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# Edgar Dale's Pyramid of Learning in Medical Education: A literature review

Ken Masters


## ABSTRACT

**Background:** Edgar Dales' Pyramid of Learning and percentages of retained learning are cited in educational literature in a range of disciplines. The sources of the Pyramid, however, are misleading.

**Aims:** To examine the evidence supporting the Pyramid and the extent to which it is cited in medical education literature.

**Methods:** A review of literature (1946-2012) based on a search utilising Academic Search Complete, CINAHL, Medline and Google Scholar conducted from September to November 2012.

**Results:** A total of 43 peer-reviewed medical education journal articles and conference papers were found. While some researchers had been misled by their sources, other authors' interpretations of the citations did not align with the content of those citations, had no such citations, had circular references, or consulted questionable sources. There was no agreement on the percentages of learning retention, in spite of many researchers' citing primary texts.

**Discussion and Conclusion:** The inappropriate citing of the Pyramid and its associated percentages in medical education literature is widespread and continuous. This citing undermines much of the published work, and impacts on research-based medical education literature. While the area of learning/teaching strategies and amount of retention from each is an area for future research, any reference to the Pyramid should be avoided.


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## INTRODUCTION

In education and training books, conference papers and peer-reviewed journal articles, it is widely-cited that students remember 10% of what they hear, 20% of what they read, and these percentages of retention increase in multiples of 10 until they describe the retention rates of students involved in activities such as Problem-Based Learning (Northwood *et al*. 2003; Wood 2004; Woods 2006; Yeh *et al*. 2011), computer-based training and simulation (Barnes 2001; Buehler *et al*. 2001; Chen et al. 2007; Krain & Lantis 2006) case-based learning (Golich *et al*. 2000) and other constructivist activities (Harker 2008; Khan *et al*. 2012; Pinto *et al*. 2012).

The academic fields in which these percentages impact upon educational methodology range across a broad spectrum, and includes education in Astronomy (Chen *et al*. 2007), Biochemistry (Campbell 1993), Chemistry (Lagowski 1990), General Education (Martinez & Jagannathan 2010; Pinto *et al*. 2012), Engineering (Northwood *et al*. 2003), International Politics (Golich *et al*. 2000; Krain & Lantis 2006), Library Science (Buehler *et al*. 2001; Harker 2008), Management (Elouarat *et al*. 2011; Joss 2001), Physics (Khan *et al*. 2012; Yeh *et al*. 2011), Poultry Science (Barnes 2001) and Veterinary Science (Bernardo 2003).

The percentages from these conference and journal articles are also supported in documents from well-respected, non-academic sources such as the WHO (PAHO 1997), UNESCO (Obanya 2010), the World Bank (World Bank n.d.), the European Virtual Campus for Biomedical Engineering (Kybartaite *et al*. 2007), the University of Newcastle Upon Tyne (University of Newcastle Upon Tyne 2004) and even State sponsored newsletters (Iowa Department on Aging 2009).

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When citing the research on which these percentages are based, authors sometimes cite secondary sources (Buehler et al. 2001; Golich et al. 2000; Joss 2001; Lagowski 1990; Obanya 2010; Pinto *et al.* 2012), or no sources at all (Barnes 2001; Iowa Department on Aging 2009; Martinez & Jagannathan 2010; PAHO 1997).

The two most common primary sources of the research are the National Training Laboratories (NTL) for Applied Behavioral Science's *Pyramid of Learning* (Kybartaite *et al.* 2007; World Bank n.d.), and Edgar Dale's *Cone of Learning* or *Pyramid of Learning* (Bernardo 2003; Campbell 1993; Chen *et al.* 2007; Elouarat et al. 2011; Harker 2008; Khan et al. 2012; Krain & Lantis 2006; Northwood *et al.* 2003; Pinto *et al*. 2012; Woods 2006; Yeh *et al.* 2011). Occasionally, the Socony-Vacuum Oil Company's research is also cited (Golich *et al*. 2000).

With the apparent credibility of these percentages firmly established, there appears nothing to be questioned. A cursory glance at these percentages, however, should surely trigger an alarm: human behaviour can seldom, if ever, be classified into neat percentages in multiples of 5 or 10. As educators, we should be prompted to ask questions like: "Are these percentages valid across all disciplines? Across all demographic groupings? Without variation? For all time?

With these questions appearing to undermine the validity of the Pyramid of Learning, it is crucial to examine the evidence supporting the Pyramid, and the obvious starting point is the research detailed in the primary sources of the Pyramid. A closer investigation of the primary sources of the Pyramid leads to some troubling findings. Indeed, an article by Lalley &

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Miller (2007), indicates that the sources of these percentages should be questioned. These will be explored in the next section.

*The sources of the Pyramid and the percentages*

The first possible primary source of these percentages, the NTL, does not have any research data, published or unpublished, supporting its Pyramid. According to email correspondence from the NTL (Raymond 2012), its Pyramid of Learning is based upon its own research, although it has never been able to locate this research and has not been able to provide details of this research. Nevertheless, the NTL explains that "the Learning Pyramid as such seems to have been modified and has long been attributed to NTL. The NTL Learning Pyramid, sometimes with slightly different percentages, appears as [Figure 1]." (Raymond 2012)

*[Insert Figure 1 here]*

This is not reassuring. Given the impact of the Pyramid and the percentages on education, and their wide application in educational literature, they would surely have been based upon a large research project, and it is disconcerting to think that there is no documentation at all detailing the research or even the names of the researchers. (There is also no explanation for why this two-dimensional figure is referred to as a pyramid, rather than a triangle, but that does not appear to be significant in any of the literature consulted).

The NTL further acknowledges that Edgar Dale produced "a similar pyramid with slightly different numbers" in his 1954 text *Audio-Visual Methods in Teaching* (Raymond 2012).



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According to the NTL, "The following [Figure 2] is the pyramid attributed to Edgar Dale's *Audio-Visual Methods in Teaching.*" (Raymond 2012)

*[Insert Figure 2 here]*

When we look at this second possible primary source, however, we see something different. In his text *Audiovisiual methods in teaching* (Dale 1946; Dale 1954; Dale 1969), Edgar Dale presents a "Cone of Experience" (Figure 3), and not a Pyramid of Learning. (Through the different editions of his text, there were some updates, such as the inclusion of television).

