Communication and Design in Multimodal Presentations

Roger Hartley[1], Adel Elsayed[2] and Milena Peshova[3]
[1]University of Leeds, UK, [2,3]University of Bolton, UK
[1]j.r.hartley@education.leeds.ac.uk, [2]a.elsayed@bolton.ac.uk, [3]MP6ECT@bolton.ac.uk

Abstract

Effective educational presentations not only communicate meaning through structured content, but indicate the attitudes of presenters and their empathic engagement with the audience. This paper considers the design of multimodal presentations, specifically examining the functional and integrative roles of gestures in the communicative process when materials are presented by experienced teachers. A gestural coding scheme is used to describe similarities and differences between the presenters when dealing with the same topics under three presentation formats. These data give useful insights into how the visual, verbal and gestural modalities are used to effect communicative and educational intentions.

1. Introduction

Communicating effectively is a principal goal in the instructional process, and technological developments can stimulate innovation in the ways educational content is designed and delivered. Broadband networking enables presentations to be delivered at a distance and visual and verbal modalities can work in a coherent and complementary fashion as presenters not only communicate meaning through structured content, but reinforce their commitment and engagement with the subject matter and with the anticipated audience. Researchers [1] [2] have proposed recommendations for the design of educational materials that use differing sensory modalities. They note that when visual information is presented with verbal information in descriptions or explanations, the verbal content should be delivered as speech rather than as on screen text which would place both sources of information onto the visual channel and add to its cognitive load. This modality principle also draws its authority from a meta-analysis of modality effects across a range of educational contexts [3].

However, [4] notes that it is the integration which makes communication effective. For example, presenters, through gestures, may locate a specific part of a visual display, illustrate or enact its properties, or relations, or dynamic processes such as expansion and contraction. The ways gestures are shaped and executed can emphasize affect, and rhetorical gestures can indicate an engagement with the audience. Studies on the nature of gestures, their roles in multimodal communication, and their influence on learning are still relatively sparse, but [5] showed that students in mathematics tutorials dealing with equations were more likely to learn new concepts when gestures not only directed attention to components of equations but enact problem solving strategies such as grouping or maintaining equality. Even telepointing experiments that are limited in their gestural roles were observed to have performance benefits for university students both in retention and time-on-task measures [6]. But what types of gestures are used to effect these various roles, and how are they engineered into coherent communicative and acts? These issues have guided the progression of our research.

2. Initial Experiments

Four science topics were chosen which require multimodality and which cause some conceptual difficulties for students. The Cable Suspension Bridge needs an understanding of tension/compression equilibrium, and the Hot Air Balloon, of the Buoyancy principle. The representation of waves through properties of Wavelength, Amplitude and Phase requires a careful exposition and Geometric Transformation via Matrix Multiplication, a clear sequence of instructions. Three presentation formats were followed which placed different restrictions of the gestural modality. One displayed the visual on a board with the teachers able to gesture freely as in a classroom. Another presentation had the visual on a desk with the camera giving an over-the-shoulder view as in a tutorial and a third presentation was essentially telepointing with the visual on the computer screen showing movements through a mouse icon. Four experienced teachers (each taking two topics in all formats) prepared the materials and gave their presentations (in random order) which were video-recorded, or automatically captured by the computer. Teachers were asked to present, speak and gesture as appropriate.

3. The Analysis Scheme

A transcript was made of the spoken contents and their structures classified under a Rhetorical Predicate DISCOUNT Analysis Scheme. The gestures were

Seventh IEEE International Conference on Advanced Learning Technologies (ICALT 2007)
0-7695-2916-X/07 $25.00 © 2007 IEEE

codified from the video-recording using a semiotic framework which distinguished the gesture icon (*eg.* an open, closed, cupped, cutting, or pointing hand(s)); the trajectory/dynamics of the gesture stroke; and the gesture referent (*eg.* the visual, the audience, or the presenter's mental model or affect). These gestural codes were overlaid on the time-lined speech transcripts, and the communicative acts were sequenced into episodes (*eg.* of priming, of affect, of empathy, and description/illustration and explanation of property, relation and process). These judgements were made using an experienced panel.

