AC 2009-152: TOWARD ELIMINATING AN UNSUPPORTED STATEMENT IN ENGINEERING EDUCATION RESEARCH AND LITERATURE

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Toward Eliminating An Unsupported Statement In Engineering Education Research And Literature

***Keywords*: learning styles, citation accuracy, learning cone**

Abstract

What evidence exists to support the commonly used STATEMENT that people remember: 10% of what they read; 20% of what they hear; 30% of what they see; 50% of what they hear and see; 70% of what they say; and 90% of what they say as they do a thing? The first archived occurrence of the STATEMENT emerges in a trade magazine article by Treichler (1967). The present paper provides a critical review of this unsupported STATEMENT and its proliferation. Those recent ASEE conference papers which provide a reference mostly cite Stice (1987), either directly or indirectly through Felder and Silverman (1988). Some authors do not provide a reference, but perhaps worse yet are those authors who erroneously cite Dale or Glasser as the source. In 2003, Subramony refuted the connection between Edgar Dale's Cone of Experience and the STATEMENT. Perhaps most disturbing are those papers that not only provide an erroneous reference, but which also augment the STATEMENT with non-existent phrases such as "after two weeks, people generally remember…" A study by Lee and Bowers (1997) of students studying physics found that reading is, in fact, more important than hearing.

Introduction

Having been challenged by a member of the public—specifically a K-12 school teacher—to provide authoritative source(s) of the STATEMENT, what was envisioned as a simple search and proof would ultimately reveal a lack of evidence for the cited statistics. The STATEMENT being referred to here is that people (or students) learn (or recall/remember):

- 10% of what they read
- 20% of what they hear
- 30% of what they see
- 50% of what they hear and see
- 70% of what they say (and write)
- 90% of what they say as they do a thing

There are various forms and permutations of the STATEMENT found in published literature. This paper details the results of the quest to find support for the STATEMENT. This is not the first investigation into the source of these numbers, as a literature search reveals that Molenda essentially debunked these numbers in 2004 [1].

The STATEMENT in Literature

In this section, some of the sources of the STATEMENT are examined as well as a brief genealogy depicting its propagation through archival literature. The first occurrence of the STATEMENT seems to appear in a 1967 trade magazine article [2] by Treichler, who was affiliated with the

Socony-Vacuum Oil Co. (note that Socony is an abbreviation for Standard Oil Company of New York) which would eventually become Mobil Oil Corp. An exact replica of the information presented by Treichler is shown in Figure 1. Treichler does not provide any reference for the source of these numbers, but within the article states that these data are from "studies that indicate what people generally remember". Perhaps what should alert us to the possibility that these are contrived statistics is the fact that each number is a perfect multiple of ten and the spacing of the values is somewhat even. In fact, Treichler states "These figures, of course, are only approximate and subject to exceptions." Another questionable aspect of the retention values is whether hearing and seeing are independent with respect to memory recall since the sum of the individual percentages for hearing (20%) and seeing (30%) equals the 50% attributed to their combined mental effect.

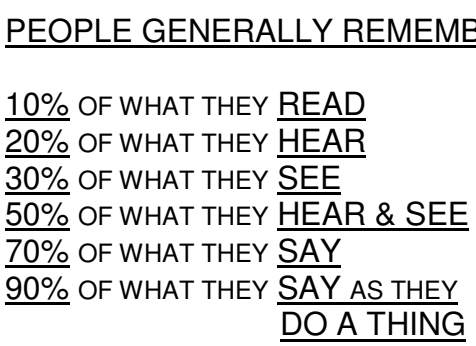

Figure 1. Original appearance of the STATEMENT in a 1967 article by Treichler [2].

An early appearance of the STATEMENT in engineering education occurs in a 1987 paper by Stice. Stice reports that the data are "from the old Socony-Vacuum Oil Company" and that "the source indicates the data are from the 1930s or 1940s, but I have no other information"[3]. One difference in Stice's paper is that "what they hear" is given a 26% retention value instead of the 20% shown earlier, but it is readily imaginable that a typographic error exists somewhere. More recently, Prof. Stice stated in an email that he received that Socony-Vacuum Oil Co. data "as a one-page handout at a workshop I attended in the 1970s at the University of Wisconsin - Eau Claire" [4]. Prof. Stice also notes that at the same workshop he obtained "a handout called 'The Cone of Learning,' as adapted by a Bruce Nyland after work done by Dr. Edgar Dale."

