

An Alternative Way To Teach Construction Terminology

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Introduction

In many courses the terminology must be introduced and explained before moving on to other topics. How to approach this varies by the instructor, the course, the text being used and the difficulty of the terminology. It is important to not only understand the meaning of a term but how it relates to other terms that are being discussed. The technique presented in this paper uses a modified version of a method that assists people to remember names: name association. In that method the person employing it uses some characteristic or distinctive feature of the individual to assist them in remembering the name. In the technique presented in this paper, used to remember construction terminology, it can be the individual who defines that term, the definition that was presented by the individual or the relationship to other terms that assists in remembering the term. Results of using this technique are compared to a traditional lecture method using the same terms. Discussion of the technique, an alternative to traditional lecture, is presented.

Course Background

CE3332, Fundamentals of Construction Engineering, is a three credit class open to sophomores that is required for all Civil Engineering students in Civil and Environmental Engineering (CEE) at Michigan Technological University (Michigan Tech). Typical enrollment is 60 students. Many students have had limited exposure to construction so their understanding of industry terminology may be limited. In order to bring students to some level of understanding there has to be some terminology introduced. In addition to the Civil Engineering students taking the class, there are usually some students from other areas such as, Environmental Engineering, Geological Engineering, Mechanical Engineering, Electrical Engineering, Chemical Engineering and Business. Many of these non CEE students take the class because they are interested in construction, have worked in construction, or plan to work in the industry. This wide range of students and varying levels of experience necessitates an understanding of terminology early in the course. The technique presented in this paper is done during the third and fourth lecture periods to help facilitate that understanding.

As this may be the only construction course that many Civil Engineering students at Michigan Tech take, it was decided that the course should cover a broad range of topics that Civil Engineers would need to know. As a result there are many topics covered that may have a course dedicated to them in other programs. These topics include a construction overview,

contracts, cash flow, equipment ownership, equipment productivity, estimating, planning , scheduling, quality and safety. The textbook in use at the present time is *Construction Management, 3rd Edition* (Halpin, 2006).

Description of Technique

The technique works best when the class meets in a room where everyone can face each other as shown in Figure 1. The chairs are arranged in a circle so all students face each other and makes everyone an equal participant and equal distance from the instructor versus the traditional classroom where students in the front may be considered more accessible to the instructor than students further back.



Figure 1 Circle of Students during Technique

During the lecture preceding the exercise the students are reminded to read the assigned chapters from the textbook as the terms can be found in the text. As students come to class the day of the exercise they are handed a sheet with the terms listed as shown in Figure 2. Once the majority of students have arrived, the instructor has students start counting off from one and working around the circle until the counting reaches the number of terms in the list. As shown in Figure 2 the count ends at 38. Since there are 60 students the counting starts again at 1 and continues until all students have been assigned a number. Students that are assigned the same number work with each other to complete the exercise. Any late arriving students are added to the end of the count.

Once students have been assigned a term they are instructed to define their term in the space provided at the bottom of Figure 2 and list other terms that it relates to. Usually ten to fifteen minutes is sufficient for this. Students are permitted to use their texts if they have brought them. Some students are unable to define or relate their term and instructor assistance is provided.

When students have finished defining the terms and identifying related terms the exercise begins. The question is posed by the instructor as where do we begin. Usually, one student is courageous enough to start and is rewarded by not having to relate their term to another since they went first. The instructions in Figure 2 state that they are to relate their term to the preceding term. After a term is defined the instructor may have to clarify or put into context the

term as rarely is the definition or relationship provided by the students perfect. In many instances the instructor tries to “coach” the students to assist in this clarification. Once the instructor is satisfied that the term is satisfactorily defined the following question is posed to the class: Who wants to define their term next? The first few terms are difficult to get anyone to volunteer but as students become familiar with the procedure there are more volunteers. Since the instructor does not know which terms students have they are selected at random from those that volunteer to be next. The next student must define the term and explain how it is related to the previous term.

In Class Terminology Exercise

1. Design Build	2. Retainage
3. Construction Management	4. Payment Bond
5. Lump Sum Contract	6. S-Curve (Not the one in Grand Rapids)
7. Unit Price Contract	8. Contract Agreement
9. Negotiated Contract	10. Bid Bond
11. Acceptance Period/Withdrawal	12. Progress Payments
13. Notice to Proceed	14. Project Delivery Systems
15. Time Extension	16. Competitively Bid Contracts
17. Change Order	18. Responsible Bidder
19. Performance Bond	20. Cost + % of Cost
21. Value Engineering	22. Public Work
23. Liquidated Damages	24. Private Work
25. Phased Construction	26. Penalty
27. Mobilization	28. Unbalancing a Bid
29. Acts of God	30. Guaranteed Maximum Price
31. Notice to Bidders	32. Constructability
33. Design – Bid – Build	34. Addenda
35. CM@Risk	36. Substantial Completion
37. Changed Condition	38. Punch List

After being assigned a number write the definition of your term below. Identify which term(s) it is related to. Be prepared to present your definition and how it relates to the term defined immediately preceding. The order of presentation will be determined as the discussion develops.

Figure 2 List of Terms Used in Exercise

An “ideal” progression through the list of Figure 2 might be: Project Delivery Systems, Design – Bid – Build, Design Build, Construction Management, and CM@ Risk. This could then be followed by the different types of contracts such as: Lump Sum, Unit Price, and Negotiated. However, “ideal” rarely happens and the progression through the list is at times unrelated. After hearing the student’s reasoning about the relationship the instructor may or may not agree. In these cases clarification may be necessary. In some cases the instructor will tell students that they should have gone at some different point of time (i.e. after some other term). Since the process of selecting students is random the opportune time may have passed for a term to be related. Usually there are several terms at the end of the exercise that are not related to the immediate previous term. The instructor asks the student defining/relating the terms what would have been a better point in time for the term to be defined.

