Designing Alternative Environments to Facilitate e-Learning

Proposal for Chapter 11

**Instructional Events in E-Lesson Design**
- By Florence Martin

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VIII. Summary
I. Introduction

Forty years ago, Robert Gagné published the first edition of his book *The Conditions of Learning* (1965) in which he proposed nine events of instruction that provide a sequence for organizing a lesson. These events remain the foundation of current instructional design practice. They represent desirable conditions in an instructional program and increase the probability of successful learner achievement. Other authors cite similar elements of instruction that promote student learning from an instructional program (Dick, Carey, & Carey, 2005; Sullivan & Higgins, 1983). The events serve as a major vehicle for incorporating the conditions of learning into an instructional situation, and serve as a framework for the design of lessons both for the face-to-face classroom and for e-learning.

The emphasis on specifying behavioral objectives, providing frequent practice and feedback to enhance the mastery of objectives show that there is a strong behavioral emphasis in these events. However, focusing on the aspects of learning (such as thinking, reflection, memory and motivation) also bring out the emphasis of cognitive learning psychology. These events of instruction are deliberately arranged external events to support the learning process (Gagne, 1992). Though the instructional events have been widely used in face-to-face classrooms, it is also beneficial if used in the design of computer-based lessons and online lessons which are referred in this chapter as e-lessons.

This chapter presents the Atkinson & Shiffrin model of learning and memory, the nine events of instruction and the internal process associated with each event. The readers are then presented with a review of research on each of these instructional events followed by steps in the design of effective e-lessons. The chapter concludes with a model for providing instructional alignment in e-lesson design.

This chapter has the following learning objectives

- Describe a basic model of learning and memory
- Explain the nine events of instruction and the internal process associated with each event.
- Review research on instructional events in lesson design
- List the steps in designing effective e-lessons
- Explain the importance of instructional alignment
- Apply the ID matrix model to an e-lesson design
II. Basic Model of Learning and Memory

The events of instruction are labels that help to relate the internal processes of learning to the external events which make up instruction (Gagné, 1974). In order to clearly understand the external events (nine events of instruction), it will be helpful to understand the internal events (learning process).

"Learning is something that takes place inside a person's head - in the brain" (Gagné & Driscoll, 1988, p.2). Instruction is a set of external events which do not directly cause the internal processes, but may influence or support them. Gagné and Driscoll (1988) defined instruction as "the set of events designed to initiate, activate and support learning in a human learner." (p. 2). Furthermore Gagné et al. (1992) defined it as "a deliberately arranged set of external events designed to support the learning process." (p. 11). Gagné (1985) noted that a designer or instructor controls these external events, and that learners control their own internal learning processes. A basic model of learning and memory proposed by Atkinson and Shiffrin (1968) is shown in Figure 1.

Figure 1. Model of Learning and Memory based on Atkinson and Shiffrin's information processing theories. Figure adapted from Gagné & Driscoll (1988)

According to this theory, external stimulation from the environment influences internal processes within the learner and affects learning (Gagné & Driscoll, 1988). Information enters the human information processing system through a variety of channels associated with the different senses (receptors). The neural impulses are sent to a sensory register which is a
mechanism in the brain. These registers reject the impulses which are irrelevant and select only the features which need to be given attention (selective perception).

The information is now coded and sent to the short-term or working memory. In the short-term memory, the information may be processed by rehearsal and preserved for longer periods. If the information is to be remembered, then it is once again transformed and enters into the long-term memory where it is stored for later recall. Information from either short-term or long-term memory, when retrieved, passes to a response generator that transforms the information into a neural message to activate the effectors (muscles). These effectors produce the performance that affects the learner's environment. The environment in turn provides feedback and reinforcement. During the entire learning process, the learner exerts control over the process of learning and memory.

III. Gagné's Events of Instruction

Gagné's model proposed nine events of instruction to facilitate and maximize learning. These events of instruction not only give a framework to organizing the lesson, but when incorporated in the same sequence as that of the learning process, it maximizes the effectiveness of instruction. Gagné's book, The Conditions of Learning, which was first published in 1965, identified the mental conditions for learning. These are based on the information-processing model of the mental events that occur when learners are presented with various stimuli. Figure 2 shows the nine events of instruction and the internal process associated with each event and an example for each of the event. The events and the research associated with each of the events are described in detail in the next section.
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<thead>
<tr>
<th>Instructional Event</th>
<th>Cognitive Process</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Gain attention</td>
<td>Stimuli activates receptors <em>(Reception)</em></td>
<td>Show variety of isosceles triangles</td>
</tr>
<tr>
<td>2 Inform learners of objectives</td>
<td>Creates level of expectation for learning <em>(Expectation)</em></td>
<td>What is an isosceles triangle?</td>
</tr>
<tr>
<td>3 Stimulate recall of prior learning</td>
<td>Retrieval and activation of short-term memory <em>(Retrieval)</em></td>
<td>Review definition of triangles</td>
</tr>
<tr>
<td>4 Present the content</td>
<td>Selective perception of content <em>(Selective Perception)</em></td>
<td>Give definition of isosceles triangle</td>
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<tr>
<td>5 Provide learning guidance</td>
<td>Semantic encoding for storage in long-term memory <em>(Semantic Encoding)</em></td>
<td>Show example of isosceles triangle</td>
</tr>
<tr>
<td>6 Elicit performance (practice)</td>
<td>Responds to questions to enhance encoding and verification <em>(Responding)</em></td>
<td>Ask students to identify isosceles triangles, given different triangles</td>
</tr>
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<td>7 Provide feedback</td>
<td>Reinforcement and assessment of correct performance <em>(Reinforcement)</em></td>
<td>Check if the identified triangles are correct/incorrect</td>
</tr>
<tr>
<td>8 Assess performance</td>
<td>Retrieval and reinforcement of content as final evaluation <em>(Retrieval)</em></td>
<td>Ask students to draw isosceles triangles/ Ask students to identify isosceles triangles</td>
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<tr>
<td>9 Enhance retention and transfer</td>
<td>Retrieval and generalization of learned skill to new situation <em>(Generalization)</em></td>
<td>Ask students where they might encounter an isosceles triangle in the real world</td>
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</tbody>
</table>

*Figure 2. Gagné’s Nine Events of Instruction*

### IV. Research on Instructional events

The instructional events that Gagné incorporated into his model have been the subject of a substantial body of research. The research literature on each of these events is briefly reviewed below.

1. **Attention (Gaining Attention)**
This external event alerts the student on reception of stimuli. In order for any learning to take place the attention of the student must first be captured. Attention could be gained by the introduction of a rapid stimulus change such as change in the room brightness, a sudden sound or alteration in the pitch of the teacher’s voice (Gagné & Driscoll, 1988). Attention can also be gained with a thought provoking question, an interesting fact or an animation. In a multimedia program, attention can be captured by an animated title screen sequence accompanied by sound effects or music that startles the senses with auditory or visual stimuli.