*[Insert Figure 3 here]*

Most importantly, unlike the Pyramid of Learning attributed to Dale by the NTL, Dale's Cone of Experience has no numbers or percentages, and no suggestion of retention of information from any input source or activity of any type, or for any length of time.

Dale's Cone of Experience is merely a classification diagram. It "classifies various types of instructional materials according to the relative degree of concreteness that each can provide." (Dale 1969) Dale presents his Cone of Experience as "only a model," a "visual analogy," comparing it to the analogy of the computer for understanding the functioning of the brain. It stems from his overall perception of learning, similar to, he notes, modes of learning discussed earlier by Jerome Bruner. It is not based on empirical evidence of any kind, and Dale makes no such claims.



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In addition, unlike the Pyramid of Learning commonly cited, there is no suggestion that the experience at the base is superior to the experience at the apex. On the contrary, in Dale's discussion, if there is an implied desired direction of movement, it tends towards the abstraction at the apex, although not all learning happens like that.

While Dale describes the value of the "direct, firsthand experiences that make up the foundation of our learning," he also makes it clear that "human life cannot, of course, be lived exclusively on the direct, concrete, sensory level," and frequently learning tends towards higher levels of abstraction. The Cone "classifies instructional messages only in terms of greater or lesser concreteness or abstractness," and it is not an "exact rank order of learning processes." The teacher and learner must be able to move through all levels.

In short (apart from contradicting common-sense), these percentages are questionable because the NTL has never been able to produce any evidence or research supporting their Pyramid of Learning (and so it is doubtful that any such research occurred), and Edgar Dale never created a *Cone of Learning* or a *Pyramid of Learning* (with or without percentages). It appears, then, that the pyramid structure, and the percentages, are based on nothing substantial.

*The problem for medical education*

The need for strong education research and theory to underpin medical education is well-recognised (Collins 2006; Gibbs *et al*. 2011; Pauli et al. 2000). It follows, moreover, that medical education practice must be based on true research, and not on suppositions and



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invalid assumptions. Just as the other academic fields cited above have used the Pyramid of Learning to influence their arguments regarding educational practices, so there is the possibility that medical education practice has done, and will do, the same.

This paper surveys the medical education literature, in order to assess the extent to which the Pyramid has been cited, the medical disciplines that are affected, the sources of the Pyramid, and the retention percentages quoted.

## METHODS

A documented search was conducted on the following databases: Academic Search Complete, CINAHL, and Medline. Google Scholar was searched in order to find other widely available documents that reference the Pyramid. In addition, where authors cited the source of their data, these references were followed until they reached either a non-medical source or a primary text (e.g. the NTL site or one of Edgar Dale's texts).

Because the Pyramid of Learning might be displayed in a variety of ways (including without an actual pyramid), and might be referenced from a range of sources, the search terms were broad. The search phrase was: "(("medical" OR "medicine") AND ("% of what they read" OR "Learning Pyramid" OR "Pyramid of Learning" OR "Dale's Cone" OR "Dale Cone" OR "Cone of Learning" OR "Learning Cone" OR "Cone of Experience" ))". The precise syntax of the phrase was adjusted to suit the requirements of the specific data bases.

To be included, the source had to be in English and from a journal or conference with some evidence of peer-review, published from 1946 to 2012. The start year of 1946 was chosen





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because that was the first publication date of Dale's *Audiovisiual methods in teaching* (Dale 1946). Other documents, such as books, letters to the editor, Masters and PhD theses were excluded. The search was conducted from September to November, 2012.

## RESULTS

*Overall*

The initial result returned a total of 2,697 references. An initial sorting process reduced this number to 54 articles, further refinement to 32 articles, and further searching for articles listed in references increased this number to 43 (Figure 4).

*[Insert Figure 4 here]*

This search could find only one article that questioned the origin and applicability of the Pyramid. Gallagher *et al*. (2012) noted that the "authority and origins of the [Learning Retention Pyramid] are disputed in some quarters," and cite Lalley and Miller (2007). Nevertheless, Gallagher *et al*. still used the percentages in the Pyramid to stimulate discussion in their workshop. All the other articles appear to accept the percentages unquestioningly.

*Articles and their sources*

Table 1 gives a summary of the articles found. This table indicates the medical education discipline that forms the context of the article, the source to whom the percentages are attributed, and the citations to the references from which the percentages were obtained. In



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some cases, no specific attribution has been made (e.g. Afandi *et al.* refer merely to the "Learning Pyramid Theory", and Arthurs merely quotes the percentages).

*[Insert Table 1 Here]*

In addition to Dale's primary text (Dale 1946; Dale 1954; Dale 1969), there are three references to a replication of his Pyramid in an edited text. In these references, this text has been given different bibliographic information, including as a chapter (or section) by Dale in a book edited by Wiman and Meierhenry (Avers & Wharton 1991; Oldaker 1992), or attributed directly to Wiman and Meierhenry as authors (Weinrich *et al*. 1994). Upon inspecting the text, one finds a chapter by Donald Stewart (Stewart 1969) in which he elaborates on Dale's Cone of Experience, and supplies a diagram of his own interpretation (Figure 5). In his diagram, however, one can see that he retains the principles of Dale's classification, and makes no suggestion of learning retention through different modes of instruction. There is no indication that Edgar Dale contributed any material to this text.

*[Insert Figure 5 here]*

*The Percentages*

All of the authors, apart from Hazlett (2009), quote percentages. Hazlett states that "Teaching modalities that require students to be actively involved in learning new knowledge and skills have been shown to be ten to sixteen times more effective [than passive activities]."

The percentages, as given by the researchers, are given in Table 2.



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*[Insert Table 2 Here]*

When one looks at the percentages, one finds a general pattern leading from a lower percentage of retention through hearing and reading to a greater percentage of retention through active learning and teaching. When one inspects the percentages in more detail, however, inconsistencies emerge, and it appears that there is no agreement on what percentage of information is retained through the different activities.

