Teaching with Visual Organisers to Learn How to Select and Apply Relevant Information for Decision-Making Within Tasks

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This study investigated the explicit teaching and use of visual organisers during everyday classroom practice to develop thinking skills for decision-making within tasks. Metacognition and organisation were identified as key areas that influenced decision-making (Costa, 1985; McGuinness, 1999). Within these areas, core thinking processes were targeted as an area where children needed mastery to ensure that, as adults, they have the skills to analyse a problem or task and make thoughtful decisions for their life and the society in which they live (Marzano et al. 1988). Deliberateness rather than impulsivity or thoughtlessness was the basis for building effective decision-making strategies. Therefore, the thinking behind decision-making had to be visible to ensure deliberate actions were taken. To address this metacognitive issue, visual organisers were used to explicitly teach thinking processes. Organisers also addressed organisational issues by providing structures for sorting information and making relationships visible. A design-based intervention within a case-study approach was used to infuse visual organisers in the primary classroom. Data were collected through pre- and post-testing and student visual-organiser helpfulness ratings. These were analysed both quantitatively and qualitatively. Conclusions drawn from this study found that the thinking behind the organiser needed to be explicitly taught and that students may benefit from the use of specific types of organisers to support and develop thinking skills for decision-making.

Introduction

Research has shown that many adults have difficulty in selecting and using relevant key information to make successful decisions in everyday life (Nutt, 2002c). Professor Paul C. Nutt, an author of over 100 journal articles and several books on decision-making, found through his 20 year study of 400 decisions, that adults tended to stay with a strategy they felt comfortable with when making decisions and, as a result, got caught in one or more of the following traps: embraced the first idea, failed to uncover concerns and resolve competing claims, overlooked other people's interests and commitments, limited the search for options, misused evaluations, ignored ethical considerations and/or failed to reflect on the outcome of their actions for future use (Nutt, 2002a). "Failure stems, not from events we cannot control, but from blunders that point unsuspecting decision-makers towards traps that ensnare them," stated Nutt (2002a). Consequently, poor decision-making skills created the problem of incorrect or lack of
selection and use of relevant information to make an informed decision for a specific purpose or situation to effectively achieve the desired result without adversely affecting the environment, others or self (Marzano et al., 1988; Tversky & Kahneman, 1974). To ensure this one-strategy-fits-all decision-making philosophy does not continue it has become an educational imperative for decision-making skills to be taught as core skills that children need to develop mastery in during their years of schooling.

**Decision-making**

Decision-making is making a choice in the face of uncertainty using a combination of beliefs and desires to decide on a course of action (Hastie, 2001; Langrehr, 1999; Tversky & Kahneman, 1974). For this study decision-making is the student's intentional selection and application of facts to answer questions and to do set tasks. One major difference between successful and unsuccessful decisions is the deliberateness rather than impulsiveness or thoughtlessness of thinking when making a decision (Nutt, 2002c). Children need to think about their own and others' thinking to develop patterns of thinking used by good decision-makers, patterns such as: planning, monitoring, adjusting, adapting, evaluating and reflecting (Costa, 1985). These are metacognitive issues. In Table 1, decision-making components and thinking skills are linked through an analysis of the reason for use and intended outcome for the learner to establish thinking skills as key components of decision-making (Marzano et al., 1988).

**Thinking**

The more conscious children are of thinking, the more aware they are of themselves as thinkers. The more aware of themselves as thinkers, the better children will understand thinking processes and be empowered to apply them at the appropriate time, in the appropriate way for the appropriate situation (Costa, 1985; Fisher, 1998). There are a myriad of thinking skills programs, frameworks and theories, none proven, on how to teach children effective and efficient thinking skills. Some approaches are based on cognitive psychology, others on neuroscience and still others on philosophy (Fisher, 1998; Fogarty, 2002; Woolfolk, 2001). Differences between these approaches relate to the structure of learning experiences to activate mental processes involved in thinking for application, understanding and transfer of learning, whereas commonalities between these approaches relate to metacognition, disposition, and integration of thinking into content and context.

In conjunction with patterns of thinking, children need skills in accessing and applying relevant key information for a specific purpose (Nutt, 2002b). This can be an arduous task in today’s information age where abundant amounts of conflicting information on any topic are easily accessible (Choo, 2000). Children need structures as visual strategies to select and sort information and make thinking explicit for informed decision-making (McGuinness, 2000). This is an organisational issue.