The ARCS model of John Keller explains how an instructor can keep the student motivated and gain and keep the learners attention. Keller's strategies (Keller, 1987) for attention include perceptual arousal (creating curiosity), inquiry arousal (increasing curiosity), and variability (maintaining interest). Perceptual arousal is created by the use of novel, surprising, incongruous or uncertain events in instruction. Inquiry arousal is created by seeking behavior by posing or having the learner generate questions or a problem to solve. Variability is created by varying the elements of instruction. (Keller & Suzuki, 1988). According to Keller, it is easier to design for learner motivation in a classroom setting where teachers can respond to changes as soon as they sense them. However, it is a greater challenge to make self-directed learning environments responsive to the motivational requirements of learners (Keller, 1999).

Gigliotti (1995) considered a self-assembled slide show, featuring novelty and humor, to assist the lecturer in gaining attention and helps in avoiding the boredom of the audience. A variety of communication techniques such as discussion questions helps one to capture and maintain the attention of the students (Catt, Miller, & Schallenkamp, 2007). Rieber (1990) pointed out that attention gaining is one of the major functions of animation. Zhu and Grabowski (2006) compared on the effects of web-based animation and static graphics to gain attention of students. Levin, Anglin, and Carney (1987) argued that attention-gaining graphics can make relationships between ideas more apparent by facilitating organization.

2. Objectives (Informing the learner of the objective)

An instructional objective is a statement that describes an intended outcome of instruction (Mager, 1984). Objectives help to activate a mental set that focuses student attention and directs selective perception of specific lesson content (Gagné, 1985). According to Ausubel (1968) stating an objective at the beginning of instruction will help the individual learners to structure
their own learning. Reiser and Dick (1996) state that, “At a fairly early stage, learners should be informed of what it is that they are going to be able to do when they finish the instructional process. By knowing what will be expected of them, learners may be better able to guide themselves through that process” (p.48).

Providing objectives establishes expectancy in the learner and it contributes to self-efficacy (Gagné & Driscoll, 1988). It also motivates the learner to complete the lesson. Objectives are critical to good design and to communicate intent. Objectives also form the basis for assessment and evaluation. When clear, concise behavioral objectives are developed, it is easier to evaluate the impact of the program or educational activity (Boone & Boone, 2005). An instructor was able to practically and efficiently evaluate how well students are progressing toward the achievement of a goal in an online discussion by identifying purposeful online interactions that work toward defined learning goals/objectives (Seo, 2006). Well-written objectives are used to select good assessments, content, and activities and point out what's needed for a highly effective course (Shank, 2005).

Some researchers have found that instructional objectives improve learning. Research on effectiveness of objectives in computer-based cooperative learning indicated that students who received instructional objectives performed significantly better on posttest items than students who received either advance organizers or no orienting activities (Klein & Cavalier, 1999). Studies have shown that objectives enhance learning of relevant content, but provide less assistance for incidental learning (Kaplan & Simmons, 1974; Morse & Tillman, 1972; Rothkopf & Kaplan, 1972). Research has also indicated that inclusion of objectives resulted in more positive student attitudes (Staley, 1978).

Hiller (1973) suggested that objectives may not influence learning because certain instructional materials carry implicit objectives that experienced students recognize, which makes statements of objectives superfluous. Hannafin (1987) found that, when computer-based instruction was systematically designed, the presence of objectives did not make a difference but that it did influence performance in lessons that were not well designed. Research has also indicated that the benefits of objectives are reduced when a more powerful instructional element such as practice is included in computer-based lessons (Hannafin, 1987; Hannafin, Philips, Rieber & Garhart, 1987; Philips, Hannafin & Tripp, 1988).
3. Prior Knowledge (Stimulating Recall of prior learning)

Jonassen and Grabowski (1993) defined prior knowledge as the knowledge, skills, or abilities brought by learners to the learning environment before instruction. Before new learning takes place, previously learned items have to be retrieved (Gagné & Driscoll, 1988). When there are links to personal experience and knowledge, it helps the learners to encode and store information in long-term memory. One simple way to stimulate recall is to ask questions about previous experiences, about the understanding of previous concepts, or content learned (Kruse & Kevin, 1999).

Bransford and Johnson (1972) demonstrated that prior knowledge is an important factor in learning and memory. Ausubel’s (1968) assimilation theory considered prior knowledge as the foundation for learning. Prior knowledge enhances human information processing by increasing the accessibility of knowledge and reducing the load on working memory. Prior knowledge is believed to influence the direction of attention, encoding of information, its processing in working memory, its storage in the long-term memory, and the retrieval of information from long-term memory (Dochy, 1994).

Dochy, Segers, and Buehl (1999) conclude from their research that prior knowledge is strongly associated with learning outcomes. Accurate prior knowledge can aid learners in extracting information from a text, inaccurate prior knowledge can actually interfere with learning (Shapior, 2004). Hannafin (1997) suggested that individuals who have higher prior knowledge are able to quickly determine their own learning needs, generate their own learning strategies, and assimilate new information into their existing knowledge structure when compared to individuals who have lower prior knowledge. Meyer (2004) found that novice teachers held superficial conceptions of knowledge and prior knowledge, while expert teachers held a complex conception of prior knowledge and made use of their students’ prior knowledge in significant ways during instruction.

Gijlers and Jong (2005) investigated how prior knowledge influences knowledge development during collaborative discovery learning. According to Cook (2006) prior knowledge is critical in determining the impact of visual representation on learners’ cognitive structures and processes. Krunic, Ruzic-Dimitrijevic, & Petrovic, (2006) found that identifying the students prior knowledge of web issues related to web design was extremely useful in
preparing the program for the web design study group. Mayer and Anderson (1992) found that students with low prior knowledge attained a higher degree of learning when verbal and visual information were presented simultaneously. On the other hand, students with high prior knowledge are able to build referential connections between verbal and visual information and their existing knowledge on their own.

4. Information (Presenting the content)

A significant part of the instructional process involves presenting students with the necessary information for learning (Reiser & Dick, 1996). All models of direct instruction include presenting information to students. The content presented depends on what is to be learned (Gagné & Driscoll, 1988). When the new content is actually presented to the learner, it should be chunked and organized meaningfully. Gagné (1985) mentions that distinctive features of what are to be learned should be emphasized or highlighted when the information is presented.

Multimedia computing also provides a variety of information presentation modality combinations (i.e., text, pictures, narration, animation, and video) (Andres & Petersen, 2001). Mayer’s (2001) multimedia learning principles have strong implications to the design and development of Multimedia content. Mayer’s (2001) modality effect suggests that multimedia presentations invoke the use of both the verbal and visual working memory channels resulting in a reduction of the cognitive load imposed by increased information complexity. This stresses the importance of designing both textual and visual information.