## DISCUSSION

This literature review has examined articles that deal with medical education and make reference to Edgar Dale's or the NTL's Pyramid of Learning and / or the percentages of learning retention associated with the Pyramid. It has found that the Pyramid is cited in a wide range of journals, and within the context of a wide range of medical disciplines. The fact that a sizable proportion of the articles was published in 2012 indicates that the Pyramid and its percentages are still currently being cited in medical education literature. Further, the error is being reinforced in new articles and books dealing with medical education (Frith 2013; Risavi *et al*. 2013; Sewell 2013;).

### *Poor referencing*

It is apparent that some authors are citing respectable secondary sources in good faith. While citing secondary sources is seldom advisable, it does not necessarily indicate an unacceptable





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academic practice. Similarly, several authors have cited the NTL diagram as a primary source, and, therefore, cannot be blamed for errors that may exist in that Pyramid.

In many other cases, however, there is a pattern of poor referencing, and this serves to undermine the research and also contributes to the contradictory percentages. These are not minor typographical errors or misplaced punctuation errors (for which students are routinely berated), but evidence of something deeper. The word "fraud" is probably too strong, but the evidence does point to something academically unsatisfactory.

In this respect, the rather large number of authors claiming to be citing Edgar Dale's percentages and Pyramid directly from his text indicates that it is unlikely that they consulted the original text that they are citing; if they had, they might have seen that Dale does not have a Pyramid of Learning, and has no percentages referring to retention of information by students.

In addition, where some authors have cited secondary sources (e.g. Pei (Pei 2003) citing Lagowski (Lagowski 1990)), it is unlikely that the authors had consulted the text, as it does not exist. This problem does not appear to be confined to medical education, however, as a search on Google Scholar reveals that Lagowski's non-existent article has been cited by six other articles. References to other non-existent texts, such as those by "Brurmer" and TB Dale are also academically unacceptable.

In cases where the secondary sources do exist, many are questionable as texts supporting arguments in an academic paper. For example, Roa and Kate (Rao & Kate 2012) give Bruner as the source of the Pyramid, citing a report by "Friiel" (Friel 2009) at the University of



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Glasgow. At the time of writing the report, Niamh Friel was a "Level 4 Psychology Student" (Friel 2009) at the University of Glasgow. Friel's source of the Pyramid is a single untitled web page showing the learning pyramid, citing Jerome S. Brumer's *Process of Learning* as its source (http://homepages.gold.ac.uk/polovina/learnpyramid/index.html). This page is a single de-contextualised page labelled as "Learning Pyramid" on a website maintained by Dr. Simon Polovina at: http://homepages.gold.ac.uk/polovina/. Similarly, the University of Newcastle Upon Tyne document referenced by some researchers (Baykan & Naçar 2007; Shenoy *et al*. 2012; Zeraati *et al*. 2008) is a general university student study guide, giving no citations relating to the source of its percentages.

In some cases (e.g. (Gordon 1996; Kumar *et al*. 2009; Murphy 1998)), the percentages are given without any reference or citation, and the implication is that they are self-evidently correct. These texts then become a source of data for other texts (e.g. (Keulers & Spauwen 2003)).

*Implication for Medical Education*

As noted by several medical education researchers (Harden *et al*. 1999; Harden & Lilley 2000; Hart & Harden 2000; Petersen 1999), a fundamental weakness in medical education research has been the reluctance of many educators to apply the same standards and expectations of quality to educational research that they would expect in clinical research. For more than a decade, however, we have had the benefit of Best Evidence Medical Education (BEME) (Harden et al. 1999; Harden & Lilley 2000; Hart & Harden 2000). While difficulties of medical education measurement have long been recognised (Harden *et al*.

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1969; Harden *et al*. 1999), it is possible to have some measure of quality of medical education evidence.

Harden *et al.'s* (1999) discussion of the quality of evidence supports the idea that Edgar Dale's Cone of Experience still has value as a classification system, as it is based on his professional experience and observation. A move to a point at which we apply percentages of learning retention, however, assumes measurement, and we should ask the pertinent question that we would ask of any medical research: "how was this measurement performed?"

The researchers cited in this study appear to have failed in asking that question. In their defence, while many have consulted literature as recommended in BEME principles (Harden *et al*. 1999), their chief errors appear to have been too trusting of secondary texts, not critically appraising them (Hart & Harden 2000), and not "establishing the reliability of the data" (Hart & Harden 2000). If medical education is to be theory- and research-based (Collins 2006; Gibbs *et al*. 2011; Pauli et al. 2000), then it is imperative that medical education researchers confirm their evidence and the reliability of their sources.

Until the Pyramid of Learning or its percentages can be verified as grounded in research, there is a need for medical education researchers to be wary of using the information associated with them. There is also a need, as noted by Azer *et al*., for peer-reviewers of medical education journals to ensure that references are accurately reported (Azer *et al*. 2012).



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From this study, it is obvious from the background that, whether citing the NTL or Edgar Dale, the Pyramid of Learning has no substance. Citing either of these would seriously damage a research paper, and may impact on a researcher's reputation.

This does, however, mean that there is an opportunity for medical education researchers to begin anew, and develop a model of learning retention.

*Implication for the NTL*

Although beyond the scope of this paper, until the NTL can show the evidence for its Pyramid, it should publicly acknowledge that there is no evidence for it. At the very least, it should stop referring to Edgar Dale's non-existent Pyramid of Learning in its correspondence with researchers.

*Limitations*

The search terms limited the subject to medicine, as the purpose was to ensure that papers dealing with the basic sciences would be included only if they were being taught in the context of a medical degree. It is likely that a less restrictive subject area would have found more basic sciences' papers, and perhaps papers in other specialties. Little material purpose would have been served by this, however, as the only difference would have been to indicate that the problem is more wide-spread that this paper indicates.

**CONCLUSION**

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This paper has reviewed the concept of the Pyramid of Learning and its related percentages of knowledge retention as raised in medical education literature.

As a background, the paper has demonstrated that the Pyramid is based on no credible evidence, and that the primary sources either have no research to substantiate their claims (NTL) or have never produced such a Pyramid or percentages (Edgar Dale).