An example of the misconnection between the STATEMENT statistics and Dale's Cone of Experience [5] is given in Figure 2. These augmented versions of the Cone of Experience are sometimes termed the 'cone of learning'. For an actual example in archival literature of the Cone combined with the STATEMENT, see [6]. But in 2003, Subramony refuted the connection between Edgar Dale's Cone and the STATEMENT [7]. Molenda states that the misrepresentation of the Cone with the retention chart has, again, been traced to the Socony-Vacuum Oil Co. [8].

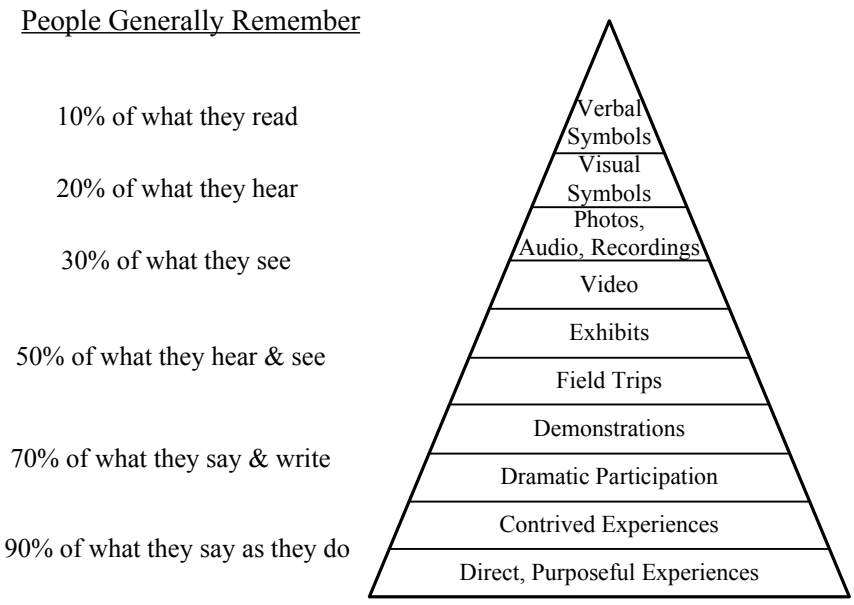

Figure 2. A representative example of the mistaken connection between Dale's Cone of Experience and the statistics quoted in the STATEMENT.

In 1988, Felder and Silverman cite the Socony-Vacuum Oil Co. statistics via Stice in a paper [9] that is more readily available in electronic format through the Internet. Perhaps the Internet is to blame for the subsequent proliferation of the STATEMENT. Not less than 35 papers at recent ASEE Annual Conferences, and other papers in various peer reviewed journals, including some in the *Journal of Engineering Education* [10,11,12,13], affirmatively repeat the STATEMENT. Note that three of the four *Journal of Engineering Education* articles cite Dale as the source of the STATEMENT. Other engineering and computer education journals are not immune to this phenomenon, for example, see [14,15,16]. Table I shows that the number of ASEE conference papers with the STATEMENT is generally increasing over time. An illustration of how such an assertion propagates through the literature is shown in Figure 3. Many of the papers citing these statistics are proponents of multimedia based education.

Of those ASEE conference papers which provide a reference, four cite Stice [3]. But some authors do not provide a reference, and perhaps worse yet are those authors who erroneously cite Edgar Dale [5] (e.g., see [11,13,17]) or William Glasser (e.g., see [18,19]) as the source. (Please note that some people mistakenly reverse Edgar Dale's first and last names, that is, his name is not Dale Edgar.) Most disturbing of all, are those papers [20] that not only provide an erroneous reference, but the authors also augment and/or embellish the STATEMENT with non-existent phrases such as "after two weeks, people generally remember…", "found that six weeks after a test", "over a period of 3 days" and "in a famous study…". Moreover, those articles of the last decade which claim that the numbers originate from "recent studies," "modern educational research" and "recent findings" become almost humorous. The percentage values from Treichler are not unique. For example, the quotation by references [21] and [22] reads "Studies have shown that people/students retain 25% of what they hear, 45% of what they see and hear, and almost 70% when they actively participate in the process", which is taken from an unreferenced anecdote in a trade

magazine [23]. These same statistics are quoted by Rickel [24], who credits them to Edwards [25]. These values are similar to those (of 20% hear, 40% see & hear, and 75% see, hear & do) presented by Eskicioglu and Kopec [26] who cited Oblinger [27], who in turn attributed the data to Fletcher [28]. Fletcher was performing a study on videodisc instruction, which was sponsored by the U.S. Department of Defense, but the actual text by Oblinger leaves one to question whether she intended to attribute Fletcher as the source of that information. Table II presents further examples of the variability of the retention statistics commonly reported.

