

**Conceptual Interview:  
Basic Drawing Setup for AutoCAD Drawings**

**Computer Aided Design**

The CAD Design Technician course is a one-year 1200 hour course designed to deliver instruction for entry-level employment in the fields of Architectural and Mechanical design. The course covers formatting, drawing, and presentation of CAD drawings. The first part of the course establishes a foundation for starting and developing industry standard drawings. Basic Drawing setup is the main framework students learn to understand all the parts of a drawing and the proper formatting. Instruction focuses on illustrating that all CAD drawings are basically a collection of line work and annotations. Guidelines are established as a process or work flow addressing the changes that need to be made to a drawing's format settings. The intent of the two Think-Aloud interviews is to reveal students' understanding of the first five steps of Basic Drawing Setup and related concepts.

The steps to follow for Basic Drawing Setup are: 1) Select a drawing type, 2) Set the units, 3) Determine the Scale, 4) Determine the scale factor, 5) Determine the sheet size, and 5) Set the Limits. The order represents a best practice work flow, but is not rigid and can be performed in any order. The key concepts to know are what scale and on what paper size the drawing will eventually be printed. These concepts will provide the additional information needed to proceed and

make changes to the drawing's formatting. First, the drawing type determines if a drawing will be an Architectural or Mechanical drawing. The units determine the unit of measurement. The scale is a standard ratio of the printed drawing to the actual model, and the scale factor is the amount a drawing is reduced or enlarged to fit on a piece of paper. The scale factor is determined by dividing the model units by the paper units. The sheet size is the intended paper size output for the drawing. This sheet size has a length and width to be represented in the computer. Finally, the Limits are the representation of the sheet size in the computer. The limits are two coordinates (x,y) that are determined by multiplying the length and width of the sheet size by the scale factor. The resulting length and width represent the (x,y) coordinate of the limits. Once these initial settings have been made, any drawing can be correctly drawn and represented to a standard scale.

The CAD class instructs both Young Adult (Ages 16-18) and Adult learners (Ages 18-65). Students selected for the interview include a male Young Adult learner and a female Adult Learner. The interviews were conducted in my office at a typical CAD workstation. The students were allowed to make notes and use the computer to recall the steps for Basic Drawing Setup. The interviews were conducted following lectures, discussions, and a test on the parts of Basic Drawing setup.

The female Adult learner was not able to recall all the steps, and had trouble with terms. She did indicate at the beginning that she did not do well at taking

tests and was nervous, but still wanted to participate. I let her know that the goal of the interview was to get an understanding of how students think about Basic Drawing Setup, and that her responses would not be graded. Despite her nervousness, she was able to use pencil and paper as well as the computer to describe the concepts and procedure for Basic Drawing Setup. As she began, she used the computer to navigate to the formatting menu to select Units, then the Limits. She overlooked scale, scale factor, and sheet size. She did however, use pencil and paper to correctly calculate the scale factor and then later the limits. She did have difficulty describing scale factor and how it was used to determine the limits, but was able to complete the steps. So although her responses did indicate some hesitation and confusion on procedure, it is clear that she understands the basic framework.

On the other hand, the male Young Adult learner was able to recall all the steps but had some difficulty with their order and underlying concepts. He started with Units and then went right into Limits, overlooking scale, scale factor, and sheet size. As he recalled the steps he used the computer to navigate through the menus, but once he got to Limits, he realized he was missing some information. At this point he gave an example of scale and sheet size so that he could determine a scale factor and then the Limits. When asked to elaborate on scale he had some difficulty giving a definition for the term, but still correctly determined the scale factor and drawing limits.

## **Research in Education**

Examining the transcribed interviews, it is clear that both students can recall the steps for Basic Drawing Setup, but still demonstrate some difficulties with the underlying concepts and their order. Nonetheless, each was able to perform the steps and make the correct calculations. It is interesting to note, however, that the part both had difficulty with was the part of Drawing Setup that is "invisible." Neither scale, scale factor, nor sheet size are obvious in the formatting for CAD drawings. These are concepts that relate to hand-drafting, and are not actual dialog boxes with selectable values. Some thought has to be made as to what these settings should be based on the actual object to be drawn. Determining the scale and sheet size is looking forward to the ultimate output of the drawing, and nowhere in the computer is this explicit. Understanding how scale, scale factor, and sheet size affect a drawing's formatting reflects a student's own knowledge construction of the concepts and procedures and how to adapt to a variety of scales and sheet sizes for the representation of designs. These are critical skills that are essential to entry-level CAD drafters.

Conducting these interviews has provided me with insight into a student's understanding of the Basic Drawing setup framework. Instruction for this part of the course could be improved by providing more clarity to scale, scale factor, and sheet size. Based on these findings, I may have to make some adjustments to my development project. In order to clarify these concepts, I will try to incorporate animations rather than just text to illustrate these concepts graphically to see if

this can clear up some confusion. I think it will also be necessary to provide some problem-solving exercises so that students can apply their understanding under different conditions. In all, this was a very informative exercise because it allowed me to see the differences between learners of different age groups, and pointed to areas of instruction that could be improved.