In spite of this, the paper has found that the Pyramid is widely cited across a range of medical disciplines, and shows no indication of losing prominence. Further, the citing of secondary resources is deeply flawed and is frequently a circular process of agreement that has more in common with the Emperor's new clothes than scientific discourse.

Even amongst these citations, there is no agreement on the percentages of learning retention. While there is a general pattern, they are mostly arbitrarily spread across the learning activities.

The Pyramid of Learning, with its percentages, is dis-credited, and should not be accepted in medical education literature.

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Figure 1: The NTL *Learning Pyramid*, "sometimes with slightly different percentages, appears as [this figure]" (Raymond 2012).

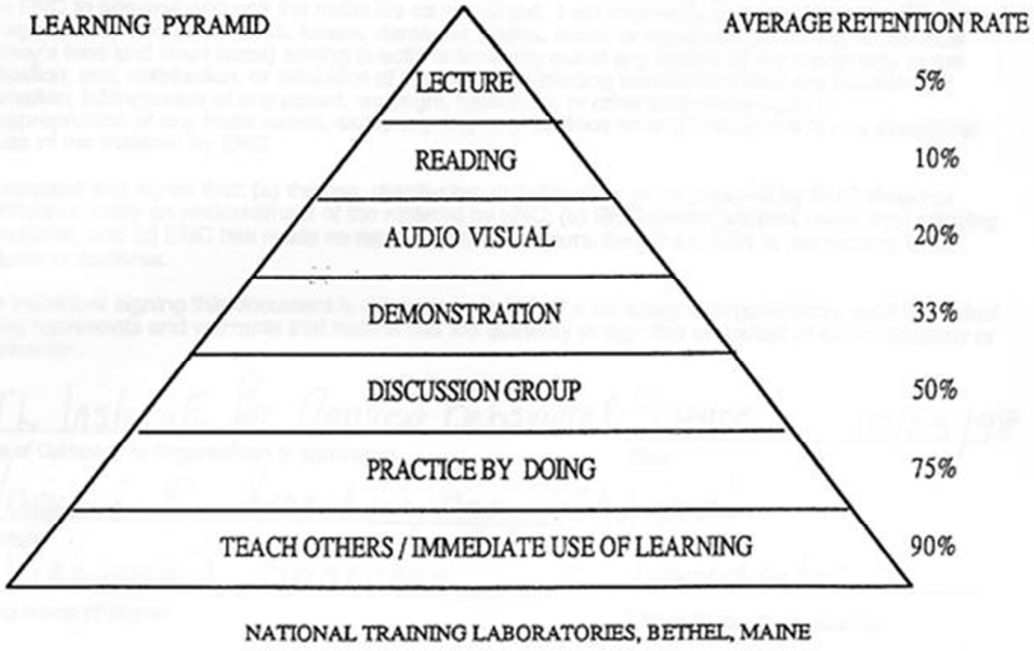


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Figure 2: *The Pyramid of Learning* attributed by the NTL to Edgar Dale from his *Audio-Visual Methods in Teaching*:

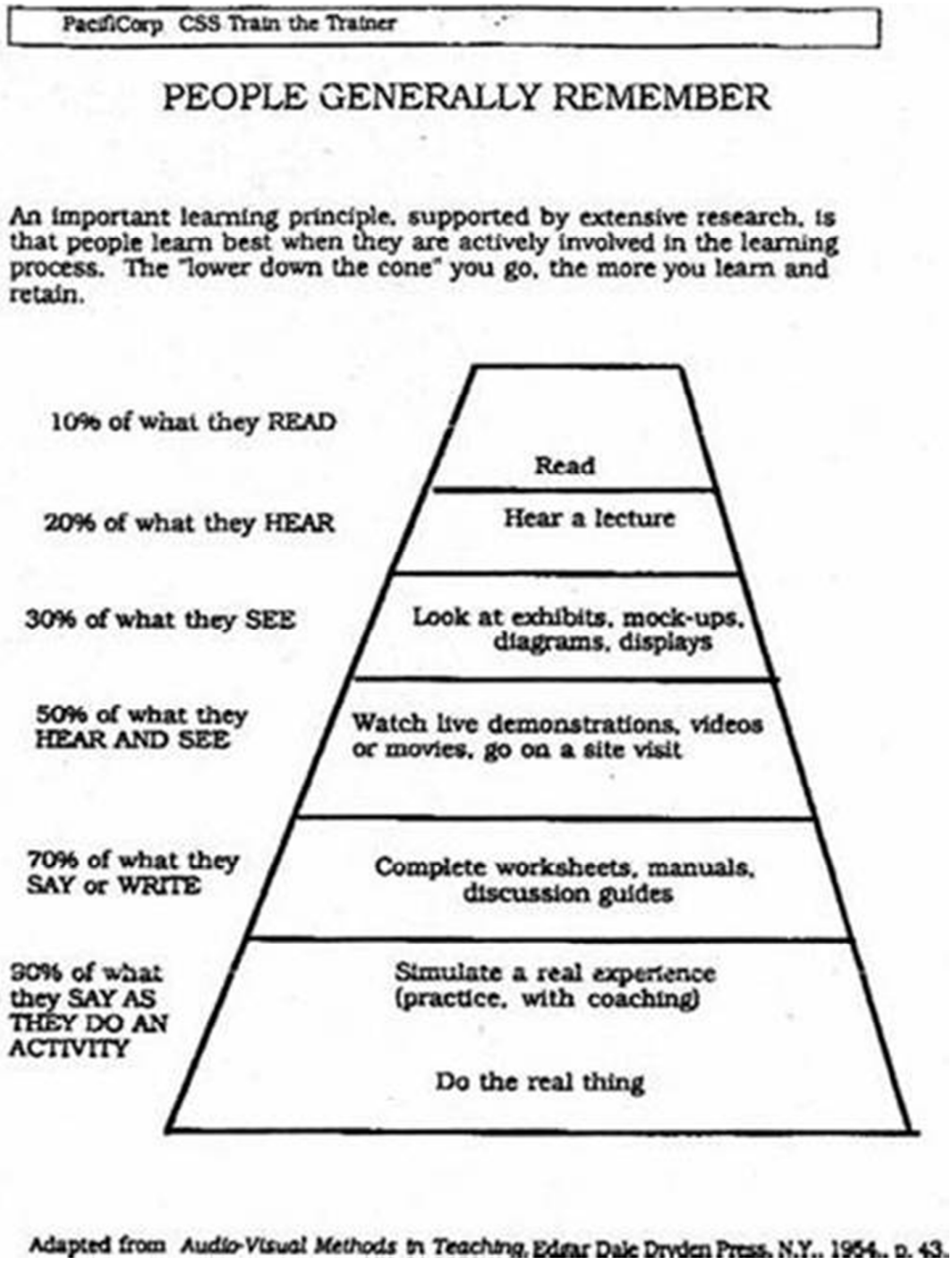

Figure 3: Edgar Dale's *Cone of Experience*, as presented in *Audiovisiual methods in teaching*, (3rd Ed.), p.107. (Dale 1969) (Earlier versions of the Cone did not include television).

