factors in performance deficiency, from both the instructional design and the system of implementation.
- Criteria and judgment guidelines for summative evaluation.

The value of this model for the ISD professional is in its heuristic approach to developing instruction specifically for DL independent of content, even as ICT systems, software and baseline instructor/student Digital Literacy levels evolve. This theory-based flexibility allows the model to be used alone as a basic ISD model for DL, or to have components of it used as enhancement to existing models where there is an online instructional component, such as in a hybrid face-to-face/online course.

Audience for this Report

This ISD model is a tool for instructional design professionals to better understand the unique communication environment found in DL in higher education, and for appropriately developing or adapting instructional content into a Web-based implementation strategy. The audience for this report may also include curriculum designers, professors, or professional development centers where there is a need to better understand the effects of the DL context on the reliability of course material or design.

Analysis and Design

Rationale

Bateson, Watzlawick and Wilden wrote extensively about “communication pathology”, or, the circumstances under which meaning in a message is distorted or lost. In short, they argue that all communication contains the following: (a) analog representation (relationships) coded into an abstract measurement, interval, state, or icon to produce “information” (Wilden, 1972); and (b) content and command, to help classify

the meaning of a given message, e.g. “what is the content of a message” (information) and “what is the message supposed to be *taken as*” (relationship) (Watzlawick, 1967). These principles help to describe the context of DL as a communication system, and help serve as a diagnostic framework for gauging clear message and interface design.

Thus, we approach the DL environment with the Semantic ISD model believing that the optimal experience of distance learning requires *clarity in communication*. This is particularly so because DL relies heavily on the instructor and student’s digital literacy in reading comprehension (text and visual reading) and in comprehending the logic of graphical interfaces for effectively facilitating learning. In this discussion, the attainment of clarity refers to (a) the quality of the dialog between teacher and student via learning material; and (b) the quality of the design and logic of the Web-based interface where operating, reading and responding takes place.

In the absence of clarity, learners are burdened with cognitively resolving linguistic ambiguities or shortcomings in the language and design used in DL instruction. (“Linguistic”, in this framework, refers to both the actual language used in instruction and the “logistical language” of functioning in the online, ICT interface-oriented environment).

Design

As a foundation, we embrace the conventional principles of each stage of the ADDIE model, and then introduce additional criteria to each phase to address the special needs of the DL environment and development environment (see Figure 1)

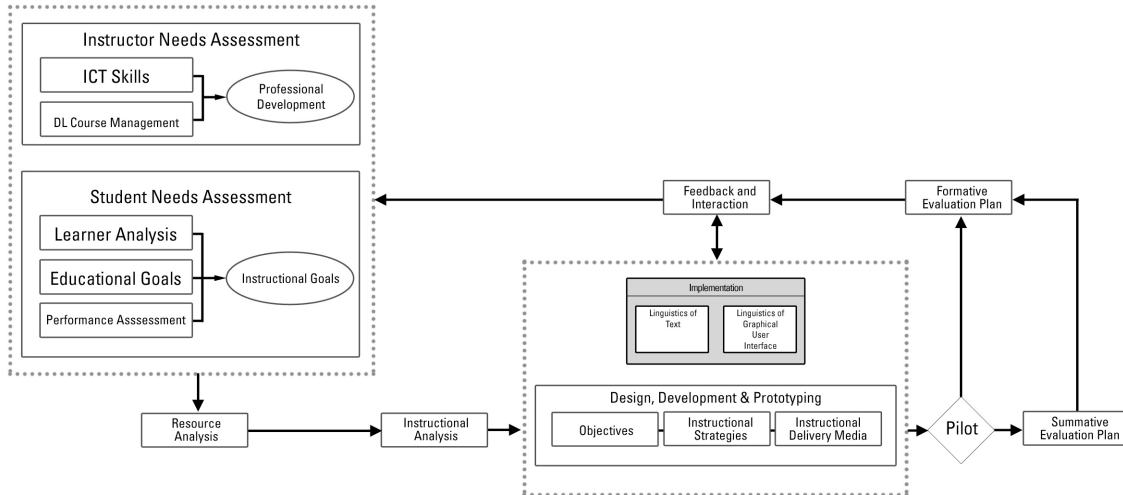


Figure 1. The Semantic ISD Model for Distance Learning

The logic of this model presumes that Implementation will be Web-based. The Web-based delivery system will be either a pre-determined application, e.g. Blackboard, Angel, Moodle, etc., a system custom designed from scratch, or a system assembled from multiple sub-applications, e.g. blogs, wikis, social networks, etc.