## Interview #1

(C) Cindy, Basic Architectural, female Adult Learner

(Me) Based on the lectures and discussions on Basic Drawing Setup, recall the first five steps for the proper formatting of a file, describing each step as you go.

(CW) I may forget one or two, but let's see..umm..[pausing, checking the pull down menu for formatting] First thing is to open your drawing and select- if you are doing Architectural, select Architectural dimensions...

(Me) So what is this referring to, what aspect of formatting is this referring to?

(C) Units, basically

(Me) Great.

(C) Then you want to uh...calculate your uh..[scribbling down numbers on a piece of paper] your scale factor, so that you can then get your limits, and set up your paper or your model.

(Me) Ok so we have step one: setup your units, then step two would be?

(C) [gesturing in front of the computer, using her hands to draw in space] I'm trying to think of this as if I were in the drawing and how I would set it up.

(Me) It's ok, take your time.

(C) You set the scale factor.

(Me) How do you determine the scale factor?

(C) It's the model space over the paper space. So you have your scale factor of say 1/4 inch. [writes down on a piece of paper:  $1/4" = 1'-0"$ ] You get your scale factor multiplying that [writes 4x12 below her first notes and points to the result of 48]. So that 1/4 inch would be 48, 3/16 inch would be 64. And then you would multiply that by the paper size [writes on piece of paper: sheet size is 17x11, then writes 48x17 and 48x11]. And that would give you your limits.

## Interview #2

(T) Taylor, Basic Mechanical, male Young Adult Learner

(Me) What would be the first five steps to Basic Drawing Setup? Describe the steps as you go along.

(T) You would change your units, and then you would...

(Me) What do the units represent?

(T) Like inches or feet...

(Me) OK, once you figure out what units you're working with, what would you do next?

(T) You go into text styles and change the text..and dimensions

(Me) How would you know how to change your text and your dimensions? Is there another part of the drawing before this that you would have to set up?

(T) Yup..You have to change your limits.

(Me) What information do you need in order to define your limits?

(T) Type in "limits." Then specify your lower left corner, which is (0,0) and whatever your scale factor is you have to....Well let's say you have a scale factor of 1, then you have to uh..

(Me) You mentioned scale factor. What is scale factor?

(T) Scale factor? Scale factor is the.....

(Me) How would you figure out the scale factor?

(T) Scale factor is...well if the scale is 1:4, the scale factor is 4. So it's the..

(Me) What does that mean: 1:4?

(T) It means that one unit on the paper is four units in the computer.

(Me) Ok, so how do you determine the scale factor?

(T) The model units divided by the paper units.

(Me) And that's telling you what?

(T) How much it has to be reduced or enlarged to fit on the paper.

(Me) Ok so you set your units, determined a scale, scale factor, now what?

(T) [whispering to himself, repeating] Scale factor, units, then you can...go in and then start changing your text and dimension styles.

(Me) You mentioned, drawing limits, right?

(T) Drawing limits! Ok,so like the scale can be 1:2, and the paper size is 8.5x11, so you would take the scale and find the scale factor, which is 2, and multiply 2 by the sheet size, so it would be 17 x 22....

(Me) So you are multiplying the scale factor by the two sides of your sheet size? And that represents what?

(T) That represents the drawing in the computer- what you'll be drawing on.

(Me) And what do you call this?

(T) The coordinate.

(Me) The result is a coordinate, but the coordinate represents what?

(T) The model size. The drawing limits.

September 4, 2008

Dear Parents/Guardians

Hello, my name is Mr. Inchaurregui and I am your child's CAD instructor. I am currently conducting research to study the effectiveness of multimedia tutorials and their correlation to student achievement. As part of my thesis, I will be learning about the students' experience with these tutorials by conducting surveys and interviews.

Before I begin this study, I need your permission to select your child as a participant. In the next few weeks, I will be presenting multimedia tutorials, making observations, and surveying selected students. I will collect all survey data in the classroom with secure digital forms. I will be personally responsible for making observations on a daily basis and keep all test scores, classwork, and personal information confidential.

The goal of this research is to determine how students are using the materials, whether the content is useful or not, and attitudes about the general design and ease of use. By allowing you child to participate in the study, you are making possible improvements to the learning process for computer aided design. Please support this effort to increase student motivation and success.

Please affirm your permission by using the checkboxes below. I can be reached for more information at [corecreator@gmail.com](mailto:corecreator@gmail.com) or at 818-445-0014

Sincerely,

Julian Inchaurregui  
CAD Instructor  
CAD/ Design Technician Program  
Education & Career Center, West Valley Campus

Please indicate below your decisions regarding the various parts of this research project:

I give my permission for the items checked "Yes" below:

\_\_\_\_\_  
(Print Student's Name)

\_\_\_\_\_  
(Print Parent/Guardian's Name)

\_\_\_\_\_  
(Parent/Guardian's Signature)

\_\_\_\_\_  
Date

Yes

No

\_\_\_\_\_      \_\_\_\_\_      I approve my child's participation in this research.

\_\_\_\_\_      \_\_\_\_\_      I approve interviewing of my child.

\_\_\_\_\_      \_\_\_\_\_      I approve observing and recording my child's work