The multimedia learning principles of Mayer (2001) has strong implications to the design and development of Multimedia programs. Spatial Contiguity principle states "Students learn better when corresponding words and pictures are presented near rather than far from each other on the page or screen." (p.81). Temporal Contiguity principle states "Students learn better when corresponding words and pictures are presented simultaneously rather than successively." (p.96) Coherence principle states "Students learn better when extraneous material is excluded rather than included." (p.113). Redundancy principle states "Students learn better from animation and narration than from animation, narration, and on-screen text" (p.184). The benefits of the flexibility of information presentation in multimedia educational systems makes it necessary for designers to think about linking and timing of what is to be presented to the learner and when (Tong, 2001).
5. Examples (Providing learning guidance)

This is the event that brings about meaningful organization (semantic encoding) and helps in the entry of the content learned into the long-term memory (Gagné & Driscoll, 1988). To help learners encode and store information in long-term memory, additional guidance should be provided along with the presentation of new content (information). Guidance is provided by the use of examples, non-examples, case studies, graphical representation, mnemonics, and analogies that can be used to further clarify new content that is presented. (Kruse & Kevin, 1999).

Few studies have been conducted to examine effects of examples in a graphical representation form. Sullivan and Maher (1982) found a significant difference favoring the use of imagery over no imagery in prose learning by intermediate grade students. Walczyk and Hall (1989) reported a significant difference for participants who received examples over those who did not in comprehension assessments. Freitag and Sullivan (1995) found that adults who received examples in a training program significantly outperformed those who did not. A considerable amount of research has been conducted recently on the effects of worked examples as an instructional aid (Atkinson & Renkl, 2007, Atkinson, Catrambone & Merrill, 2003; Atkinson, Renkl & Merrill, 2003; Renkl, Stark & Gruber, 1998). Crippen and Earl (2007) found that the combination of a worked example with a self-explanation prompt produces improvement in performance, problem solving skill, and self-efficacy.

6. Practice (Eliciting performance)

Practice is defined as the event of instruction provided to learners after they have been given information required to master an objective (Gagné, 1985). This is the external event that asks the learner to practice what is to be learned (Gagné & Driscoll, 1988). Eliciting performance provides an opportunity for learners to confirm their correct understanding, and repetition increases the likelihood of retention (Kruse & Kevin, 1999). Unlike questions in a posttest, the exercise within a lesson should be used to help the learners confirm their understanding and not for formal scoring.

Practice is effective when it is aligned with the assessment in the form of a posttest and with the skills, knowledge and attitudes reflected in the objectives (Reiser & Dick, 1996).
Researchers have found that practice has a significant effect on performance. Hannafin (1987) reported a significant difference between practiced and non-practiced items on the learning of cued and uncued information presented via computer-based instruction. Phillips et al. (1988) found a significant difference favoring practice over no practice in an interactive video in which practice items were embedded questions. Hannafin et al. (1987) noted that practice effects were more pronounced for facts than for application items in computer-based instruction. Participants who received intellectual skills practice in a cooperative learning environment performed significantly better than those who received verbal information practice (Klein & Pridemore, 1994).

Research has found that practice effects were more pronounced for facts than for applications in interactive video (Philips et al, 1988) and in computer-based instruction (Hannafin, Philips & Tripp, 1986; Hannafin et al., 1987). Simple practice typically tends to support the learning of factual information, while elaborate practice tends to aid the learning of inferential information (Philips, 1987). However in several studies, varying the level of practice appeared to have very little effect on the learning type (Hannafin et al., 1986; Philips et al., 1988). Hannafin (1987) confirmed the power of practice in learning of verbal information. Factually explicit practice items have increased learning of verbal information, but have not increased learning in higher-level skills (Hamaker, 1986; Philips et al., 1988). Higher-order questions are more effective than factual questions in helping learners apply what they learn from a lesson (Andre, 1979; Hamaker, 1986).

When combined with feedback, practice also enables learners to confirm their correct understandings and identify their incorrect ones. This increases the probability of retention of correct responses and decreases the probability of incorrect responses (Philips et al., 1988; Reiser & Dick, 1996).

7. Feedback (Providing feedback)

Feedback can be defined as “knowledge of one’s performance provided” (Delgado & Prieto, 2003, p. 73). Practice provides an opportunity for feedback that confirms the student’s answer as being correct or indicates that it is incorrect. As learners practice new behavior, specific and immediate feedback of their performance has to be provided (Kruse & Kevin, 1999). The display of performance should be closely tied to informative feedback, so that reinforcement
can occur. This informs the learner of the degree of correctness or incorrectness of the performance (Gagné & Driscoll, 1988).

Feedback strengthens the probability of correct responses and reduces the probability of subsequent incorrect responses (Philips et al., 1988). Kulhavy and Stock (1989) define feedback as information consisting of two components: verification and elaboration. Verification is the simple, dichotomous judgement that an initial response was right or wrong. Elaboration consists of all substantive information contained in a feedback message. Pridemore and Klein (1995) found that level of feedback (elaboration feedback, correct-answer feedback and no feedback) had a significant effect on achievement and attitudes. Several research studies found that elaboration feedback is more effective than simple verification feedback for enhancing learning (Bangert-Drowns, Kulik, Kulik, & Morgan, 1991; Pridemore & Klein, 1995). However, some studies have found that verification feedback is more effective than elaboration feedback to promote learning (Mason & Bruning, 2001; Merrill, 1987; Mory, 1992).

Providing feedback in response to written instruction increases the amount of correct information remembered from the target material (Kulhavy, Yekovich & Dyer, 1979). Feedback facilitates criterion performance as it corrects the inaccurate information obtained during instruction, and has little effect on correct responses where the learner has correct understanding of the text information (Kulhavy & Anderson, 1972). Pridemore and Klein (1995) found that variation in the level of feedback produced a significant difference in achievement. Simple forms of feedback are effective when learners answer items correctly. But more elaborate forms such as providing and explaining the correct answer and explaining why a wrong answer is incorrect are helpful when learners answer items incorrectly (Kulhavy, 1977). Simple forms of feedback are most effective for simple verbatim and verbal information types of learning (Kulhavy, White, Topp, Chan & Adams, 1985).

8. Review

The review process typically provides an outline of the key information that was presented to learners. It is intended to reinforce learning, at the end of the instruction, often just before students are tested. Review is used to provide an outline of the key information that was presented to learners. This is an instructional event that is not included in Gagne’s nine events of instruction. However, it further reinforces the content learned and it is typically provided
between the feedback for practice and the assessment. Mattiske (2001) suggests that a review activity immediately after participants have learned something new reassures them that they are learning. Klein et al. (2004) suggest that learners should be given time to reflect and review after new information has been presented to them. Gagné et al., (2005) indicate that spaced reviews should be given to learners to help them retrieve and use newly acquired information.

Reiser and Dick (1996) cite the value of reviews to bring closure to instruction and to help reinforce the skills and knowledge students should have acquired. Research has suggested that reviews benefit learning of incidental material because instructional stimuli are introduced after the content has been presented and initially processed (Kaplan & Simmons, 1974). The use of reviews to summarize salient information has been shown to enhance learning (Hartley & Davies, 1976). In studies on prose learning, reviews of relevant information yielded significantly better performance than when the information was presented without review (Bruning, 1968).

Lee (1980) examined the effects of different types of review questions on transfer skills on seventh grade Math students and found that relatively difficult review questions can effectively facilitate the retention of these skills. Petros and Hoying (1980) examined the influence of review on children’s delayed retention of prose passages and found that repetition of the original learning experience was the most effective review treatment.