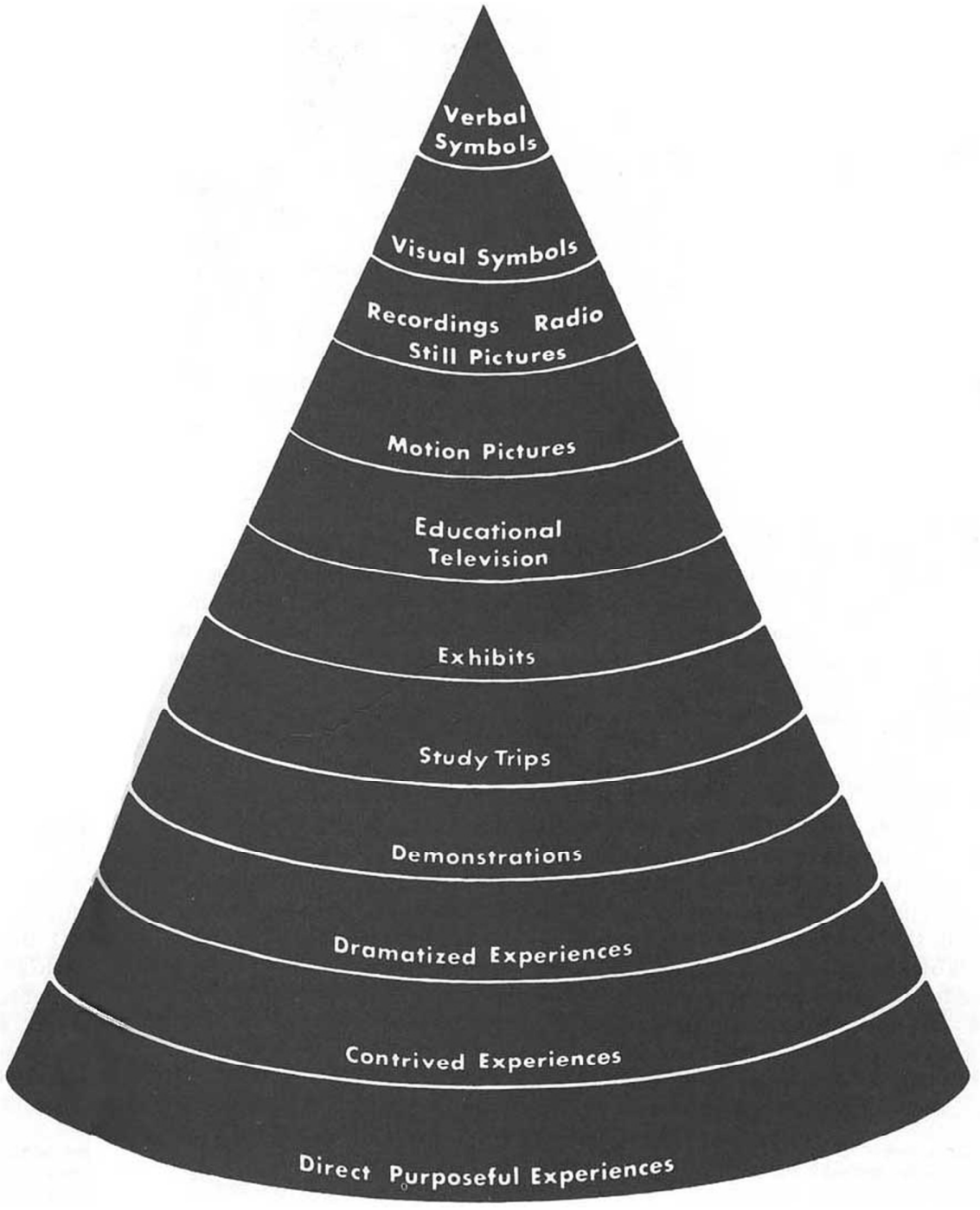

Figure 4: Article Selection Process.

