Vol. 18, No. 2, April 2008 ISSN 0853 - 0920

WIDYA DHARMA

Majalah Ilmiah Kependidikan

Terakreditasi kembali (B), November 2005

Diterbitkan oleh Lembaga Penelitian Universitas Sanata Dharma
Jln. Gejayan, Mrican, Tromolpos 29, Yogyakarta 55002
E-mail : widya_dharma@staff.usd.ac.id

WIDYA DHARMA

Majalah Ilmiah Kependidikan

WIDYA DHARMA adalah majalah ilmiah kependidikan yang terakreditasi dan diterbitkan oleh Lembaga Penelitian Universitas Sanata Dharma, dua kali setahun : Oktober dan April. Majalah ini memuat laporan penelitian, pemikiran, dan pertimbangan buku tentang pendidikan

Redaksi menerima naskah, baik yang berbahasa Indonesia, maupun yang berbahasa Inggris. Naskah harus ditulis sesuai dengan format yang berlaku di WIDYA DHARMA, dan harus diterima oleh Redaksi paling lambat dua bulan sebelum terbit. Isi karangan yang dimuat tidak selalu mencerminkan pandangan Redaksi.

ALAMAT REDAKSI

FKIP, Universitas Sanata Dharma
Tromol Pos 29, Yogyakarta 55002
Telepon : (0274) 513301, 515352 Fax. : (0274) 562383
E-mail : widya_dharma@staff.usd.ac.id

WIDYA DHARMA

Majalah Ilmiah Kependidikan

DAFTAR ISI

EDITORIAL

Mencermati laporan jurnalistik selalu menarik meskipun tidak akan selengkap dan serinci laporan ilmiah. Tahu sedikit-sedikit tentang banyak hal. Inilah substansi laporan jurnalistik.

Kompas (8 Maret 2008) menyajikan laporan jurnalistik tentang penyelenggaraan pendidikan di berbagai daerah di Indonesia; mungkin lebih tepat tentang potret realisasi dari persepsi pimpinan suatu daerah tentang pendidikan. Hanya dua laporan dikutip di sini.

Di sebuah provinsi di Kalimantan, Kutai Kartanegara merupakan kabupaten terkaya di Indonesia, dengan representasi fisik yang berupa berbagai gedung (pemerintah, swasta, rumah pejabat, dan tauke) yang megah, berarsitektur perpaduan modern dan lokal; dan masih dilengkapi Taman Wisata Pulau Kumala di tengah Sungai Mahakam.

Tetapi, apa yang terjadi tentang potret pendidikan di kabupaten terkaya itu. Sebuah SMP, negeri, urutan 1, yang terletak di jantung kota, bangunannya sudah rapuh dan bocor. Sebuah SD filial, di kabupaten itu juga, terpaksa memanfaatkan rumah warga.

Sebaliknya, di sebuah provinsi di Sumatera, Musi Banyuasin merupakan kabupaten yang tertinggal. Tetapi, apa yang diperbuat oleh bupatinya? Sejak tahun 2002, biaya sekolah (SD hingga SMA, negeri maupun swasta, dan madrasah) digratiskan; juga buku pelajarannya. Guru mendapat berbagai fasilitas: uang makan, seragam dinas, bantuan transportasi, pengangkatan guru honorer, dan peningkatan kemampuan malalui program wajib kuliah. Anggaran pendidikan dibuat melebihi ketentuan: tahun 2007 sebesar 22,79%, tahun 2008 menjadi 24,23%.

Sebagai bahan refleksi, mengapa terjadi keadaan yang bertolak belakang seperti ini: di daerah kaya, pendidikan "terabaikan", di daerah miskin, pendidikan "terangkat"?

Ternyata, kepedulian pemimpinnyalah yang menjadi kuncinya. Indonesia membutuhkan orang-orang seperti itu; juga di pimpinan teras republik ini.