The logic of its use is as follows:

1. Instructor Needs Assessment, to produce a profile of professional development needs, if necessary.
2. Student Needs Assessment, to provide a profile of student prerequisites, course-level instructional goals and a basis for student testing.
3. Resource Analysis, to provide a profile of logistic and instructional resources available to use in Design, Development and Prototyping, and ultimately for use in full implementation.
4. Instructional Analysis, to provide a profile of areas of instruction to be included or omitted.
5. Design, Development and Prototyping, to produce instructional plans, content, and prototypes of the implementation.
6. Implementation analysis of language, graphics and interface design for quality of messaging and navigational logic.
7. Prototyped products, to submit to instructors for feedback and revisions.
8. Revised prototypes, to test in small-scale pilot programs.
9. A pilot program, to formatively improve the program through instructor

and student feedback, with results informing both Instructor and Student Needs Assessment.

10. An additional cycle of development (if needed), or a large-scale pilot program for further testing.
11. Summative evaluation, to express the value of the course for the institution and students.

Front-End Analysis. The Front-end analysis phase of this ISD model encompasses the Instructor and Student Needs Assessments, Resource Analysis and Instructional Analysis. The developers must ascertain the appropriate levels of instructor and student skills/knowledge needed to function in the online learning environment according to the Resource Analysis for implementation. These profiles will help determine the need for prerequisite professional or student skills development according to the conclusions of the Resource Analysis. The outcome of this stage is to establish certainty for both the instructor and the student that they can operate in the DL environment without struggling with functional logistics at the expense of time spent participating in instruction and in learning activities.

In the Instructor Needs Assessment, we employ a pre-test or questionnaire to determine instructor skills to determine if professional development will be necessary. In the Student Needs Assessment, we employ standard ADDIE analysis tasks to this phase: (a) identify the learning problem; (b) establish goals and objectives; (c) determine learner needs; (d) determine existing knowledge; (e) determine learning styles. To this list, we add a Digital Literacy competency pre-test. This may take the form of developing a simple questionnaire that touches upon the significant points of skills and knowledge needed for the specific learning context, or a comprehensive diagnostic instrument (e.g. Project SAILS, ETS iSkills) depending on the audience or degree of complexity of the

course of instruction. The following are recognized areas of Digital Literacy skills (see Table 1) (NARUC, 2008).

Table 1

Basic Elements of Digital Literacy Assessment

Elements	Definitions
Access	Knowing about and knowing how to collect and/or retrieve information.
Manage	Applying an existing organizational or classification scheme.
Integrate	Interpreting and representing information - summarizing, comparing, contrasting.
Evaluate	Making judgments about the quality, relevance, usefulness, or efficiency of information.
Create Information	Generating information by adapting, applying, designing, inventing, or authoring information.
Ethical and Human Element	Developing and practicing ethical, cultural and societal attitudes toward technology uses.

In addition, the ISD developers will need to establish Level I (course-level) decisions based on analysis of Educational Goals and Learner Analysis, and then, in the Instructional Analysis, determine which topics to include or exclude in instruction.

Design, Development and Prototyping of Instruction. The design and development phases include (a) specifying objectives; (b) sequencing; (c) employing learning strategies; and (d) prototyping learning material, and then actually creating learning material based on the designs.