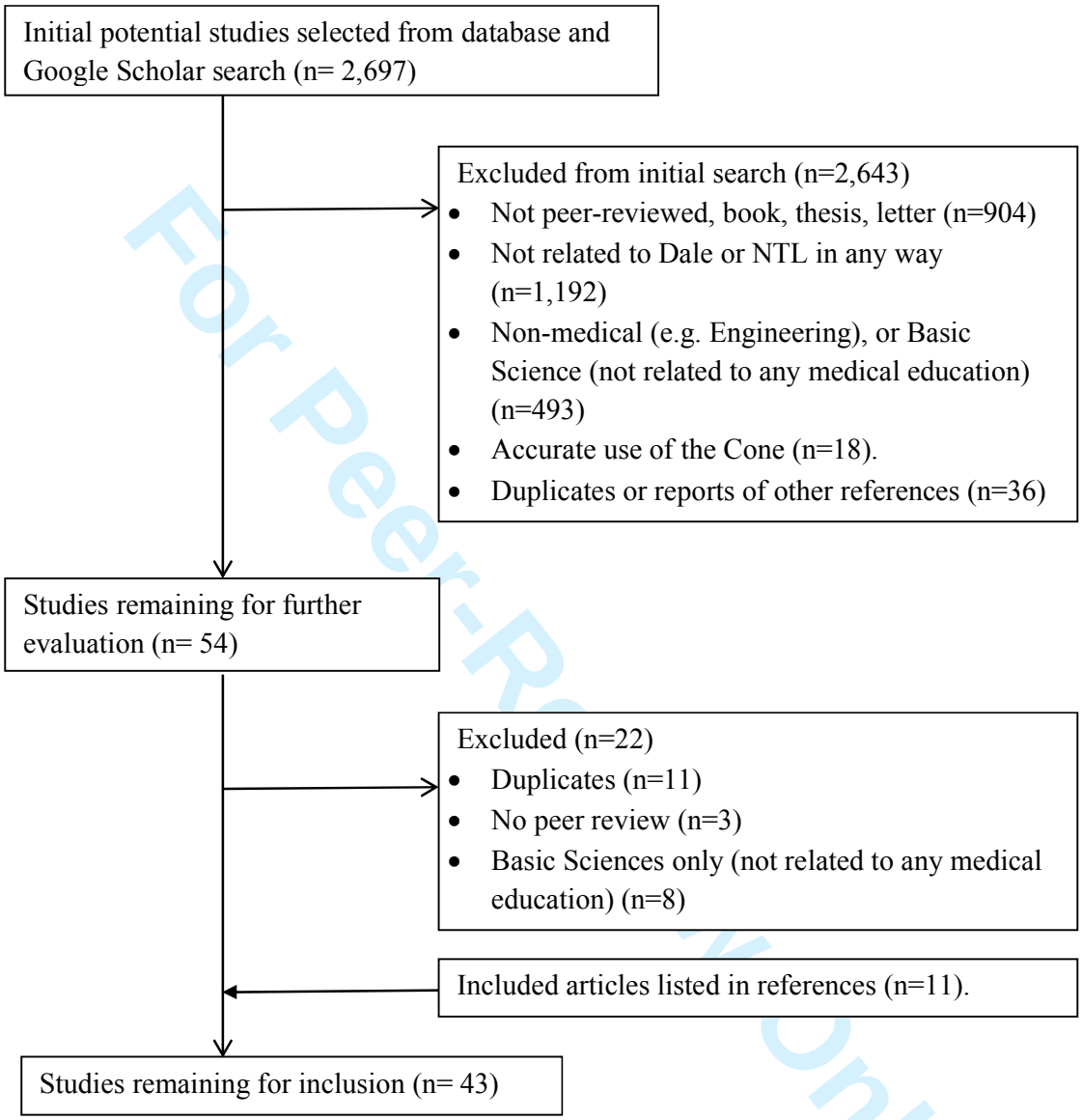


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Figure 5: Stewart's *Simulation through Use of Instructional Media* (Stewart 1969), p. 161, "Based in part on Edgar Dale's 'Cone of Experience.'"

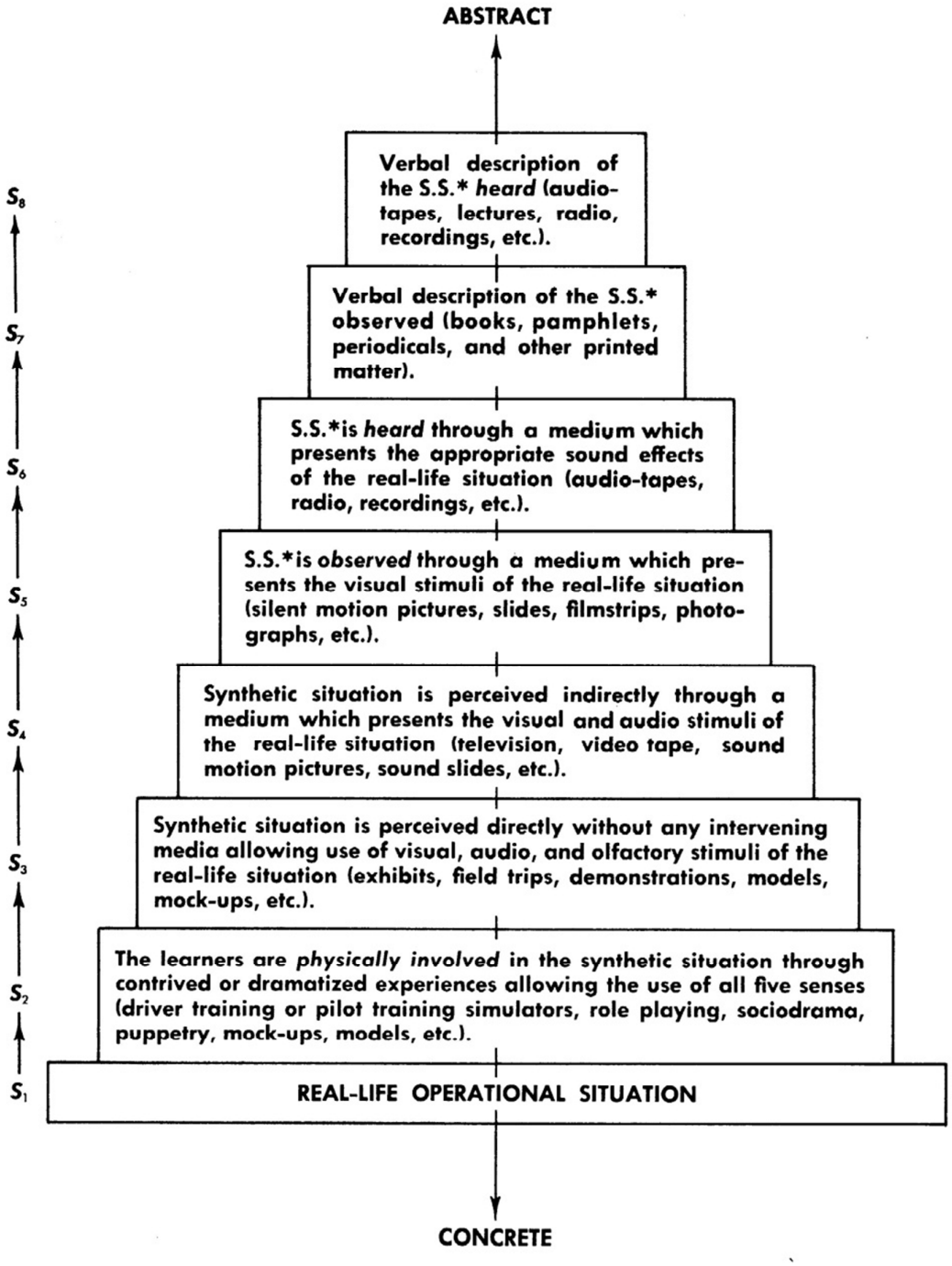

Table 1: List of references, the medical discipline, the person to whom the Pyramid and / or percentages are attributed, and the cited source of the information.