A.M. Slamet Soewandi

INSTRUCTIONAL ANIMATIONS IN ENGLISH PREPOSITION LEARNING: IS HIGH-TECH DELIVERY EFFECTIVE?

Y.G. Harto Pramono

ABSTRACT

This article explores the instructional effectiveness of "high-tech" and "low-tech" animations in supporting the learning of English prepositions by Indonesian primary school students. It reports on a study in which participants were presented with simple English sentences from each of which a motion preposition had been omitted. These sentences were accompanied by either "high-tech" or "low-tech" animations representing the dynamics of the missing preposition. Subjects were required to identify the target preposition from a list of four alternatives. The results indicated that the high-tech animations were not intrinsically superior to low-tech counterparts. These findings show that the technological level of animation alone does not determine its effectiveness in supporting learning. Rather, it appeared that the animation's design features (and not the sophistication of the presentation technology) was central to instructional effectiveness. In order to support learning, animations must be appropriately designed, irrespective of the technology used to present them. Implications for developing and using instructional animations are discussed.

Keywords: "low-tech" and "high-tech" animations, mental model building, animation design features, preposition learning

I. INTRODUCTION

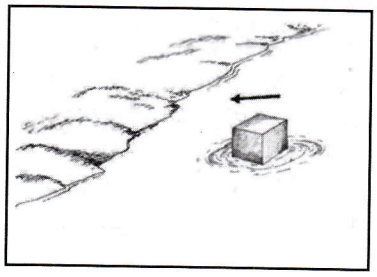


Figure 1. An example illustration accompanying an incomplete sentence.

Pictures are widely used to complement texts (written and verbal information) as part of second and foreign language teaching. The illustrations that accompany texts are intended to facilitate learners' acquisition of language components in several ways. This includes the application of a picture-text combination involving the presentation of a sentence, for example, "*The box floats* _____ *the beach*," in which the preposition is blanked out, with students being required to produce or choose the correct change-related (motion) preposition (that is, *towards*) on the basis of information given in the illustration (see Figure 1). The sentence contains a target object (*the box*), that is, the object to be located, and

Y.G. Harto Pramono, Ph.D., A Teaching Staff of the English Departement, Widya Mandala Catholic University, Surabaya

the reference object (*the beach*), that is, the object in relation to which the target object is located. The referent situation represented via the sentence and its accompanying picture involves *dynamic* information, that is, the motion of the target object towards the reference object. The dynamic information can be presented via static or dynamic illustrations. Both static and dynamic illustrations are thought to contribute to learning through their role in constructing mental models, which are "situational representations that an individual constructs as the need arises. Once constructed, a mental model provides a basis for thinking about the represented situation" (Lowe, 1993: 226).

With the advent of new technologies, dynamic information is often presented via dynamic visuals such as animated pictures, instead of, or as an adjunct to, static visuals. Animations are dynamic depictions that can be used to make change processes *explicit* to the learner. Thus, by their nature, animated pictures convey the dynamic information of a situation *explicitly* or *directly* compared to static pictures which also convey the dynamic information but *indirectly.* Further, animated pictures can show information about two important visual attributes: *motion* and *trajectory*, where trajectory refers to the direction of the path of travel of an animated object (Rieber, 1994). Animations can provide information about an object's motion (if it is moving) and how it is moving (its path, patterns, etc). They can also show information about which way the object is moving.

The dynamic information of a situation can be *directly* represented by either *low* technology or *high* technology animations. Low-tech animations refer to physical manipulations of images presented manually, rather than via computers. These low-tech animations provide a direct external representation of a situation's dynamics by showing change in position without the need for computing equipment. The direct external representation of a situation's dynamics, in high-tech animations, is presented as computer-based versions. However, because the goal of animations is simply to make the necessary dynamic information explicitly available, it is the dynamics that matter, not the sophistication of the technology used to present them *per se*. This of course assumes that low-tech and high-tech animations are able to present the dynamic information in ways that are equally effective.