McGuinness's (2000) *Activating Children's Thinking Skills* (ACTS) infusion methodology is a metacognitive approach where visual organisers were infused into everyday classroom practice to clarify steps or components in the thinking process and made thinking explicit during discussions, co-operative and collaborative activities, evaluation and reflection. McGuinness stated that because thinking was a hidden skill,
visual organisers provided a language to talk about thinking and make it explicit (McGuinness, 2000). Visual organisers have a wide range of structures to suit specific situations or purposes for selecting and sorting information and understanding how things are related (Marton, Dall'Alba, & Beaty, 1993). Figure 1 is a flow chart illustrating the inter-relatedness of visual organisers, thinking skills and decision-making.

Table 1
Comparison of decision-making components and thinking skills
(Adapted from Costa, 1985, Triangles of decision-making and Marzano et al., 1988, Dimensions of thinking).

<table>
<thead>
<tr>
<th>THINKING SKILL</th>
<th>OUTCOME FOR LEARNER</th>
<th>REASON FOR USE</th>
<th>DECISION-MAKING COMPONENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Focusing</td>
<td>Direct attention to specific information.</td>
<td>Clarify problem situation. Establish direction and purpose.</td>
<td>Identify the problem. Set a goal and choose an option.</td>
</tr>
<tr>
<td>Information Gathering</td>
<td>Acquire relevant data.</td>
<td>Obtain information through one or more senses. Seek new information through questioning.</td>
<td>Gather information by researching. Gather information by questioning.</td>
</tr>
<tr>
<td>Organising</td>
<td>Arrange information so it can be used more effectively.</td>
<td>Order according to a given criterion for specific need. Compare and classify for sorting and grouping.</td>
<td>Prioritise needs. Analyse components and processes of plan.</td>
</tr>
<tr>
<td>Integrating</td>
<td>Connect and combine information.</td>
<td>Restructure by incorporating new information into existing knowledge.</td>
<td>Synthesise into coherent whole and make adjustments.</td>
</tr>
<tr>
<td>Analysing</td>
<td>Clarify existing information through deeper investigation of the parts.</td>
<td>Determine the characteristics of the parts and the relationship between them.</td>
<td>Analyse the likely outcomes from the plan.</td>
</tr>
<tr>
<td>Evaluating</td>
<td>Assess the reasonableness and quality of ideas</td>
<td>Confirm accuracy of the plan Identify errors or alternative ways. Establish criterion to make judgement about the plan.</td>
<td>Implement and monitor plan. Consider improvements. Report on the plan.</td>
</tr>
</tbody>
</table>
Information processing theories

Three information-processing theories in particular explain how and why visual organisers are important tools for thinking and learning. First, Paivio’s (1971) Dual Coding Theory proposes that information processed and stored in memory in both verbal and non-verbal forms, dual coded rather than either one or the other, is easier to retain and retrieve. He claimed that picture memory was superior to verbal memory because whenever a picture was seen, an individual would automatically represent it verbally but whenever a word was seen it was not always represented in image form. Visual Organisers are like road maps showing paths to organise information and connect meanings and relationships in a manner that makes it easier to understand, retain and recall (Crane, 1998; Dye, 2000).

Second, Bartlett’s (1932) Schema Theory proposes that memory takes the form of basic structures for organising information called schema which provide a mental framework for understanding and remembering information (Tip Psychology, 2003; Woolfolk, 2001). It is these schemas that determine how new information is dealt with (Sweller, 1994). Children often have difficulty grasping the connections between new and known
information and may ignore information that does not fit into their current schemata unless supported (Ferry, Hedberg, & Harper, 1997). Organisers can help children think in abstract ways and make connections that pull the pieces together to determine relationships for informed decision-making (Trepagnier, 2002).

Third, Sweller’s (1988) Cognitive Load Theory builds on Miller’s (1956) research of the limited capacity in short-term memory of manipulating seven chunks of information at any one time. The amount of information contained in these chunks depends on the types of schema or prior knowledge a learner has (Institute of the Advancement of Research in Education (IARE) at AEL, 2003). Organisers make connections visible between knowledge and information and promote inclusion of additional information for a greater likelihood of transfer and application (Novak, 1998).

**Visual organisers**

It should be made clear from the beginning that this study assumed visual organisers to be more than two-dimensional (2D) shapes (Crane, 1998; Dye, 2000). Broadly speaking, visual organisers are ways of communicating information in a condensed, precise way. For example, Physical Education is a visual organiser that uses spatial relationships, movement, timing and key words when modelling or instructing skills as a whole or in parts of a whole (Pangrazi, 2001). To throw a ball a student is shown to stand side-on, take the throwing arm way back, step forward on opposite foot and follow through with the throwing arm coming across the body. This is combined with use of key words for the actions of: side-on; arm back; step and follow through, for children to know how the movement feels and what is happening at each stage. By connecting verbal and movement components children then have a better understanding of what is required and can develop autonomous skills (Dillard, 2003; Pangrazi, 2001; PE Central, 2001). There are also science experiments, role-plays, computer simulations as well as visual art, graphs, maps, scales and co-ordinates. The list of areas where organisers are used is endless, but for visual organisers to be used effectively, both the teacher and the student need to be aware of their use and the thinking involved (Westhaver, 2003).