Research shows varied results on the effects of review in learning facts and concepts. Ladas (1973) found that factual review questions did not produce a significant effect on incidental learning when compared to no question at all. Chezik and Dwyer (1982) concluded that difficult or detailed concept learning may require review and practice rather than reading a text or viewing a visual. Ho, Savenye and Haas (1986) researched the effects of review on three learning outcomes (verbal information, concrete concepts and rule learning). Computer-controlled review and learner-controlled review significantly differed from the no review condition for all the three dependent measures. Passerini (2001) analyzed learners' performance within a knowledge representation framework that looked at recall and application of facts, concepts, principles, or procedures. It was found that student recall performance was higher than application performance.

9. Assessment (Assessing performance)
Assessments are used to determine whether and to what extent learners have learned specific knowledge or skills based on the instructional goals and objectives of the lesson. Upon completing the instructional module, students should be given a posttest or final assessment that helps to measure their learning. This assessment should be completed without additional coaching, feedback or hints. Mastery of material or certification is granted after achieving a certain score (Kruse & Kevin, 1999). Herman, Aschbacher, and Winters (1992) point out that "learners perform better when they know the goal, see models, know how their performance compares to the standard." Assessments should also be designed in such a way that they are aligned with the objectives and measure the learning of all the objectives in the instructional material.

Assessment helps students reflect on the course as a whole and consider what they have gained from it. It also provides an opportunity for students to think about their learning process and what has helped and hindered it. Assessment should be designed such that it helps students make connections between classroom material and "real life," which is crucial to intellectual growth. In addition, the assignment gives the teacher one final opportunity to offer students personal feedback, such as study tips based on the learning strengths and weaknesses (Lerner, 2007).

In 1956, a group of educational psychologists headed by Benjamin Bloom found that more than 95 percent of test questions required students merely to recall facts. In response, Bloom developed a classification of intellectual behavior important in learning. These six levels start with recall of facts and move up through increasingly complex and abstract levels, to evaluation. They are 1) Knowledge 2) Comprehension 3) Application 4) Analysis 5) Synthesis and 6) Evaluation.

Along with the traditional assessment, alternate assessments have also become popular. Since implementation of IDEA, three academic assessment response formats have been used for alternate assessment: portfolios, observations, and performance assessments. With portfolios, teachers collected student work samples during the year, usually selected according to some general criteria. With Observations teachers are asked to select a behavior that represents a student need and then observe it in a functional environment. Performance assessments reflect the kind of measurement most similar to the traditional testing program. Basically, a series of
tasks are administered to the student and scored in terms of correctness (Yovanaff & Tindall, 2007).

An assessment rubric, delineates the expectations for a task or assignment (Stevens & Levi, 2005). By clearly describing the concept and evidence of its understanding, students and faculty are more likely to recognize it when students perform it. In addition, rubrics facilitate communication among students and provide students, preceptors, and faculty with language to foster both feedback and discussion (Lasater, 2007).

There are a variety of ways in which computer and information technologies can be used to address assessment issues. Online learning management systems come with in-built assessment tools. This provide opportunity to create different types of assessment items such as short answers, essays, multiple choice answers, web portfolios. The major advantage of these systems is their ease of management, freeing teachers to spend more time on other aspects of teaching. Some of the different test items are graded automatically and immediate feedback is provided to the student.

10. Retention and Transfer (Enhancing retention and transfer)

The repetition of learned concepts is an effective means of aiding retention (Kruse & Kevin, 1999). Gagné and Driscoll (1988) mention that spaced reviews enhance retention and retrieval of what is learned. Transfer of learning to other fields is made possible by providing a variety of examples and situations. Promotion of transfer of learning is made possible by instruction that provides novel tasks for the student, that is spaced over time and calls for the use of what is learned previously (Gagné & Driscoll, 1988).

Retention can be defined as the power of retaining and recalling past experiences and information gained. The underlying rationale for any kind of formal instruction is the assumption that knowledge, skills, and attitudes learned in this setting will be recalled accurately, and will be used in some other context at some time in the future. If we want transfer, then we not only have to increase student performance while at school but we also need to teach in ways that actually enhance the probabilities of transfer. Students can also be better prepared students by giving them predictable real world tests.

Halpern and Hakel (2003) provide some principles on how one can enhance retention and transfer 1) Provide practice at retrieval 2) Vary the conditions under which learning takes
Place. It makes learning harder for learners but results in better learning. 3) Require learners to take information that is presented in one format and "re-represent" it in an alternative format. 4) Lectures work well for learning assessed with recognition tests but work badly for understanding. 5) The act of remembering itself influences what learners will and will not remember in the future. These principles can be applied in any adult learning situation, including distance education with online components, learning from texts, laboratory and classroom instruction, and learning in informal settings.

Discovery learning activities were found to improve student learning, retention, and transfer (Foster, 1996). The students became more aware of what they were doing and why by when the teacher asked them leading questions that helped them to focus on the task at hand. Mayer (2001) researched on the transfer of the effects of multimedia principles.

11. Combination of Events

Most of the research on instructional events was conducted with a single event or two events together. Very few studies have been conducted where the effects of a number of events from the Gagné set have been tested (Coats, 1985; Gleason, 1986; Martin, Klein & Sullivan 2006; Martin & Klein, 2008).

Gleason (1986) conducted a study on effects of Gagné’s instructional events (lesson, examples, practice and quiz) in a computer-based mathematics lesson. No significant differences were found in achievement based on the number of events (instructional support) in the lesson. Coats (1985) tested for the effects of Gagné’s instructional events on posttest and retention test scores. The experimental group received all the nine events and the two control groups had some events deleted from them. No significant differences were found among the three treatment groups on achievement.

Chezik and Dwyer (1982) found no significant difference when they tested for the effects of review sheets, practice worksheets, combination of review and practice and an advance organizer on learning from prose text. Sasayama (1984) compared the effects of rules, examples and practice on learning concepts, principles and procedures. The full program (rule, example, practice) treatment was more effective than rule-only, example-only, rule-example-only treatment for all groups. Martin, Klein & Sullivan (2006) compared the effects of objectives, practice, examples and review in a computer-based lesson. They found that that among the
instructional events tested in the study, practice had the most impact on both learner achievement and attitudes. Martin & Klein (2008) compared the effects of objectives, practice and review in a multimedia program. They found that the effects of practice were stronger when compared with the combination of objectives and review when students learned from a multimedia program. Practice was the one consistently effective instructional element for enhancing student achievement and attitude in the study. Their findings implied that practice with feedback should be included in computer-based, multimedia instruction especially when students are tested using items aligned with the objectives and practice items.

Many of these events may produce a much different effect when they are studied individually than when they are combined into a more complete set that incorporates most or all of Gagne’s nine events. As Hannafin (1987) noted, some design strategies may have positive effects when used in isolation that are diminished or negated when these strategies are used in combination with more powerful techniques.

VI. Instructional Events in E-lesson Design

This section includes sample screens that were designed using the instructional events in a computer based and web lesson. The next section explains the steps in designing effective e-lessons.