Table I. ASEE Annual Conference Papers Positively Citing the STATEMENT

Year	No. of Papers	Specific Papers
1996	1	X[21]
1997	2	N[29], D[30]
1998	1	D[31]
1999	1	X[32]
2000	3	N[33], D[34], C[35]
2001	1	S[36]
2002	3	S[37], X[22], C[38]
2003	4	X[39], X[40], D[41], C[42]
2004	5	D[43], N[44], D[45], D[46], X[47]
2005	4	S[48], F[49], X[50], X[51]
2006	4	D[52], D[53], D[54], (D,S)[55]
2007	5	C[56], D[57], X[58], D[59], D[60]
2008	3	N[61], X[62], X[63]
Key to capital letters: (C) = uses Cone of Experience diagram with STATEMENT statistics (D) = references Dale (F) = references Felder (N) = no reference given (S) = references Stice (X) = miscellaneous references		

Table II. Variations of the Statistics Associated with the STATEMENT

Recall	Treichler[2]	Stice[3]	Eskicioglu[26,40]	Arnold[64]	McGoldrick[65]	Wade[66]
What they read	10%	10%				
What they hear	20%	26%	30%	20%	10%	10%
What they see	30%	30%	20%	40%	15%	15%
What they see and hear	50%	50%	50%		25%	20%
What they say	70%	70%				
What they say as they do a thing	90%	90%				