The types of thinking that visual organisers foster can be grouped under two main headings – bottom-up or top-down (Clarke, 1991). A bottom-up organiser starts with an example and through inductive reasoning a general principle is formulated (Clarke, 1991; Woolfolk, 2001). For example, by providing examples of land with and without erosion problems, students identified conditions that caused erosion and from this determined how to prevent it. By contrast, top-down organisers start with a general principle then use deductive reasoning to work down to specific examples (Clarke, 1991; Woolfolk, 2001). For example, students used their understanding of the water cycle to set up their own 'rain-in-a-bag' experiment. In short, bottom-up organiser thinking is inductive and top-down organiser thinking is deductive.

**Previous research**

Previous research studies have largely used organisers as visual 2D shapes for comprehension or conceptual understanding with varying success (Dunston, 1992; Griffin, Malone, & Kameenui, 1995; Griffin, Simmons, & Kameenui, 1991; Griffin & Tulbert, 1995; Institute of the Advancement of Research in Education (IARE) at AEL,
2003; Merkley & Jefferies, 2001; Moore & Readence, 1984; National Centre on Accessing the General Curriculum, 2001; Novak, 1998). The major reasons for mixed results seemed to pertain to:

- Organisers being implemented into the classroom as an isolated activity and added onto the current teaching methods instead of being a teaching method;
- Teacher/Researcher constructing the organisers, rather than student, and therefore organisers did not activate student prior knowledge and motivate students to engage in learning;
- Control groups not using organisers actually using an organiser just a different type to the other group such as a list which is a structured overview;
- Testing focusing on content learning and not the thinking within the content to develop understanding; and
- Testing being linguistic through verbal or written answers rather than student construction of their own visual organiser.

Research design

In view of the findings from previous research and the findings from the pilot study, where organisers were identified as more than 2D shapes, combined with a review of literature on decision-making, thinking skills and visual organisers, this study adopted a post-positivist paradigm using a design-based experiment within a descriptive case study approach to infuse visual organisers into everyday classroom practice. As such both qualitative and quantitative data were collected for a rounded view of the research (Cohen, Manion, & Morrison, 2001; Verma & Mallick, 1999; Schulze, 2003). Figure 2 depicts the research design.

![Research design of study](image)

Figure 2.
Research design of study.

Case study

A case study approach was taken for two main reasons. Firstly, for a better understanding of the dynamics behind children's organiser use and decision-making through gathering evidence of interactions within a practical situation (Merriam, 1988;
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Nisbet & Watt cited in Verma & Mallick, 1999). Secondly, to ensure construct validity and reliability of the research design. The complexity of ensuring the control group was not using an organiser of some form (such as a map, poster, retrieval chart, list or computer image commonly used and displayed in the classroom) voided the selection of research methodologies that used control groups in their design (Cohen et al., 2001; Yin, 1994). To overcome issues of selection in this approach, a design-based intervention was engineered to collect multiple sources of data for comparing empirically-based patterns (Yin, 1994). The greatest weakness of case studies is whether the sample is representative of the population. Therefore the onus is on the reader to discern whether this case study can be applied to their or other situations (Hancock, 1998; Verma & Mallick, 1999).

**Design-based intervention**

A major problem with educational research is that each classroom possesses a unique culture and set of goals and therefore the same intervention in a different classroom is likely to elicit different results (Cook, 2001). This leads to the problem of making research accessible to teachers in practice. A design-based experiment blends both research and practice and employs many of the same processes used in planning a unit of work (Shavelson, Phillips, Towne, & Feuer, 2003). This invention was designed to address three key areas (Brown, 1992):

- to explicitly teach and use the thinking behind the organiser to develop thinking skills for decision-making,
- to collect evidence of student's using organisers for decision-making, and
- to document the implementation of the intervention for future use by others.

The researcher-teacher therefore had to know and understand the key concepts to be covered in the unit of work to plan the type of organiser to use for the type of thinking needed as well as the type of evidence to collect of student learning and understanding. In doing so, the evidence gathered throughout the study could be used for reporting on both the study itself and student learning.