Painting Styles Computer Based Lesson

A computer-based, multimedia program entitled “The Painting World” was developed using Macromedia Director and consisted of four units: (1) Strokes in History, (2) Paintings and Styles (3) Know the Masters, and (4) The Masters’ Styles.

The materials were designed such that it included the following Gagne’s instructional events.
Title Screen/Introduction Screen – To Gain Attention

The graphics in the program and the colorful title screen was used to gain the attention of the students.

**Title Screen**

**Introduction Screen**

**Objective Screen**

**Information Screen**

**Renaissance** which means "rebirth" is the term used to describe the development of Western civilization that marked the transition from medieval to modern times.

It began in the second half of the 13th century in Florence, Italy.

During the middle ages the Church had been almost the sole patron of arts. In the 15th century, the rapid increase of private collectors created a new demand for secular subjects in contrast to the purely religious painting of the middle ages.

Leonardo Da Vinci represented the humanistic values of the period in his art. Michelangelo and Raphael were also vital figures in this movement.
IPSO (Input, Processing, Storage and Output) Web-Based Lesson

A computer-based lesson on the topic *Input, Processing, Storage and Output of a Computer (IPSO)* were developed using Dreamweaver. IPSO explains the primary operations of the computer. An introduction section was included before the primary operations were explained in detail. The next four sections described the concepts of the Input, Processing, Storage and Output operations in a computer and explained the function of the different components associated with
that operation. The materials were designed such that it included the following Gagné’s instructional events.

**Objective Screen**

![Image of Objective Screen]

**Goal**

The goal of this *Know Your Computer* module is to teach learners about what computers do and how they work. The different functions in a computer are explained individually and in the end, they are put together to show how the computer works.

**Objectives - Input**

By the end of this section, you will be able to:

- Describe the concept of the input operation in a computer.
- Describe the function of the components associated with the input operation in a computer.

**Information Screen**

![Image of Information Screen]

**Examples of Input Devices**

**Keyboard**

Keyboard is the most common input device of a computer. Pressing the keys on the keyboard sends messages to the computer. It consists of number keys which send numerical information, letter keys which send text information, and additional function keys for control purposes.

**Mouse**

Mouse is a popular input device. You move it across the desk and its movement is shown on the screen by a marker known as a cursor. You will need to click the buttons at the top of the mouse to select an option. With this “point and click” device, you can move data around on the screen and send commands to the computer.
Practice / Feedback Screen

Introduction-Practice

These practice questions are similar to the questions on the IPSO posttest. If you get a wrong answer while practicing, keep trying until you get it right.

1. The physical components from which a computer is constructed (electronic circuits and input/output devices) are known as

   - Software
   - Hardware
   - CPU
   - Memory

   Hardware is correct

Review Screen

Review - Input

Input Devices

<table>
<thead>
<tr>
<th>Device</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Keyboard</td>
<td>Sends messages by pressing keys</td>
</tr>
<tr>
<td>Mouse</td>
<td>Sends data by clicking</td>
</tr>
<tr>
<td>Joystick</td>
<td>A rotary lever and used in computer games</td>
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<tr>
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<td>Touch sensitive screen</td>
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<tr>
<td>Light screen</td>
<td>Draws directly on the screen</td>
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<tr>
<td>Digital cameras</td>
<td>Inputs images from camera to computer</td>
</tr>
<tr>
<td>Optical mark reader</td>
<td>Inputs numbers or letters</td>
</tr>
<tr>
<td>Scanner</td>
<td>Scans photo or text into computer</td>
</tr>
<tr>
<td>Barcode reader</td>
<td>Reads barcodes (pattern of printed lines)</td>
</tr>
<tr>
<td>Magnetic reader</td>
<td>Reads magnetic strip on a card</td>
</tr>
<tr>
<td>Voice data entry</td>
<td>Accepts spoken word as input data</td>
</tr>
</tbody>
</table>
VI. Steps in designing effective e-lessons

Instructional Design is a system of developing well-structured instructional materials using objectives, related teaching strategies, systematic feedback and evaluation (Moore & Kearsley, 1996). It can also be defined as the science of creating detailed specifications for the design, development, evaluation, and maintenance of instructional material which facilitate learning and performance.

This section categorizes ten tasks that an instructional designer, a teacher or a trainer performs during the design phase of the instructional design process. The author has uniquely listed the design tasks or components which can be used as a step by step guidance to design effective e-lessons.

1. Describe the goal of the instructional program
2. Identify, and sequence instructional objectives
3. Identify instructional content (information) to achieve the objectives
4. Identify examples to support instructional material
5. Design practice activities
6. Provide feedback for the practice activities
7. Review the key points in the instructional material
8. Design assessments aligned with objectives
9. Identify instructional media/technology
10. Identify Instructional strategies

Below is a brief description of each of the steps along with an example of the design task. The examples are from the Hardware of the Computer IPSO web based lesson.

1. Analyze and describe the Instructional Goal

Goals are broad, generalized statements about what is to be learned. They are thought as a target to be reached. The goal is developed based upon the results of a needs assessment. A goal describes an outcome of instruction and does not refer to the instructional process itself. Instructional goals helps us measure student competency in the goal at the end of the instruction. Designers and instructors can save a great deal of time and money and the e-lessons can be more effective when designers start the design process with a goal in mind for their learners.
2. **Identify, and Sequence the Objectives**

Once the goal is identified, the second step in the design of e-lessons is to identify the instructional objectives. The instructional objectives are then sequenced in a manner that maximizes learning. E-lessons are more effective if the objectives are stated at the beginning of the lesson.

Objective is like a roadmap and tells us where we are going; they are the ends and not the means. A common error in identifying instructional objective is to confuse objectives and activities. Objectives are ends of instruction, but activities represent means to these ends. Objectives have to be worth-while and also well-written. Well-written objectives are commonly created at two levels--terminal and enabling. Terminal objectives describe what the student will be able to do as a result of the instruction. Enabling objectives are the incremental skills the student gains along the way to the terminal objectives.

Objectives must be stated appropriately in order for them to be useful in instructional planning and assessment of student learning. The two elements that have to be clearly specified when writing an objective are: 1) the description of the expected student performance and 2) the description of conditions for assessing. It is also important to use verbs that indicate observable behavior rather than internal state (Sullivan & Higgins, 1983).

Hannafin and Peck (1988) stressed the importance of sequencing, which is determining the sequence in which the objective will be met. Sequencing the objective helps in creating the outline of the instructional material. There are different ways of sequencing objectives such as topical, known to unknown, general to specific, chronological, and step by step. There has also been research conducted on sequencing objectives from a learning hierarchy in an attempt to generate a minimal memory load sequence (Nesbit & Hunka, 1987).
### Instructional objectives/ Sequence of objectives

1. Explain the IPSO (Input, Processing, Storage and Output) cycle.
2. Describe the function of the components associated with the input operation in a computer.
3. Describe the function of the components associated with the processing operation in a computer.
4. Describe the function of the components associated with the storage operation in a computer.
5. Describe the function of the components associated with the output operation in a computer.