Evaluation

Two methods of evaluation of student understanding have been done. One is to make the initial definition an assignment in the class. Each student is given two copies of Figure 2: one to keep for themselves and the other to turn in and be graded. Another method is to have students write a paragraph on the exam using the terms from Figure 2. This exam question is shown in Figure 3. A variation on the exam question is to provide all of the terms in Figure 2 and have the students select 8 or 10 terms to write in a paragraph. The intent of these questions is to see how well the students can relate the terms. This is accomplished when students understand the definitions in addition to the relationship the terms have to each other. The use of a figure was suggested as it may assist them in answering the question. Concept maps were included since some students may be able to visualize the solution. Trochim (1993) describes concept mapping as “...a process that can be used to help a group describe its ideas on any topic of interest.” .

In the Fall semester of 2006 there was an opportunity to evaluate the method presented in this paper as two sections of CE3332 were taught by the same instructor. In one section the above method would be utilized and in the other section a more traditional lecture would be delivered. In the morning section the students received the form in Figure 2 while the afternoon section received a list of the words with the words arranged in a order similar to the sequence on a construction project. Each class spent a little over two class sessions on this lesson.

On the exam the students were asked the question shown in Figure 3. This question was worth 15 points on a 100 point exam. The “school” solution to the question is:

Design Build, Design-Bid-Build, Construction Management, and CM@Risk are all Project Delivery Systems. Within these systems there are different contract types that can be used. These include Lump Sum, Unit Price, and Negotiated. Within Negotiated Contracts there are Guaranteed Maximum Price and Cost plus % of Cost.

One point was given to each of the ten terms, two points were for identifying the relationship between Project Delivery Systems (PDS) and the opportunity to use various contract types, and three points were given for following the instructions of the questions for a total of 15 points. Very few points were deducted for not following instructions. Many students did not directly answer the question but defined the terms in addition to relating them. No points were deducted

for this. When students defined all of the terms it did take additional time and left them less time to complete the other questions on the exam. Figures and concept maps were rarely used to help in answering the question.

The following is a partial list of terms that was provided to you in class and discussed in class. Using the 10 terms correctly write a short paragraph that categorizes/classifies these terms and relates the categories/classifications. This paragraph must be comprehensible and the flow must make sense and be correct. Use the space below. **Underline** the **terms** in your paragraph. A figure or concept map may be used to supplement the text.

a) Design Build	b) Negotiated Contract
c) Construction Management	d) Design – Bid – Build
e) Lump Sum Contract	f) CM@Risk
g) Unit Price Contract	h) Project Delivery Systems
i) Cost + % of Cost	j) Guaranteed Maximum Price

Figure 3 Exam Question

Various exam scores are shown in Table 1. There is only a slight difference between the section scores. It was anticipated that the students in the morning section would perform better. However, the preliminary analysis shows no significant difference. Further analysis of the data is being done to determine if there is any difference in student performance as a result of the method of presentation.

Table 1 Results from Exam Question in Figure 3

	AM	PM
Number of Students	58	56
Average on Question Shown in Figure 4	11.86/15	11.50/15
Standard Deviation of Above	2.45	2.50
Identified PDS/Contract Types Relationship	19	13
Exam Average	79	78

Modification of Exercise for Use in an Estimating Class

A modification of this technique is used in CE4333, Estimating, Planning and Control. CE4333 is a senior elective in Civil Engineering. The topic being covered at the time of this exercise is the contractor's decision to bid on a project. The modification is that the students do not define the term but they tell a story that builds upon what was said earlier. The sheet that the students receive when entering class is shown in Figure 4. Usually the story gets fairly outrageous but the understanding of the terms is enhanced by the exaggeration of the students. If an instructor were hesitant to do this in class they could easily adapt it and define and relate terms as discussed earlier.

Define your term in the context of a contractor's "decision to bid". **Circle** the term you are defining.

1. Bidding Time/Bid Date	2. Surety Bond/Bonding Capacity
3. Management Personnel	4. Cost of Bidding
5. Business Plan	6. Other Projects to Bid
7. Equipment	8. Supervision
9. Finances/Cash Flow	10. Project Delivery System Used
11. Competition	12. Relationship of Parties
13. Risk	14. Contract Conditions
15. Quality of Documents	16. Suppliers
17. Subcontractors	18. Location of Work
19. Prequalification	20. Licensing
21. Economy	22. Estimating Team
23. Completion Date	24. Type of Contract
25. Owner	26. Time of Year
27. Labor Force	28. Project Financing
29. Profit	30. Complexity
31. Type of Work	32. Size of Project

After forming groups (if necessary) of two, write the answer to your term below on both papers. Turn one in, save the other to use for discussion. You will need to integrate your term into a **story**.

Figure 4 Terms used in an Estimating Class

Summary

This paper presented a modified name association technique to teach terminology in a construction engineering course. The technique has student not only defining the terms but relating them to other terms to assist comprehension. The results of comparing the technique presented in this paper to a more traditional teaching method showed only a slight difference in the performance of students on an exam question. Currently further analysis of the data is being performed to compare the results of student understanding using the technique described in this paper compared to a traditional lecture of terminology. These will be reported in a later paper.

Note: The first time that the author did this exercise in class was very unsettling as the instructor relinquishes control of the class. However, the experience has truly been rewarding and the author is unsure who enjoys this exercise more: the students or the instructor. There is generally considerable laughter during these exercises and the author believes that laughter enhances the learning experience.

References

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