However, as was the case with static illustrations, design features also influence the effectiveness of animations in supporting learning to the extent that they facilitate the construction of appropriate dynamic mental models (see Pramono, 2005). Because low-tech animations are restricted in the range of design features they can readily provide, it was also considered necessary, in this research, to explore the effectiveness of high-tech animations that offer more opportunities for manipulating design features. Thus, this paper compares the effectiveness of direct external representations of situational dynamics provided by "low-tech" animations with that provided by "high-tech" animations. The aim of this paper is to determine which design features of animations are most likely to foster students' capacity to select change-related prepositions most

appropriate for use in ambiguous incomplete text expressions.

2. SUPPORT OF ANIMATED ILLUSTRATIONS FOR MENTAL MODEL BUILDING IN ENGLISH PREPOSITION LEARNING

Although animations have been commonly used in educational materials, the animations are often use d to impress rather than to teach (Rieber, 1994). Few studies have been conducted on the use of animations to facilitate learning and their results are inconsistent (see Mayer and Anderson, 1991; Poohkay and Szabo, 1995; Rieber, Boyce, and Assad, 1990). It is possible that dynamic presentation is more effective than static presentation, as animated pictures convey both *structure* information and *process* information. Animations may enhance the construction of dynamic mental models, which can be "run" in mental simulations to represent the dynamics of the subject matter (Schnotz and Grzondziel, 1996). In some domains involving dynamic information (motion), animations can be better than static pictures because the phenomenon being explained is too complex to be mentally simulated. As dynamic illustrations offer a complete model for generating a mental representation of motion, and so reduce the level of abstraction of temporal ideas, they should support a deeper understanding than is the case with static pictures (Park and Hopkins, 1993). When static pictures are used, learners are forced to infer this model on their own. Therefore, it is expected that animations will be more helpful in fostering the learning process if motion is a relevant aspect of the learning material (Lewalter, 2002).

In a number of studies, however, animations resulted in lower performance than static pictures. A study conducted by Wolfgang Schnotz and Harriet Grzondziel (1996) comparing learning from static pictures and animated pictures of time zones of the earth found that learners who had access to the animated pictures did not perform better in questions requiring the use of mental simulations. Schnotz and Grzondziel conclude that the use of animated pictures can result in a more superficial processing of the subject matter compared with the use of static pictures. Dorothy Chun and Jan Plass (1996) found a similar effect for second language vocabulary acquisition, where students who used the text and picture annotations scored higher on the follow-up vocabulary test than students who used text and video annotations. Further, Richard Lowe's (1999) research indicates that "in some circumstances, animations may not be instructionally superior to static depictions because the processing demands involved can have negative effects on learning" (p.225). It is possible that, in some conditions, static presentations will be more effective than animations, especially when learners have the knowledge necessary to mentally simulate processes from the static pictures. Moreover, there is a risk that providing people with external simulations can prevent them from developing their ability to mentally simulate complex events.

Although the findings from research on animations in instructional material are mixed to some degree, animations still appear to have significant potential for use in computer-based instruction (Milheim, 1993). A previous study conducted by the author on the effectiveness of static illustrations used to present prepositions learning, revealed that well-designed static illustrations could improve learners' capacity to choose the change-related (motion) prepositions that were most appropriate for use in ambiguous incomplete text expressions (Pramono, 2005). The support given by these illustrations was attributed to their function in helping learners build effective mental models that appropriately represented the situational dynamics. Thus allowed learners to disambiguate an incomplete sentence sufficiently to identify the preposition required for its proper completion (see the model of text-picture comprehension proposed by Schnotz, Böckheler and Grzondziel, 1999). Static illustrations also support learning by constraining the possible interpretations of a situation represented in text in which more than one preposition can be utilised to complete the sentence (Ainsworth, 1999).