### 3. Identify Instructional content (information)

The third step in the design of e-lessons is identifying instructional content which is a significant part of the instructional process and is the necessary information for learning. After the objectives are sequenced, instructional content (information) and activities are designed. Information should be provided for all the objectives of the lesson. It is important to provide information that is aligned with the objectives for the lesson.

Students learning to perform a new task normally lack basic information needed to perform the task correctly. It is important to present the necessary information in a clear and concise manner and also present only the information necessary for learning to perform this task.

Information can be presented in a variety of modalities (text, pictures, narration, animation, and video). E-lessons can be more effective if the multimedia learning principles are applied and a good balance of text and graphics are provided on each screen. The important parts of the lesson can also be emphasized by highlighting or by providing sufficient contrast from the rest of the content. Organizing and chunking information will maximize learning.
Instructional Content (Information) – Sample

**IPSO**

Most computers have four types of hardware components: input, processor, storage (auxiliary storage) and output. Input and output (I/O) devices allow the computer to communicate with the user and the outside world. The CPU (central processing unit) executes programs (“software”) which tell the computer what to do.

**IPSO Cycle**

The diagram given explains the operations in the computer. First the data enters the computer through the input device, and then processing occurs at the processing unit. The processing unit is the microprocessor chip. Processing unit comprises of the control unit and arithmetic and logical unit and main memory. There are storage devices (auxiliary storage) which store the processed data and data can be retrieved at anytime. The processed data is sent out to the output devices for the user.

![Diagram of IPSO Cycle]

- **Input** - data goes in
- **Processing** - data is processed
- **Storage** - data stored
- **Output** - data comes out

4. **Identify examples to support the Instructional material**

   Once the information is identified, the next step in designing the e-lesson is to identify examples for the information presented. Examples are verbal or graphical information that provides additional clarification of rules or information presented to learners. In mathematical content, it is common to provide worked-examples for the learner.
Examples of Input Devices (Sample)

Mouse
Mouse is a popular input device. You move it across the desk and its movement is shown on the screen by a marker known as a cursor. You will need to click the buttons at the top of the mouse to select an option. With this "point and click" device, you can move data around on the screen and send commands to the computer.

Joystick
Joystick is a rotary lever, similar to an aircraft's control stick. It enables you to move within the screen's environment, and is widely used for computer games.

5. Design Practice Activities

Practice is to learners after they have been given information required to master an objective. Practice provides an opportunity for learner to confirm their understanding of what they have learned. The repetition of the task also helps them to retain the information.

Practice will have a significant effect on student achievement if learners are provided an opportunity to perform an identical task to that assessed on the posttest. Practice is effective when it is aligned with the assessment in the form of a posttest and with the skills, knowledge and attitudes reflected in the objectives. It is important to provide appropriate practice is practice of the exact task stated in the objective and also provide individual and frequent practice.

In an e-lesson, interactive practice can be designed by providing multiple choice items, drag and drop items, or even have the students discuss a topic online or write a short answer or an essay which will help them master the content for the objective. Hands on project development also provide practice opportunity for the students in online lessons.
Input Devices - Practice

These practice questions are similar to the questions on the IPSO posttest. If you get a wrong answer while practicing, keep trying until you get it right.

1. A peripheral used to transfer data from the outside world into a computer system is called

- Input device
- Processing device
- Storage device
- Output device

2. Which of the following is a rotary lever and enables you to move within the screen's environment?

- Touch sensitive screen
- Joystick
- Barcode reader
- Magnetic reader

6. Provide Feedback

Feedback is provided to a learner after he gets an opportunity to practice. Practice provides an opportunity for feedback that confirms the student’s answer as being correct or indicates that it is incorrect. Feedback can be provided as verification or elaboration. Verification is the simple judgment that the response was right or wrong. Elaboration consists of detailed information contained in a feedback message. Providing feedback to learners increases the amount of correct information remembered and it helps them perform better on their assessment.

In an e-lesson immediate feedback can be provided to interactive practice activities such as multiple choice items.
**Input Devices – Practice/Feedback**

These practice questions are similar to the questions on the IPSO posttest. If you get a wrong answer while practicing, keep trying until you get it right.

1. A peripheral used to transfer data from the outside world into a computer system is called

   - [ ] Input device
   - [ ] Processing device
   - [ ] Storage device
   - [ ] Output device

   Input device is correct.

2. Which of the following is a rotary lever and enables you to move within the screen's environment?

   - [ ] Touch sensitive screen
   - [ ] Joystick
   - [ ] Barcode reader
   - [ ] Magnetic reader

That is incorrect

7. **Review the key points in the instructional material**

   The review process typically provides an outline of the key information that was presented to learners. It is intended to reinforce learning, at the end of the instruction, often just before students are tested.

   It is good to provide some format of review or summary at the end of the lesson before the students are ready to take their assessment. This helps them remember the content that was taught earlier and also helps them reflect on what was learned in the lesson.

   In an e-lesson review can be provided as a summary page, a table with the outline of the content provided, a concept map of the lesson, and also main points highlighted from the lesson.
Review

Computer

It is a machine that performs calculations
It has hardware (physical components) and software
It has four types of hardware components: input, processing, storage and output
It responds to a set of instructions

IPSO

Input – Data goes in
Processing – Data is processed
Storage – Data is stored
Output – Data comes out

Input Devices

<table>
<thead>
<tr>
<th>Device</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Keyboard</td>
<td>Sends messages by pressing keys</td>
</tr>
<tr>
<td>Mouse</td>
<td>Sends data by clicking</td>
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<tr>
<td>Joystick</td>
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<td>Touch sensitive screen</td>
<td>Interacts by touching the screen</td>
</tr>
<tr>
<td>Light screen</td>
<td>Draws directly on the screen</td>
</tr>
<tr>
<td>Digital cameras</td>
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</tr>
<tr>
<td>Voice data entry</td>
<td>Accepts spoken word as input data</td>
</tr>
</tbody>
</table>

8. Design Assessment aligned with objectives

Assessment should help you assess how well students can perform each objective. It helps you find out whether the students learned what was intended and how well they learned it. When writing the assessment items, the two things that you need to consider are, 1) Does the assessment item and procedures require the same performance of the student as that specified in the instructional objective? 2) Does the assessment item provide the same conditions or givens as
those specified in the instructional objective? Assessment items should be clearly written so that students understand exactly what is required (Sullivan & Higgins, 1983).

In an e-lesson, depending on the instruction, assessments could be a posttest, or an alternative assessment such as a portfolio, or project.

<table>
<thead>
<tr>
<th>Assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>The physical components from which a computer is constructed (electronic</td>
</tr>
<tr>
<td>circuits and input/output devices) are known as</td>
</tr>
<tr>
<td>- Software</td>
</tr>
<tr>
<td>- Hardware</td>
</tr>
<tr>
<td>- CPU</td>
</tr>
<tr>
<td>- Memory</td>
</tr>
</tbody>
</table>

Which of the following is called a "point and click" device?

- Magnetic reader
- Optical mark reader
- Mouse
- Digital camera

9. Identify Instructional Media/Technology

Selecting the appropriate media and technology that can be used in the instructional material is extremely important. Care should be taken not to select media just because they are available. The majority of instructors use media that are “off the shelf,” that is, ready-made or easily accessible. However, the purpose of the media selection process is to determine the “best” medium. Choosing the right medium should result in an efficient and effective learning process.