To these tasks we add an analysis of text, graphic and video representations that inform the quality of the design and development for use in DL. Guidelines for this analysis include (Clark, R. C., 2004; Tufte, E., 1983):

- Leveraging analysis of learner's skills and knowledge to determine an appropriate approach for graphical representation.
- Reducing unnecessary details in the lesson content environment that

- distract the learner from focusing on critical content.
- Eliminating elements that may potentially activate the wrong prior knowledge.
- Leading the viewer's eyes in logically relevant directions.
- Sufficiently supporting graphics with text explanation to describe the details or actions.
- Creating video media with narrative logic and message design focused on the topic without extraneous decorative effects, sound or distracting content.
- Designing text elements that offer coherence by avoiding fragments or inferences to undocumented information.

These guidelines assure that the design and development stages will include more than just consideration of learning strategies and media, but account for the effect the DL environment may have on the clarity of information in the absence of a live teacher.

Instructors must be included in this development phase as both a resource for validating instructional material, but also to assure development prototyping is in alignment with professional development skills. For extended examples, see Appendixes A and B.

Pilot Testing. This stage will include guidelines to support a process for selecting appropriate test conditions and methods for extracting meaningful feedback. Pilot testing must also include a means for assessing alignment of instructor and student ICT skill prerequisites with task competency. The results of these assessments will inform formative evaluation of prerequisite professional development, student skills, and implementation design. These guidelines include:

- How to select an appropriate student participant.
- How to properly situate the instructor in the test environment.
- A definition of the ICT systems and network standards used by both instructor and student.
- The structure and duration of the test.
- The optimal forms of output.
- Post-test methods for data extraction, including ICT analytics, structured interviews, surveys, etc.

Formative and Summative Evaluation. The Semantic ISD model focuses on two components of formative evaluation: (a) continuous improvement of instructional design and development; and (b) improvement in the implementation system. The results of formative evaluation may be used to share with ISD developers and instructors to improve curriculum, course, and instructional levels, and Web-based implementation design. It may also indicate prerequisite skills for refining professional development, and to clarify student support needs for functioning within the DL environment. Evaluation methods in this model will produce information about:

- Evidence of student application of learning based on assessment guides.
- Attitudes of both instructors and students about the course.
- Instructor experiences with functioning within the Web-based delivery system, and experiences managing the course system.
- Feedback from students addressing aspects of the implementation system independent of content, e.g. navigation logic, usability, organization of content, and which areas of instruction were least effective in conveying information.
- Student response patterns aligning with command structures as indicated in instruction, e.g. were responses consistent with instruction or with the informal conventions of using a given online social media application (if they are different)?
- Usefulness of the course within an overall institutional educational mission.

Evaluation documentation may include coding methods for analysis of teacher and student questionnaire responses, criteria for analysis of course analytics (statistics of online use), points for comparison of test results to other traditional classroom implementations of the same subjects (if possible), and criteria for analysis of learned content as applied to output in subsequent courses. Summative evaluation guides may include references to established norm or criterion referenced testing instruments for

measurement of course output.

Documentation

The theoretical basis of the Semantic ISD model is rooted in Communication theory, Media Philosophy, Cognitive theory, and Media Psychology. We use these theories to distinguish the DL context as a unique communications environment – characterized by the absence of realtime interpersonal exchange, reliance on ICT interface devices, and the influence of online social media behavior – and to show how an ISD model can be used to assist in developing clarity in instruction.

The Semantic ISD model proposes, in pre-theory, that the products of ISD for DL represent a worldview about the role of technology in instruction. In formulating and selecting instructional strategies, Jonassen, Grabinger and Harris (1990) propose that, "Many of the activities that are referred to as instructional strategies are not in fact strategies, but rather are presentation vehicles" (p. 64). We take this as a call to assess "presentation" as a critical aspect of DL instruction, being the proxy for traditional face-to-face instruction. This requires assessing the integrity of communication to locate pathologies that may reduce the quality of information, and ultimately negatively affect outcomes. In essence, the products of ISD attempt to operationalize a communications calculus, or "a method resting upon the employment of symbols, whose laws of combination are known and general, and whose results admit of a consistent interpretation" (Watzlawick et al. 1967, p.39). Thus, as we rely on the Internet delivery system for acting as the structural voice of the instructor, the ISD model must serve as its calculator for predicting outcomes.