The author's previous research indicates that not all static illustrations were equally effective in providing the required disambiguation (Pramono, 2005). This lack of effectiveness may have its origins in the inability of static illustrations to represent situational dynamics *explicitly*. Accordingly, learners must correctly infer the changes involved in the depicted situation in order to build an appropriate dynamic mental model. The necessity for inference could be circumvented by using *animated* illustrations that can provide a *direct external* representation of a situation's dynamics. The use of animation for such a case was also recommended by Anthony Galton (2002) who suggests that the most appropriate illustrative scenarios to present to learners in investigation of change-related prepositions would be *animated* sequences. For the studies presented in this paper, the problematic static illustrations (from the previous study) were converted into appropriate animations (low- and high-tech animations), aimed to determine which design features of animations were most likely to foster students' capacity to select intended prepositions most appropriate for use in ambiguous incomplete text expressions. The first study utilised low-tech animations and the second study utilised high-tech animations that offer more opportunities for manipulating design features.

2. STUDY 1. EFFECTS OF LOW-TECH ANIMATION IN THE DIRECTION OF LEARNERS' CHOICE OF INTENDED PREPOSITIONS

2.1 Method

This first study explored the effects of direct external representation of situational dynamics provided by low-tech animations in directing learners' choice of prepositions. Sixty nine primary school students in Surabaya completed two separate tests: change-related (motion) prepositions and general proficiency in English prepositions, with a

one week interval between the two tests. Schools were selected on the basis of their students' good command of English (that is "average to above average"), especially prepositions, because the research was about the role of animations, and so required the language aspect to be a non-problematic variable. Moreover, these schools provided students from a mixed range of socio-economic groups.

The test of general proficiency in English prepositions assessed the subjects' mastery of the target (change-related) prepositions for the purpose of isolating the effect of design variables. The materials used for this purpose covered all the prepositions used in the test of change-related prepositions—both the target prepositions (dynamic) and the distractors (static and dynamic)—but the context for each item and types of options were different. The two tests had different purposes, which determined the use of different supporting media. The test of general proficiency in English prepositions utilised three-dimensional objects, rather than static illustrations, to represent the missing preposition in each expression. Under these conditions, students' inability to choose the intended prepositions would be more likely to be due to problems with the prepositions themselves.

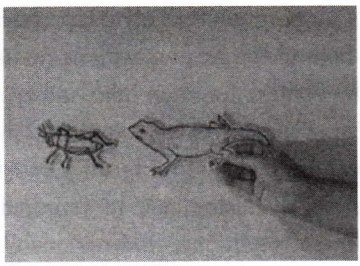
The test of change-related prepositions was used to explore the effects of direct external representation of situational dynamics provided by low-tech animations on the direction of learners' choice of particular prepositions. This test consisted of six "less effective" static illustrations found in a previous study (see Pramono, 2005), that is, those that could not direct at least 80% of all participants to choose intended answers. These six items containing "less effective" static illustrations are presented in Table 1.

Table 1
The Six Items Containing "Less Effective" Static Illustrations

1.	The balloon goes (away from, towards, towards or away from, over) the tree.
2.	The boy on the scooter moves (forwards, backwards, forwards or backwards, along) in the circle.
3.	The lizard walks (behind, away from, towards, towards or away from) the grasshopper.
4.	The boy on the unicycle moves (backwards, forwards or backwards, forwards, along) in the circle.
5.	The box floats (towards, away from, near, towards or away from) the beach.
6.	The kangaroo jumps (out of, into, near, into or out of) the bush.

These items were converted into animations. This test was essentially the same as the test used in the static illustrations, that is, it was a multiple-choice test with a set of simple incomplete sentences in English from which the change-related preposition had been omitted. Each written incomplete sentence was accompanied by a brief animated illustration based closely upon the original *static* illustrations. While the static illustrations in the previous study had been presented close to each incomplete sentence

and alternative answers (printed on the same A4 paper), the animated illustrations used in this present study were presented as large cardboard cut-outs that could be manipulated by the investigator to show the situational dynamics as explicit behaviour of the subject matter. One example can be seen in Figure 2. The investigator presented the animations to participants in classroom settings on the white-board, item by item. Participants indicated their choices by marking them on a printed response form.