Media should be selected based on different criteria such as learning outcome, instructional strategy, learner characteristics and instructional setting. Hence aligning the media used based on the other instructional elements is important. The purpose in media/technology selection should not be to show the mastery of the technology, but to select media that will best magnify learning.
E-lesson is an instructional media by itself, however care should be taken to insert multimedia such as graphics, animations, audio along with the textual elements in the e-lesson.

<table>
<thead>
<tr>
<th>Instructional Media</th>
</tr>
</thead>
<tbody>
<tr>
<td>Self-designed and developed web-based lesson for beginners in computers.</td>
</tr>
</tbody>
</table>

10. Identify Instructional Strategies

Instructional strategy for course delivery is the approach used to present information in a manner that achieves learning and performance. Approaches include face to face delivery, blended or hybrid delivery, computer/web based lessons, tutorial, gaming, simulation, etc. Some of the aspects of the instructional strategies include the order of presentation, level of interaction, and testing strategies. Some of the commonly used instructional strategies are lectures, self-directed learning, case study, projects, demonstrations, discussion forums, co-operative or collaborative setting, and small group activities.

A variety of learning technology tools/learning management systems are available in the market today and makes it easier for the instructional material to be delivered online or in a blended setting. Even most of the face to face classes use learning management systems as a supplement to deliver the course material. With the presence of rich learning environments, it is important to consider which instructional strategies can best be utilized for different delivery options. Just as in the traditional classroom, instructional strategies are most effective when employed specifically to meet particular learning goals and objectives. Hence the alignment between the instructional strategies and the other instructional elements is critical.

<table>
<thead>
<tr>
<th>Instructional Strategies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Online web-lesson with visuals of the hardware of the lesson. An animation of the IPSO cycle will be provided.</td>
</tr>
</tbody>
</table>
VII. Importance of Instructional Alignment

*What is Instructional Alignment?*

Instructional Alignment is the process by which the different instructional elements are connected to each other and in the end make the instructional material effective. For example, it is important to align the goals with the objectives in the lesson. The instructional objectives have to be aligned with the information, examples, practice/feedback and review. The instructional media and strategies have to be aligned with all the different elements.

If these steps are aligned with each other the quality of instruction designed is higher. Alignment within the instructional elements is commonly mistaken with curriculum alignment, which is aligning curriculum with standards. Instructional alignment can also be defined as aligning curriculum with appropriate goals, objectives, content, teaching strategies, and assessment. This paper describes two types of design models that were used in the creation of instructional material on Digital Visual Literacy. This work was supported by the National Science Foundation Grant No. 0501965 for Advanced Technical Education.

The Matrix model proved to be more effective in the design of material with instructional alignment. In both cases, faculty were given a template to help them in creating an instructional module. The five main elements objectives, information, practice with feedback, and assessment were listed on both the template and the matrix. Described below are the two design models that the faculty used for the design document.

*Design Process 1 (Top-Down Model)*

In the first process, the design document had the title, an overview of the course, learning objectives, instructional information, related activities, practice activities and feedback and assessments. Each of these items was listed one below the other and the connection between each of these items with the previous item was in a top-down manner. This can be called as the top-down model.
The instructional elements were linked in a top-down manner, and the linking between the items in the elements was unclear (e.g., the relationship between objective 1 and the assessment item connected to it was unclear). Instructors design the outline in a top-down manner. They write the objectives and then think about information, related activities, practice and assessment. However, they do not link each of the items with one another. So there is no proper alignment between each of these elements.

**Design Process 2 (Matrix Model)**

In the second process, the design document is in the form of a matrix. The instructional elements (objectives, information, practice/feedback and assessment) are listed as columns and the objectives are filled as rows. Due to lack of space, the matrix can be transposed such that the instructional elements can be listed as rows and the objectives are listed as rows.
Here in this model, the goal of the instructional program is first listed on the top. The matrix can be filled either by rows or by columns. In either way the alignment between the elements are still maintained. Some instructors choose to enter the objectives first, and then proceed to the second column where they enter the information. But while doing so, they make sure that the alignment between the objectives and the information is maintained. This process is continued with the practice activities and the assessment items.

Other instructors choose to do one objective at a time. They list the objective, enter the aligned instructional material and then the practice activities and assessment for that particular objective. Then they continue in the same manner for the other objectives. For information, most of them had an outline of slides or handouts or other material that they had designed. It was advised that the practice activities that they design be aligned with the assessment type. Example, if an excel project was the final assessment, then a practice excel activity was used as the practice item. It was advised to provide feedback on the practice activities before the students were assessed. This made it possible for the students to correct their understanding of the concept. Assessments were well aligned with the objectives and normally came with a clear rubric for grading.
**Instructional Design Matrix**

### Objective 1

<table>
<thead>
<tr>
<th>Goal</th>
<th>Students will be able to explain what computers do and how they work.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Objectives</td>
<td>Describe the concept of the input operation in a computer.</td>
</tr>
<tr>
<td>Information</td>
<td>A computer accepts data that are provided by means of an input device. Peripherals used to transfer data from the outside world into a computer system are called Input devices. Input devices let users enter commands or data into the computer. Most familiar is the keyboard. Information typed at the keyboard is manipulated by the computer program to perform a specific action or to enter text into a document.</td>
</tr>
<tr>
<td>Examples</td>
<td>Keyboard is the most common input device of a computer. Pressing the keys on the keyboard sends messages to the computer. It consists of number keys which send numerical information, letter keys which send text information, and additional function keys for control purposes.</td>
</tr>
</tbody>
</table>
| Practice | Practice item #3 A peripheral used to transfer data from the outside world into a computer system is called  
- Input device  
- Processing device  
- Storage device  
- Output device |
| Feedback | Input device is correct |

### Input Devices

<table>
<thead>
<tr>
<th>Input Devices</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Keyboard</td>
<td>Sends messages by pressing keys</td>
</tr>
<tr>
<td>Mouse</td>
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<tr>
<td>Joystick</td>
<td>A rotary lever and used in computer games</td>
</tr>
<tr>
<td>Digitizing tablet</td>
<td>Pointing device which inputs drawings</td>
</tr>
<tr>
<td>Touch sensitive screen</td>
<td>Interacts by touching the screen</td>
</tr>
<tr>
<td>Light screen</td>
<td>Draws directly on the screen</td>
</tr>
</tbody>
</table>

### Assessment

**Assessment item #6**

Which of the following is called a “point and click” device?
### Instructional Design Matrix – Example - Know your Computer Module

<table>
<thead>
<tr>
<th>Objective 1</th>
<th>Objective 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>☐ Magnetic reader</td>
<td>☐</td>
</tr>
<tr>
<td>☐ Optical mark reader</td>
<td>☐</td>
</tr>
<tr>
<td>☐ Mouse</td>
<td>☐</td>
</tr>
<tr>
<td>☐ Digital camera</td>
<td>☐</td>
</tr>
</tbody>
</table>

**Instructional media**
- Graphics, Simulation of the Computer

**Instructional strategies**
- Web-based lesson – [http://www.florencemartin.net/kyc](http://www.florencemartin.net/kyc)

*Figure 4. Instructional design matrix – Completed*

*Note: If this matrix is designed in excel, it can be transposed such that the objectives are rows and the instructional elements are columns. Due to the lack of space, they are formatted in the other direction here.*

**Faculty Perception on the importance of Instructional Elements**

A 26 item survey was sent to a group of faculty at a major community college in the United States to find out the effectiveness of the revised ID matrix. The survey questions are included in the results section.