The Internet, however, maintains no static conventions for interpersonal communication or connectivity, navigation, iconography, and terminology – they are in constant flux. Moore’s theory of Transactional Distance, in Giossos et al’s interpretation (2008), argues that DL creates three contexts: (a) an interpersonal relationship between teacher and learner; (b) a relationship among the members of the learner group; and (c) a mediating relationship between learners and the educational material. The DL presentation vehicle, viewed in interpersonal terms as a proxy for the instructor, may introduce inhibiting factors in both instructors and learners if there are pathologies or ambiguities in the instruction or its implementation that introduce uncertainty.

Berger and Calabrese (1975) argue in Uncertainty Reduction Theory (URT) that, in interpersonal communication, when communicators share attitudes, beliefs, values, and more personal data, communicators feel more personally connected and tend to communicate more freely with each other. West and Turner state (2000), "High levels of uncertainty can severely inhibit relational development. Uncertainty can cause stress and anxiety which can lead to low levels of communicator competence." If we accept the degree of clarity as a negative covariant with uncertainty, then ISD systems should attempt to achieve the highest level of clarity possible to foster a sense of personal connectedness, and a greater willingness in both instructors and students to participate.

Dills and Romiszowski (1997, p.7) describe technology as “a function to provide human capacity with an expanded repertoire of abilities and functions,” and ISD, as a process technology, “... is a psychological and cultural extension of the normal human abilities to teach and learn, ... naturally, ... and unconsciously (p.7)”. Instruction

presented via the Internet is thus filtered by students through the extensions of human sensory and cognitive perceptions, developed from having been socially integrated into the Internet paradigm. We argue, therefore, that instructors and learners who have acquired proficiency in aspects of Digital Literacy bring a set of linguistics to the online learning environment that may or may not align transparently with the “dialect” of purposeful online learning (Conkey, C., 2007). Gapski (2007) states:

A digital literate person is able to interact with artificial agents. This interaction raises the issue of information autonomy: To which extent can a digitally literate person rely on the processed information, or can doubt and deconstruct delivered information products? The more information processing is done automatically and hidden, the more user-friendly the system appears (p. 53)....

In Giossos et al’s (2008) interpretation of Transactional Distance – where DL introduces a mediating relationship between learners and the educational material – the ISD model must attempt to reconcile learner’s linguistic dialects into automation by promoting explicit command language, and presenting a logically organized interface. For extended examples, see Appendixes A and B.

The ISD professional must also consider how the medium of delivery itself may impose meaning or a semantic background effect on information. Distance Learning, imprinted on the Internet medium, raises a philosophical discussion about how “the medium is the message” (McLuhan, 1964), or, how the Internet frames the meaning of content independent of the content itself. An example might be how interpersonal communication conventions dictate the degree of appropriateness of presenting a “break-up” message to one’s girlfriend or boyfriend in-person, or by email. The content of the

message is the same, though the medium shapes the degree of impersonality of it.

The Internet has its strength in uniform repeatability and instantaneous data transfer, but weakness in framing the context of content (thus, the use of emoticons in casual text communication). Extended further through popular online social media, learners acquire an intuition about the context of information, the nuances of identity, and appropriateness of certain responses that distinguishes the character of output as the foreground to a background of media semantics.

For example, the essay, as a traditional literary argument form, has prescribed guidelines for structure, narrative sequence, argumentation, and citation. Online social media, however, employ no such guidelines by convention, and learners who are immersed in a purposeful DL course may be influenced by the “meaning” of composing on a Web-based medium, such as participating in a “discussion” or composing a “comment”. Although these terms have functional meaning in online social media, they have no pedagogical meaning. An ISD development model ought to prescribe methods to achieve clarity in this dimension for students to operate coherently in the online environment.