The lizard walks _____ the grasshopper.

a. towards
b. away from
c. towards or away from
d. behind

Figure 2. An Example Item of The Test of Change-Related Prepositions.

To determine the effect of the direct external representation of the situational dynamics presented via low-tech animation, data from the six problematic static illustrations (previous study) were compared with those from the corresponding items of the animated versions (present study). The effectiveness of the animated versions was measured by the proportion of students choosing the intended prepositions. Only data from the students who passed a test of general proficiency in English prepositions (N=58 out of 79) were included in the analysis.

2.1 Results

The overall rate at which intended responses were chosen for problematic static items was lower than that for the corresponding animated items (69.2% static; 78.6% animated). Figure 3 presents more detailed analysis of the data. The results show that there was considerable variation in the difference between animated and static versions. For example, there was a marked difference in the choice frequency between static and animated versions of the "kangaroo" item. By contrast, for the "balloon" item the choice rate for the animated version was lower than for the static version. The difference for other items was only marginal.

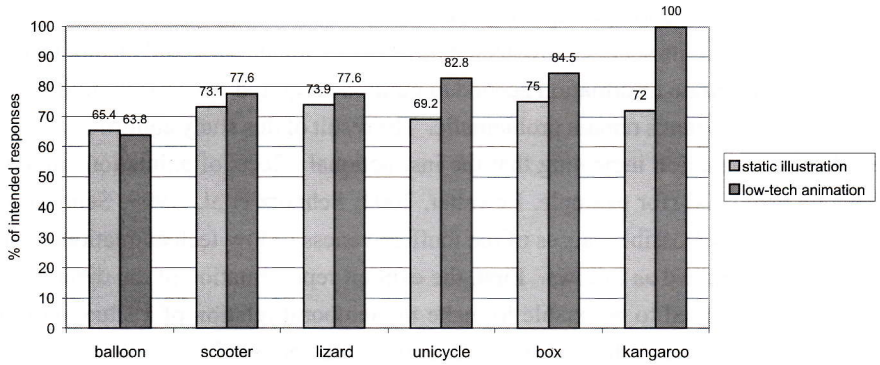


Figure 3. Rate of Intended Responses for Static Illustrations Vs. Low-Tech Animations.

Although the *overall* rate at which intended responses were chosen was higher for the animated versions than for the corresponding static versions, this general superiority was not reflected for all individual items. Some were still problematic. Low-tech animations for which the choice rate was less than 80% were considered less effective. Figure 3 shows that the kangaroo, box, and unicycle items were effective, whereas the balloon, scooter, and lizard items were less effective.

2.1.3 Discussion

The results of the study show that direct external representation of a situation's dynamics provided by low-tech animations was, to some extent, able to circumvent the problematic items that were not accounted for by the dynamic cues provided by static illustrations. Compared with static illustrations, it appears that animation is more likely to represent the situational dynamics needed to build the required dynamic mental model that produces the intended choice of change-related prepositions. This result can be related to the literature on whether or not there are advantages of animations over static presentations (for example, Rieber et al., 1990).

Possible reasons for the success of low-tech animations over static illustrations under the specific condition of the present study can be suggested as follows. First, with animation the motion of the target object becomes explicit and salient. This, to some extent, can affect the spatial relation of the referent situation to be less dominant over the temporal relation. Motion provided by animation appeared to be able to overcome the problems that occurred with "unicycle," "box," and "kangaroo" items in static illustrations in which a "locational" preposition was the main chosen distractor; this locational preposition was powerful in static illustrations but became less powerful when the dynamics of the referent situation was explicitly represented in low-tech animations. Second, besides motion, a trajectory of a target object can also be made explicit by animation. Sometimes the presence of motion alone may not help, but when motion is incorporated with an accurate trajectory, together they can be synergistic to effectively

make the temporal relation perceptually more salient than the spatial relation.