| Reference | Discipline | Attrib. to | Citing |
|---|---|---|---|
| (Afandi *et al*. 2009) | Bioethics | "Learning Pyramid Theory" | (Lalley & Miller 2007) |
| (Akaike *et al*. 2012) | Simulation / Clinical skills | Dale | (Sprawls 2008) |
| (Arthurs 2007) | Nursing | None | (Bowman 1997; Nilson 2003) |
| (Avers & Wharton 1991) | Geriatric Rehabilitation | Dale | (Dale 1969b)[1] |
| (Baykan & Naçar 2007) | Physiology | None | (University of Newcastle Upon Tyne 2004) |
| (Boctor 2013)[2] | Nursing | Dale | (Kennedy 2006) |
| (Brueckner & MacPherson 2004) | Dental Gross Anatomy | "The learning pyramid" | (Eyler & Giles 1999) |
| (Croley & Rothenberg 2007) | Critical Care | Dale | (Dale 1969) |
| (Dark & Perret 2007) | General Healthcare | None | (Chandler & Sweller 1991) |
| (Darmer *et al*. 2004) | Nursing | NTL | (Lowery Jr n.d.) |
| (Dickerson 2003) | Nursing | None | (Jackson 1993) |
| (Gallagher *et al*. 2012) | Cross-Discipline | NTL | (World Bank n.d.) |
| (Garden 2009) | Obstetrics and Gynaecology | NTL | NTL |
| (Gordon 1996) | Medical Communication Skills | None | None |
| (Hazlett 2009) | Cross-Discipline | NTL | (Lowery Jr n.d.) |
| (Jalali & Wood 2012) | Anatomy | Dale | (Dale 1954) |
| (Jarvis et al. 2009) | Pharmacy (medication disposal) | Industrial Audio Visual Association | (Pakes 1995; Montero 1998) |
| (Karabulut & Cetinkaya 2011) | Patient Education | "In the literature" | (Ergin 1995)[3] |
| (Katsuragi 2005) | Dentistry | Brurmer [sic] | (Brurmer n.d.)[4] |
| (Kennedy 2006) | Patient Education | Dale | (Dale 1969) |
| (Keulers & Spauwen 2003) | Patient Education | None | (Murphy 1998) |
| (Krishna *et al*. 2006) | Patient Education | "the theory of learning and retention" | (Dale 1969) |
| (Kumar *et al*. 2009) | Cross-Discipline | None | None |

[1] This is a citation to a non-existent reference: "Dale E. Cone of Experience. In: Wiman C, ed. Educational Media. Charles E. Merrill; 1969. See discussion below for further information about this reference.
[2] This article was in press and available electronically at the time of the search. This reference has been updated to reflect its current citation details.
[3] This reference is given as: Ö. Ergin, "Instructional Technolog [sic] and Communication," Tegem Publication, Ankara, 1995, p. 102." The existence of this text cannot be verified.
[4] This reference is given as: "Brurmer [sic] JS. Learning pyramid. The process of learning. Bethel, Maine: National Training Laboratories." It appears to be a conflation of Bruner's *The Process of Education* and the NTL's Pyramid.

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| Reference | Discipline | Attrib. to | Citing |
|---|---|---|---|
| (Lott 2006) | Nursing | None | (Dickerson 2003) |
| (Lou 2012) | Chemistry | NTL | (Dale 1969) and NTL |
| (Manning 1983) | Nursing | None | (Medearis 1974) |
| (Mitchell 2007) | Patient Education | None | (Rief 1993) |
| (Murphy 1998) | Patient Education | None | None |
| (Okolie *et al*. 2007) | Nursing and Radiography | TB Dale | (Dale 2000)[5] |
| (Okuda *et al*. 2009) | Simulation | None | (Croley & Rothenberg 2007) |
| (Oldaker 1992) | Patient Education | Dale | (Dale 1969b)[6] |
| (Pei 2003) | Pharmacy | None | (Lagowski 1990)[7] |
| (Rao & Kate 2012) | Surgery | Bruner | (Friel 2009) |
| (Sarikcioglu *et al*. 2011) | Physiology | Dale | (Arthurs 2007) |
| (Shah *et al*. 2012) | Cross-Discipline | None | (Bonwell & Eison 1991) |
| (Shenoy *et al*. 2012) | Cross-Discipline | None | (University of Newcastle Upon Tyne 2004) |
| (Sprawls 2008) | Medical Physics | Dale | None |
| (Sujatha *et al*. 2011) | Clinical skills | "Learning Pyramid" | None |
| (Thomas & Baker 2008) | Nursing | NTL | NTL |
| (Videla 2010) | Cross-Discipline | "Learning Pyramid" | Unknown[8] |
| (Weinrich *et al*. 1994) | Patient Education | None | (Wiman & Meierhenry 1969)[9] |
| (Wood 2004) | Biochemistry | NTL | NTL |
| (Zeraati *et al*. 2008) | Cross-Discipline | None | (University of Newcastle Upon Tyne 2004) |

[5] Reference given as : "Dale, T. B. 2000. Teaching Materials. *American Journal of Education.* 38 (9): 63-69." But, in 2000, the *American Journal of Education* published volume 108. Volume 38 (as *The School Review*), was published in 1930. Volume 38 (9) runs from pp. 641-720.

[6] This citation is also to the non-existent section in Wiman & Meierhenry 1969.

[7] Cited as "Lagowski (1990) Retention Rates for Student Learning. *Journal of Chemical Education*, **67**, 811." There is no such paper. There is a 1990 *editorial* by Lagowski (Lagowski 1990) entitled "Teaching is more than Lecturing" in the *Journal of Chemical Education*, 67 (10): 811. That editorial quotes the percentages, citing its source as a 1987 article from *Engineering Education* by Stice (Stice 1987).