We also notice limitations in the use of video as a medium for instruction. A video, by its inherent one-way character, places the learner in the position of being a passive audience member, and does not adequately serve as a complete substitute for a live instructor. Video offers perfectly repeatable reproduction of linear information, but it “asks” the viewer, semantically, to be distant from the content – to be detached – as opposed to participating in a live interpersonal learning context. It cannot offer the

learner more than what is in the content, and video cannot “know” if the information it presents is being understood. The effect of this passive relationship between the medium and the viewer is that the viewer may also assume a passive position to the message.

The guidelines for the ISD professional, in this model, are designed to aid in selecting the video medium as a learning strategy for its ability to integrate time, repetition, linear narrative, parallel action, and visual relationships, but to be mindful that it is a finite medium whose content must be developed to fulfill only what is necessitated by its use.

Conclusion

A metaphor for the paradigm of ISD for Distance Learning might be best described by imagining a person attempting to craft a message to a faraway love interest. The sender must devise a system of communication that will assure that his or her intentions are received precisely as intended, with the desired immediate and longterm results. This involves not only crafting the appropriate text or imagery in the message itself, but also selecting a method for transferring the message in a container that would be appropriate for the nuances of the message, but would neither “color” the message with unintended implications. Further, in the sender’s absence, the receiver of the message should read the message, hopefully, with a sense of certainty about the information, and what it is supposed to be taken as. We hope, then, that the system that was devised for this encounter fosters further openness and engagement between sender and receiver (rather than confusion), leading to more personal connectedness between our imaginary couple, despite their distance.

Distance Learning, like negotiating a distant love interest, is fraught with difficulties. Maintaining the integrity of information and messaging through the Internet medium presents a challenge for instructional systems developers beyond prescribing the means for producing good instruction. It requires attending to fundamental questions about what constitutes “information”, and how literacies and linguistics contribute to comprehension of online textual and graphical information in the achieving of instructional goals.

The goal of using the Semantic ISD model guidelines is to increase clarity in Distance Learning by developing a thorough presentation of content information, and to support implementation with products that reduce overall uncertainty in the Web-based environment. These guidelines will create conditions that foster higher probabilities for instructor and student interaction, and for successful learning experiences.

Appendix A

An Example of Analogic Differences and Codifying Problems in
A Graphical Presentation

Graphic design requires attention to certain details that may potentially elicit unwanted cognitive processing. The graphic below (Figure 2) represents an example of an ISD model for use in developing an instructional system.

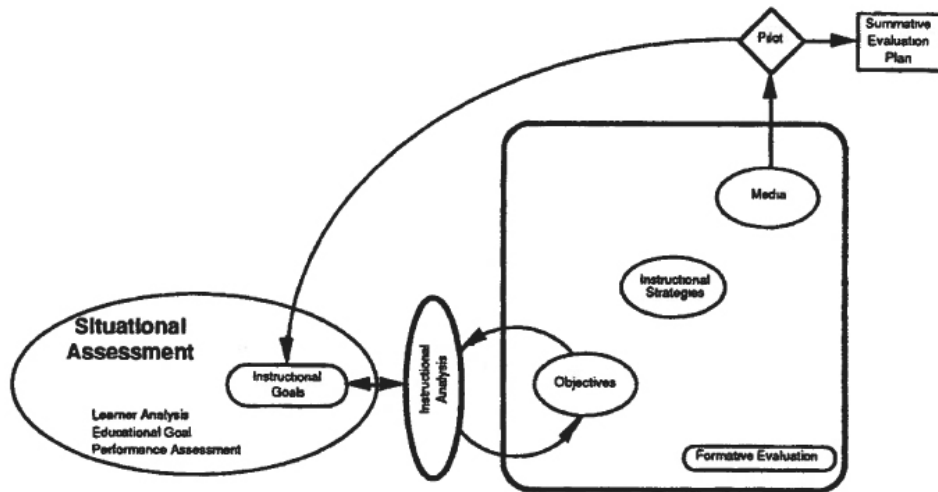


Figure 2. ISD Graphic Model

Edmonds, G., Branch, R., Mukherjee, P. (1994). A Conceptual Framework for Comparing Instructional Design Models. Educational Technology Research and Development