**Data gathering instruments**

Pre- and post-tests were used to evaluate student's decisions on the selection and use of relevant, key information about a specific topic for a specific task prior to and after the 4-week intervention. Both the pre-test and post-test consisted of student's constructing their own organiser of how water entered the ocean and answering three questions. Note: the questions were provided for clarification of visual representations rather than for relational purposes. Criteria used to grade the tests were based on curriculum standards to ensure performance changes from no understanding to some understanding to deeper understanding could be rated as similar (Gay & Airasian, 2003). For example, tests graded as showing no understanding depicted a cloud and rain over the ocean with no acknowledgement of catchment areas, tests graded as showing some understanding depicted clouds and rain falling on mountains and flowing out to the ocean and tests graded as showing deeper understanding drew arrows for water evaporation and condensation into clouds before precipitation, clearly marked runoff into a river and
labelled mouth of river. Some also included discolouration of water as it flowed out to the ocean.

Instruments used to gather data within the intervention included participant observations, teacher researcher notes and reflections, supervising teacher's comments, and student artefacts of interaction with organisers. Also, three organiser helpfulness response sheets were used as specific measures of student's reaction to organisers. The response sheets consisted of a thumbnail of each organiser being rated by the student, an attitudinal scale to rate the helpfulness of the organiser in making decisions within the task and an area to write which organiser was the most helpful and why and which was the least helpful and why. Note: Figure 3 is an overview of the layout of a response sheet and is to be viewed rather than read. These data were used for content analysis and pattern recognition (Yin, 1994).

![Organiser Rating Response Sheet]

**Figure 3.**
Overview of the layout of an organiser rating response sheet.

**Site and participants**
The main study was conducted in a rural-residential, outer-Brisbane school. Two Year six classes, a total of 57 students, currently taught together in a team-teaching situation, participated in the study. Both classes consist of high to high-mid academic achieving students. Two students had been identified with Autistic Spectrum Disorder; one student had been diagnosed with Asperger's Syndrome, and one student who had emotional issues had a break schedule to prevent behavioural problems and assist with learning goals.

**Results**
Descriptive statistics of central tendency measurements, frequency, significance tests and content analysis were used to quantify events and explain the overall pattern of complexity of how visual organisers had or had not supported students' decision-making within set tasks (Gay & Airasian, 2003; Yin, 1994). Through this pattern-matching
framework the appropriate relationship links were analysed and conclusion drawn (Yin, 1994).

Pre-post test analysis
A student-constructed visual organiser was selected as the tool to measure change, as students needed conceptual understanding of the parts within the topic matter to represent them diagrammatically. It was proposed that test results would improve through explicitly teaching and use of visual organisers to learn thinking skills that thereby enabled student to use key information when making decisions on how to answer test questions. To look for this pattern in the data, test results out of 15 were ranked from lowest to highest pre-test score and displayed in graphic format omitting one-test only results. Results showed an improvement in all but two of the 39 participants who completed both tests. A paired t-test confirmed that students performed better in the post-test ($m = 9.6, sd = 1.8$) than the pre-test ($m = 5.7, sd = 1.3, t (47) = 14.26, p = .000$). This noted improvement in student’s post-test scores indicated that explicit teaching and use of organisers for selecting and applying relevant information had been beneficial for decision-making needed within this task.

Also emerging from this analysis was an apparent pattern of a large improvement in student post-test scores for those who had achieved low pre-test scores and a small improvement in student post-test scores for those who had achieved high pre-test scores. Results from frequency graphs showed the distribution of scores were skewed. More students had scored at the lower end than the higher end of the scale in the pre-test end and the opposite had occurred in the post-test. A test of correlation between pre-test scores and the improvement in scores confirmed that there was a significant negative correlation between the two ($r = -.304, p = .018$). Measures of central tendency of the same pre-test score by the post-test difference clearly showed that the mean average improvement of low (3 –6) pre-test scores ($m = 4.3$) was greater than that of high (7 – 9) pre-test scores ($m = 2.5$). Both tests confirmed that students with lower pre-test scores showed greater improvement than those with higher pre-test scores. Alternative answers for these results, such as ceiling effect or gender, were investigated but no significance was found. Further research is needed to know why the explicit teaching of organisers benefited students with lower pre-test scores more than students with higher pre-tests.

Organiser helpfulness response sheets analysis
Although the researcher could observe how organisers helped students with tasks, the degree of helpfulness to students could not be measured in a valid, reliable way through observation only. Therefore to ensure construct validity of helpfulness measurements students, as the experts who used the organiser for the task, were asked to complete an organiser rating response sheet (Tashakkori & Teddlie, 1998). This type of judgemental validity was useful in defining and evaluating organiser attributes as students had differing opinions about the helpfulness of organisers used in tasks (Tashakkori & Teddlie).