[8] The reference was to "Learning Pyramid; 2004," with a URL: www.coe.uncc.edu/maps/wspowerpoint/w2pp/sld004.htm but this URL no longer exists.

[9] Reference in the citation given as Wiman and Meierhenry as authors.

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Table 2: Percentages of information retention given by the authors

| Activity: / Reference | Read | Hear / lecture | See / audio visual | Dem. | Say / Disc. Group | See and hear | Do | Say | Say, hear, See and Do | Teaching others |
|---|---|---|---|---|---|---|---|---|---|---|
| (Afandi *et al.* 2009) | | | | | 50 | | | | | |
| (Akaike *et al.* 2012) | | | | | | | | | 90[10] | |
| (Arthurs 2007) | | 10-20 | 20-50[11] | | 80 | | | | 90 | |
| (Avers & Wharton 1991) | 5-10 | 10-20 | 30-50 | | | | | 70[12] | 90 | |
| (Baykan & Naçar 2007) | 20 | 30 | 40 | | 50 | | 60 | | 90 | |
| (Boctor 2013) | 10 | 20 | 30 | | | | | | 90 | |
| (Brueckner & MacPherson 2004) | 10 | 5 | | | 50 | | | | | 90 |
| (Croley & Rothenberg 2007) | 10 | 20 | 30 | | | 50 | | 70 | 90 | |
| (Dark & Perret 2007) | 10 | 20 | | | | | | | 90 | |
| (Darmer *et al.* 2004)[13] | 10 | 5 | 20 | 30 | 50 | | 75 | | | 90 |
| (Dickerson 2003) | 5-15[14] | | 10-20 | | | | 40-50 | | | |
| (Gallagher *et al.* 2012)[15] | 5 | | | | | | | | | 90 |
| (Garden 2009) | 10 | 5 | 20 | 30 | 50 | | 75 | | | 80 |
| (Gordon 1996) | | 25 | 45 | | | | 70 | | | |
| (Jalali & Wood 2012)[16] | 10 | | | | | | | | 90 | |
| (Jarvis *et al.* 2009) | 10 | 20 | 30 | | | 50 | | | | |
| (Karabulut & Cetinkaya 2011) | 10 | 20 | 30 | | | 50 | | | | |
| (Katsuragi 2005) | | 5 | | | | | | | | |
| (Kennedy 2006) | 10 | 20 | | 30 | | | | | 90 | |
| (Keulers & Spauwen 2003)[17] | 40 | 20 | | | | | | | 80 | |
| (Krishna *et al.* | | | | 50[18] | | | | | 90 | |

[10] "Active Learning"
[11] "Adding visual material to a presentation such as pictures or graphics almost doubles student recall. With lecture and visuals, faculty can increase retention to approximately 50%"
[12] Say and Write.
[13] This is given as a "rough guide"
[14] Read or hear
[15] Citing (Lalley & Miller 2007), the authors note that "the authority and origins of the [Learning Retention Pyramid] are disputed in some quarters."
[16] After 2 weeks.
[17] Citing Murphy

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| Activity: / Reference | Read | Hear / lecture | See / audio visual | Dem. | Say / Disc. Group | See and hear | Do | Say | Say, hear, See and Do | Teaching others |
|---|---|---|---|---|---|---|---|---|---|---|
| 2006) | | | | | | | | | | |
| (Kumar *et al*. 2009) | 20 | 30 | 40 | | 50 | | 60 | | | |
| (Lott 2006)[19] | 5 | 15 | 10-20 | | | | 40-50 | | | |
| (Lou 2012) | 10 | | 20 | 30 | 50 | | 75 | | | 90 |
| (Manning 1983) | 10 | 20 | 30 | | | 50 | | 80 | 90 | |
| (Mitchell 2007) | 10 | 20 | 30 | | 70 | 50 | | | 90 | |
| (Murphy 1998) | 40 | 20 | | | | | | | 80[20] | |
| (Okuda *et al*. 2009)[21] | 10 | | | | | | 90 | | | |
| (Oldaker 1992) | 5-10 | 10-20 | | | | 30-50 | | 70[22] | 90 | |
| (Okolie *et al*. 2007) | 10 | 20 | 30 | | 70 | 50 | | | 90 | |
| (Pei 2003) | 10 | 50 | | | | | | | 90 | |
| (Rao & Kate 2012) | 5 | | 20 | | 50 | | | | 75[23] | |
| (Sarikcioglu *et al*. 2011)[24] | | 10-20 | | | | | | | | |
| (Shah *et al*. 2012) | 20 | 30 | 40 | | 50 | | 60 | | 90 | |
| (Shenoy *et al*. 2012) | 20 | 30 | 40 | | 50 | | 60 | | 90 | |
| (Sprawls 2008) | 10 | 20 | 30 | | | 50 | | 70[25] | 90 | |
| (Sujatha *et al*. 2011) | | | | 30 | | | | | 90 | |
| (Thomas & Baker 2008) | 10 | 5 | 20 | 30 | 50 | | 75 | | | 90 |
| (Videla 2010) | | 5[26] | | | | | | | | |
| (Weinrich *et al*. 1994) | 10 | 20 | 30 | | 50 | | | 70[27] | 90 | |
| (Wood 2004) | 10 | 5 | 20 | 30 | 50 | | 75 | | | 90 |
| (Zeraati *et al*. 2008) | 20 | 30 | 40 | | 50 | | 60 | | 90 | |

[18] "According to Edgar Dale's Cone of Learning, passive methods of learning lead to a maximum of 50% content retention whereas interactive learning methods provide up to 90% retention of the content."
[19] Citing Dickerson
[20] "Up to 80% of what they receive through interactive multimedia programs."
[21] Citing Croley & Rothenberg.
[22] "Verbalize and write."
[23] Specifically, Problem-Based Learning (PBL).
[24] Citing Arthurs.
[25] "Say and Write"
[26] "According to the learning pyramid the average rate of retention is 5% if the class is only theoretical."
[27] "Say or Write"

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