**Method.** 32 faculty from a major community college participated in the survey. The survey had 26 questions and the faculty were asked to rate it on a Likert Scale of (4= Strongly Agree, 3= Agree, 2= Disagree, 1=Strongly Disagree). Descriptions of each of the instructional elements along with a sample instructional design matrix were provided in the survey to help the faculty answer the questions. The survey had two categories of questions A) How important it is to design each of these instructional elements? B) Do they currently design these instructional elements in their lessons?

**Results.** The survey results are tabulated below (Table 1).
<table>
<thead>
<tr>
<th>A. Instructional goals</th>
<th>Importance of the items</th>
<th>I design them</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Instructional goals are important in the design of instruction.</td>
<td>3.91</td>
<td></td>
</tr>
<tr>
<td>2. I start designing my lessons by identifying the instructional goals.</td>
<td>3.61</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>B. Instructional objectives and sequencing</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>3. Instructional objectives are important in the design of instruction.</td>
<td>3.88</td>
<td></td>
</tr>
<tr>
<td>4. I design instructional objectives for my lessons.</td>
<td>3.45</td>
<td></td>
</tr>
<tr>
<td>5. Sequencing instructional objectives are important in the design of instruction.</td>
<td>3.50</td>
<td></td>
</tr>
<tr>
<td>6. I also sequence the instructional objectives after I have designed them.</td>
<td>3.39</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>C. Instructional material (information)</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>7. It is important to design Instructional material (information) for all the objectives.</td>
<td>3.42</td>
<td></td>
</tr>
<tr>
<td>8. I design information material needed for all the objectives.</td>
<td>3.07</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>D. Examples to support instructional material.</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>9. It is important to support the instructional material with aligned examples.</td>
<td>3.72</td>
<td></td>
</tr>
<tr>
<td>10. I design examples for the information provided in my lessons.</td>
<td>3.40</td>
<td></td>
</tr>
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<table>
<thead>
<tr>
<th>E. Practice activities</th>
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<tbody>
<tr>
<td>11. It is important to support the instructional material with aligned practice activities.</td>
<td>3.81</td>
<td></td>
</tr>
<tr>
<td>12. I design practice activities for the information provided in my lessons.</td>
<td>3.48</td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>F. Providing Feedback</th>
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<tbody>
<tr>
<td>13. It is important to support the instructional material with feedback for the practice activities.</td>
<td>3.66</td>
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<tr>
<td>14. I design feedback options for the practice activities in my lessons.</td>
<td>3.27</td>
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<tr>
<td>G. Reviewing the key points in the instructional material</td>
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<tr>
<td>15. It is important to review the key points in the instructional material.</td>
<td>3.72</td>
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<tr>
<td>16. I design review for the key points in the lessons.</td>
<td>3.27</td>
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<tr>
<td>H. Assessment aligned with objectives</td>
<td></td>
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<tr>
<td>17. It is important to design assessments aligned with the objectives in the instructional material.</td>
<td>3.78</td>
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<tr>
<td>18. I design assessments aligned with the objectives in the lessons.</td>
<td>3.30</td>
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<tr>
<td>I. Selecting Instructional Media/Technology</td>
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<tr>
<td>19. It is important to select the appropriate media/technology that can be used in the instructional material</td>
<td>3.78</td>
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</tr>
<tr>
<td>20. I select appropriate media/technology that can be used in the instructional material.</td>
<td>3.48</td>
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<tr>
<td>J. Identify Instructional Strategies for Course delivery</td>
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<tr>
<td>21. It is important to select Instructional strategies that are most effective.</td>
<td>3.78</td>
<td></td>
</tr>
<tr>
<td>22. I select appropriate instructional strategies that make my lessons most effective.</td>
<td>3.45</td>
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<tr>
<td>K. Instructional alignment</td>
<td></td>
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<tr>
<td>23. It is important to align each of these ten instructional elements with each other.</td>
<td>3.60</td>
<td></td>
</tr>
<tr>
<td>24. I align the different instructional elements with each other in my lessons.</td>
<td>3.33</td>
<td></td>
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<tr>
<td>L. Instructional design matrix for instructional alignment</td>
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<tr>
<td>25. The instructional design matrix helps in aligning the instructional elements in the lesson.</td>
<td>3.48</td>
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<tr>
<td>26. I would use the instructional design matrix to help me provide alignment in my lessons</td>
<td>3.28</td>
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</tr>
<tr>
<td>Mean</td>
<td>3.69</td>
<td>3.37</td>
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</table>
The mean of all the 26 items were (M=3.53). The mean of the items that were rated on the basis of importance was (M=3.69) and the mean of items that were rated if they used it in designing their lessons was (M=3.37). The importance of instructional alignment was rated at (M=3.60) and faculty response average for using it in the design of instruction was rated at (M=3.33). All the items were rated important and faculty mentioned using most of the instructional items in designing their lessons.

Discussion. The importance of these items were once again stressed by the faculty, even though some of them agreed that they have not used it in the design of the lessons to the extent they thought that it was important.

Implications. This research has implications for the design and development of all types of instructional material (print based, computer based). The important elements of the design process have been pointed out and also the importance of alignment between these instructional elements has to be kept in mind in the design of instructional material. Using the matrix model in the design process saves much time and makes the instructional material more effective compared to just using the top-down approach in the design of instruction.

VIII. Summary
Expertise of the Author (Florence Martin)

Author Biography

Florence Martin is an Assistant Professor in Instructional Technology at the University of North Carolina, Wilmington. Currently, she is also a co-principal investigator on the Digital Visual Literacy NSF grant working with Maricopa Community College District in Arizona. She has a bachelor's degree in electronics and communication engineering from Bharathiyar University, India, and a master's degree and a doctorate degree in educational technology from Arizona State University. She has worked with University of Phoenix, Cisco Learning Institute, Intel and Arizona State University and has expertise in instructional design, performance technology, corporate training and distance learning. She is interested in the research areas of instructional elements, instructional alignment, multimedia design and development, process and performance improvement, learning management systems and virtual classrooms. http://www.florencemartin.net

Expertise on elements of lesson design

My doctoral dissertation was to study the effects of instructional elements in computer based instruction. I also conducted a pre-dissertation study and a post-dissertation study along the same line. I’ve attached the study published in BJET for more detailed reading.

I’m also researching on instructional alignment in lesson design. I implemented an instructional design matrix in the design of instructional modules in the digital visual literacy NSF project, and it was a big success. This has been submitted to a journal for review.

References to related work


References of the articles cited
I will provide references of the articles cited.