Analysis of response sheets revealed that in Rating 1 (recorded in Week 1) the students rated the bottom-up organisers ($m = 4.0, sd = .18$) more helpful than the top-down organisers ($m = 3.7, sd = .08$), with the number eight bottom-up organiser as the
most helpful and number six a top-down organiser as the least helpful. In Rating 2 (Week 2), students rated bottom-up ($m = 3.7, sd = .33$) and top-down ($m = 3.8, sd = .40$) organisers relatively equally with the number three top-down organiser as the most helpful and number one bottom-up organiser as the least helpful. In Rating 3 (Week 3) students rated top-down organisers ($m = 4.0, sd = .16$) more helpful than bottom-up organisers ($m = 3.5, sd = .10$) with the number five top-down organiser as the most helpful and the number 2 bottom-up organiser as the least helpful. The overall pattern of organiser helpfulness seemed to be bottom-up organisers in the introductory phase of a new topic leading to the use of both during the investigation phase with top-down organisers being preferred by students to synthesise information and demonstrate learning in the final phase.

Paired t-tests were conducted on the organiser rating by type to confirm that the statistical differences between top-down and bottom-up means were relative to the variability of scores (Trochim, 2000). Results as shown in Table 2, showed that students rated bottom-up organisers more helpful in Rating 1 ($t(7) = 2.411, p = .026$) and less helpful in rating 3 ($t(5) = -3.67, p = .033$) while the reverse was true for top-down organisers. A test of correlation further confirmed the significant negative correlation between Rating 1 and organiser type ($r = -.919, p = .013$) and Rating 3 and organiser type ($r = -.991, p = .043$).

Table 2
Paired t-tests of organiser rating mean by organiser type

<table>
<thead>
<tr>
<th>RATING/TYPE</th>
<th>TOP-DOWN MEAN</th>
<th>BOTTOM-UP MEAN</th>
<th>T-TEST (p value)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rating 1</td>
<td>3.681</td>
<td>4.002</td>
<td>0.026</td>
</tr>
<tr>
<td>Rating 2</td>
<td>3.755</td>
<td>3.704</td>
<td>0.372</td>
</tr>
<tr>
<td>Rating 3</td>
<td>4.061</td>
<td>3.500</td>
<td>0.033</td>
</tr>
</tbody>
</table>

The open-ended written responses were then analysed by frequency to see if they supported the analysis of organiser ratings. Results showed that in Rating 1 students found bottom-up organisers most helpful (89.5%) and top-down organisers the least helpful (60.5%), while in Rating 3 students found top-down organisers most helpful (77%) and bottom-up organisers least helpful (75%). This pattern of responses supported the previous results from analysis of organiser ratings by type and is further supported by content analysis of student's comments. A common comment on the helpfulness of organisers was "It helped me see what I needed to do". Results from this analysis indicate that students prefer particular types of thinking organisers at different stages in learning.

Conclusion
For this particular classroom and set of students, the infusion of visual organisers into everyday classroom practice resulted in an overall deeper understanding of key subject matter that thereby enabled students to select and use relevant information when deciding
how to demonstrate their knowledge and understanding in the post-test. A pattern of bottom-up organisers in the initial stages of the topic linked current understanding to new learning and provided a base for students to construct deeper understanding of the topic matter. This was combined with a pattern of top-down organisers preferred by students to demonstrate their knowledge and understanding in the synthesising stage of the four-week teaching period.

These findings have many implications for classroom use. Foremost is the importance of both the teacher and the student being aware of the thinking behind the visual organiser and the key concepts within the task. Next in importance is the use of specific types of organisers at specific stages of learning such as bottom-up inductive thinking organisers in the initial stages of new learning and top-down deductive organisers in the latter stage of learning when demonstrating understanding. It should not be assumed that by using a certain type of organiser students develop a particular type of thinking; the teaching of the thinking behind the organiser has to be explicit (Clarke, 1991). This metacognitive process develops effective patterns of thinking for a repertoire of skills in decision-making (Costa, 1985; McGuinness, 2000).

Finally, further research is needed on decision-making strategies used by students and the impact these strategies have on the choices students make in their daily life. Decision-making is a key skill used throughout life and as such has a huge impact on life choices and life courses. As Nutt's (2002c) 20-year study found, poor use of information and a one-strategy-fits-all decision-making philosophy generally results in poor choices, some of which can have far-reaching effects. Therefore, there is not only an educative need to ensure students develop a repertoire of decision-making strategies for their future but also a research imperative to shed light on ways that this may be facilitated.

References
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