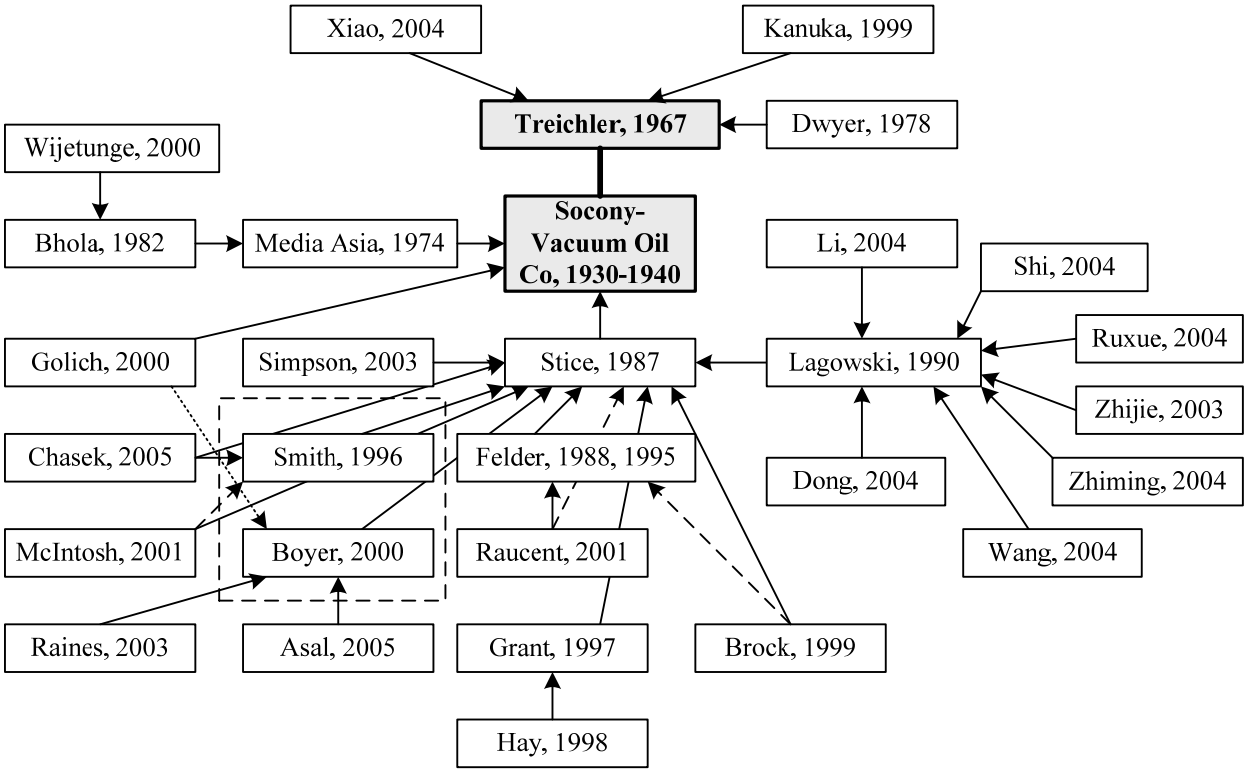

Figure 3. Depiction of the proliferation of the STATEMENT into educational literature. The dashed lines indicate information passage between papers and authors by either direct or indirect means.

In rare papers, the author simply admits that the source is unknown [67]. And of course, there are those papers which do not reference anyone in particular. One of the more interesting of these citations, taken verbatim, is "There are numerous references (outside the scope of this article) in educational journals and books that give mathematical definition to the efficacy of tutorial methods, and averaging those numbers gives us the following general statistics: 'we remember about 20% of what we hear, 50% of what we see, but 80% of what we do.' " [68].
Other disciplines are not immune to propagating the STATEMENT, for instance, the Federal Bureau of Investigation (FBI) Law Enforcement Bulletin [69] and others [70,71,72,73] (note that these latter two references actually cite Treichler).

This paper is certainly not the first to call these statistics into question. For example, in 2005 Jacobs said, "Can we trust the often cited alleged facts about memory retention, statistics which tell us, for instance, that we remember 10% of what we read, 20% of what we hear, 30% of what we see, 70% of what we see and hear, and 90% of what we see and hear when we have discovered something for ourselves?" [74]. Najjar (1996) referred to Treichler's STATEMENT as a "completely unsupported assertion" [75]. Perhaps the earliest criticism originated in 1978 from Dwyer, who stated that the reported percentages are misleading [76].

Closing Remarks

The purpose of this paper is neither to criticize others for repeating an assertion put forth in the literature, nor to suggest that active learning is ineffective. Rather the intention is to clarify that the statistics cited in the STATEMENT do not appear to have evidentiary support. Oftentimes we must rely upon the publication review process to remove faulty information and conclusions. In our busy lives, little time remains to check every fact cited or produced by others. Perhaps one might fault the existing (or perceived) academic pressures to produce quantity rather than quality. More importantly, the fact that these STATEMENT statistics are unsupported should be an impetus for actual controlled studies in this area.

A literature search revealed one study that compares the STATEMENT statistics to an actual experiment conducted. Lee and Bowers exposed 112 undergraduate students to training materials concerning the basic physics of light and diffraction [77]. The students were assigned to one of eight conditions: control, audio alone, text alone, animation/graphics alone, audio plus text, audio plus graphics, text plus graphics, and combined audio, text and graphics. The results from one of their experiments are shown in Table III. The tabular values show that 'seeing' is more important than 'reading', which in turn is of greater significance than 'hearing'—this is qualitatively in disagreement with the STATEMENT.

Table III. Comparison of STATEMENT Statistics with Lee and Bowers Experiment [77]

	STATEMENT Statistics			Lee and Bowers Experiment 1		
Base	+Audio	+Text	+Visual	+Audio	+Text	+Visual
Control	20%	10%	30%	7.2%	26.7%	63.2%
Audio	—		50%	—	32.3%	91%
Text		—		11.9%	—	55.6%
Visual	50%		—	25.5%	20.9%	—
Audio+Text	—	—		—	—	45.5%
Audio+Visual	—		—	—	0.8%	—
Visual+Text		—	—	4.6%	—	—

In terms of the reliability of information found in publications, other disciplines have performed studies on the accuracy of citations within published literature in their field. A similar search of scientific literature in the engineering fields found no such studies (although there may be). Several evaluations of citation and/or quotation accuracy have appeared in medical related journals. For example, in a study of 199 randomly selected references in three anatomy journals, Lukić *et al.* found errors in 19% (52 of 272) of the quotations, and 94% of the errors were classified as major [78]. In another investigation, Pitkin *et al*. found that between 18% to 68% of the abstracts in a random sampling of 44 articles from six medical journals were 'deficient', which was defined as containing data that were either inconsistent with corresponding data in the body of the article or not found in the body at all [79]. Based on quotation errors, Evans *et al*. hypothesized that authors do not check their references or may not even read them, and they questioned whether the reviewers check references [80].

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