4. Commentary

The presentations each lasted approximately five minutes duration, and they showed presenters used several types of gestures. For example, there were **Offering/Empathic** gestures with open hand, palm to audience in an over-to-you movement: **Indicative/ Inductive** types of gestures again with open palm to audience, slightly cupped, index finger raised invitationally moving from the audience to the visual: **Locative** gestures with pointing finger directed attention to a component or position on the visual: **Descriptive/Illustrative** gestures, *eg.* tracing or outlining to indicate size or volume or grouping, and **Explanatory/Enactive gestures** where hands demonstrated events, principles of equilibrium, or processes such as expansion and contraction.

The types of gestures under a topic were influenced by the conceptualizations of the presenters. For example, in the Board presentation of the Hot Air Balloon, one presenter saw it as a collaborative problem solving exercise, "How do **we** get the balloon to fly?" Indicative and Illustrative gesture emphasized the audience link with a large trajectory moving from the audience to the visual. The explanation focused on difference in temperature and density between air in the balloon and outside, and were largely locative and illustrative in character. The other presenter was more enactive in explanation, using two hands directly on the visual to demonstrate the heating of air in the balloon, the expansion forcing air out of the balloon, with the weight loss disturbing the buoyancy equilibrium. However, in the Suspension Bridge presentations both teachers gave similar explanations and used similar gestures, *eg.* the supporting hand showing take-up of the weight of the roadway, causing tensions in the cable (two hands enacting on the visual pulling repetitively either side of a parapet) resolved into a compression reaction (flat hand pressing down successively) on the parapet.

A second major influence was the presentation format. The visual in the desk presentation occupied a large part of the field of view, the detail was clearer, the gesture trajectories had to move a shorter distance and were close to the surfaces of the visual so were essentially two-dimensional. Hence the gestures were more precise in their locative and descriptive trajectories and less enactive in their execution. In the telepointing presentations, the gesture icon was restricted to locating and outlining: rapid movements to illustrate process or relations were not often used and were judged to be distracting.

5. Are Gestures Redundant?

Some gestures seem to overlap so completely with speech and the visual that they seem to be redundant, *eg*. locative gestures picking out the wicker basket or the burners on the balloon. There is much less redundancy when illustrating equilibrium for neither the speech nor the visual shows the directional interplay of forces, and even less when events and processes are described, *eg*. the tension in the cable of the bridge causing compression in the parapet, or the process of causing the Hot Air Balloon to rise. Also gestures make other communicative contributions for they are visual, spatial and actional and invite a sharing in this enactment with the presenter. But are these engagements are taken up by the audience? Our current experiments are considering the effects on learning and use a balanced design covering the four topics and four presenters and presentation formats with pre-test post-test measures that include free recall, comprehension and problem solving. The expectation is that these studies will show the utility of gestures and reinforce their roles in supporting learning through multimodal presentations.

6. References

[1] Mayer, R E, 2005 (Ed). *Cambridge Handbook of Multimedia Learning.* New York, Cambridge University Press.

[2] Moreno, R, 2006. Does the modality principle hold for different media? A test of the method—effects learning hypothesis. *JCAL*, 22; 3; 149-158.

[3] Ginnis, P, 2005. Meta-analysis of the modality effect. *Learning and Instruction*, 15; 313-331.

[4] Kendon, A, 1984. Do gestures communicate? A review. *Research on Language and Social Interaction*, 27; 175-200.

[5] Goldin-Meadow, S, Kim, S, and Sidger, M, 1999. What the teacher's hands tell the student's mind about maths. *J.Educ Psychology,* 48; 4; 720-730.

[6] Adams, J, Rogers, B, Hayne, S, Mark, G, Nash, J, and Leifer, L, 2005. The effect of a telepointer on student performance and preference. *Computers and Education,* 44; 1; 35-52.