In the above example (Figure 2), the reader encounters a variety of figures, shapes and relationships and is tasked with cognitively assembling its meaning, syntax, and logical implications based on decoding similarities/differences and symbols/relationships. Of this schematic, the reader may ask:

- Why are all of the objects oriented normally, except the sideways oval containing “Instructional Analysis”? Is there something analogously “sideways” or “rotated” in this element that is distinct from the other elements? Does this represent an action in the process or a relationship of the information to the orientation of other information? Or is it oriented like that to save space?

- What does the “upwards” progression in the Objectives, Instructional Strategies, and Media elements represent? Does “up” mean an accumulative process, such as foundation + elaborated upon? Does “up” mean hierarchically more complex or important? Why are there no arrow indications here to suggest relationship or logic to the elements surrounding them when other elements do have them? Or is it a visual tactic to lead the eye upwards towards another phase?
- Why are some objects round, some square, and some rounded squares? Is there a meaningful distinction to be drawn from these differences? If so, what are they, and how do they relate to the logic of each phase? Is there a transformation taking place in the information, or in the context? Or are these design decisions the result of a limited tool set in the design software?
- Why is the shape of Formative Evaluation different than the other objects in the same container? Is there something semantically different in that process compared to the others? If so, how is its shape analogous to that difference? How does its position relative to the other elements in the container connote its role or position within the logical steps indicated? Or does it mean that Formative Evaluation is a “resident” of the larger squarish space independent of the other elements?

The reader may arrive at a logical and functional conclusion about the graphic, despite the cognitive triage needed to eliminate the missing or irrelevant connotations, though this extra cognitive effort is needless and avoidable. This phenomenon is explained by Wilden (1972) who proposes that “information” is the generative result of codifying relationships into an abstract measurement, interval, state, or icon. Gestalt systems theory also proposes that cognitive goalseeking attempts to form closure where information is missing. To achieve clarity in the presentation of information in the DL environment, we must define all relationships with enough semantic closure and consistency to reduce the learner’s cognitive load to resolve cognitive disorientation, detachment or cognitive load.

Appendix B

An Example of Semantic Relationships in Interface Design

The guidelines proposed here seek clarity in two contexts: (a) logical coherence in the presentation structure; (b) use of language, symbols and spatial relationships. Fundamental Web design principles apply in the DL implementation strategy, which include using the Web page focal points and logical eye movement patterns to present primary, secondary and navigational information. To this foundation, we add the following guidelines:

- Consider that learners are likely more accustomed to operating with personal and business Internet applications more so than DL applications. Thus, the response commands and output expectations in DL contexts must be clear, and the space allocated for functioning in the response output must accommodate the expected output.
- The logic and navigation of the Web-based application must be designed with the ability for the learner to navigate and organize information in efficient and accessible ways.
- The platform of the learning context must not influence the learner's perception of the expected output.

The figures below represent examples of Internet applications used to compose instructional output. Figure 3 is a section of a Blogger.com blog where we see the space offered as a Comment response.



Figure 3. Blogger.com Comment space

The Semantic ISD model guidelines suggest considering the implications of both the use of command language and the design of the operating space that may influence the quality of student's response desired by the instructor for an assignment.

- A student using a Blogger.com blog, used as a platform for a portion of course design, is imbued primarily with the usage style, conventions and dialect found in online social interaction. The student who writes in (or responds in) a blog will be applying non-instructional writing style conventions and behavior unless specifically directed otherwise.
- The command to write a “Comment” is an undefined term in the education environment. The learner cannot know what is expected from them as a response, e.g. structure, style, content, length, references, etc., unless specified.
- The space designated for composing text is limited to the window provided (overflow of text invokes scrolling, but no expansion of the window). This suggests to the responder that only a short response is required, or that responses, in general, are insignificant compared to the space allocated for other information. (Some blogging platforms do not permit copy/paste functions into Comment areas, making offline workarounds impossible).

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