Apart from its success, low-tech animation, in some cases, still cannot provide complete and accurate information needed to build the required dynamic mental model. Accordingly, some items remain problematic. The result of this study confirms a number of studies on animation indicating that the instructional effects of animations may not always be beneficial (for example, Lewalter, 2002; Schnotz et al., 1999; Schnotz and Grzondziel, 1996). Possible causes of the ineffectiveness of low-tech animations in this study can be explained as follows. First, the explicit representation of the dynamics of a target object seemed to be unable to make the temporal relation of a situation more salient than the spatial relation. Consequently, both temporal and spatial relations seemed to appear equally compelling. This allows students to create two possible mental models: one is a mental model of a situation representing a temporal relation and the other a model representing a spatial relation. As a result, choosing the intended preposition was problematic. Second, problems with the dominance of spatial relations over temporal relations cannot always be overcome by low-tech animation. Particular items remain problematic: "balloon," "scooter," and "lizard" items. For these items, the locational preposition appeared to be a powerful distractor. It can be concluded that low-tech animations are limited in their ability to provide an accurate trajectory of target objects in relation to the reference object.

With regard to items that remained problematic, it was decided to investigate whether they could be improved if the accompanying animated illustrations were redesigned via high-tech animation. This issue was dealt with in the subsequent study presented below.

3. STUDY 2. EFFECTS OF HIGH-TECH ANIMATION IN THE DIRECTION OF LEARNERS' CHOICE OF INTENDED PREPOSITIONS

The previous study indicated that animation (via low-tech animations) can further disambiguate the dynamics of referent situations and so help direct student choice towards particular change-related prepositions. However, in some cases, the animations used still did not provide sufficient disambiguation. One possible reason for this relative lack of effectiveness is that particular designs of the animations used were deficient. To investigate this possibility, these animations were redesigned and presented as computer-based versions (referred to here as high-tech animations). A key reason for changing to computer-based animation was that it allows for a wider range of design possibilities to be explored than does the low-tech animation used for the previous study. For example, to illustrate the textual information, *The boy on the scooter moves forwards in the circle,* it is possible to give the animated target object ("the boy on the scooter") a wider range of trajectories in relation to the reference object ("the circle") and provide a clearer distinction between them by using computer-based animation. It is also more accurate to implement certain types of design features

via high-tech animation. For example, to show the trajectory of the animated target object ("the balloon") in *The balloon goes away from the tree* via low-tech animation, the balloon should be moved in the direction away from the tree by hand, but the hand movement may cause distraction or interference on the accuracy of the trajectory intended. As a result, it can distract learners' construction of an intended mental model of the referent situation. This possible distraction may be avoided when the animation is presented via computer. The study explored effects of the redesigned animations in directing learners' choice of intended change-related prepositions.

3.1 Method

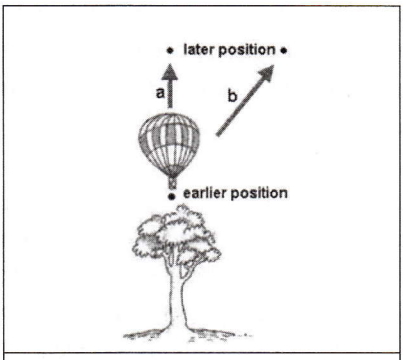
Fifty nine primary school students in Surabaya (aged 9-10 years) completed a test of change-related prepositions. A week after completing this test, they completed a test of general proficiency in English prepositions as an instrument to isolate the effect of design variables. The test of general proficiency in English prepositions was identical to that used in Study 1. The test of change-related prepositions covered all "low-tech" animation items used in Study 1. These items were converted to high-tech forms. Items that were found to be effective in Study 1 (that is, 80% or more of participants chose the intended answers) were converted without being redesigned; this conversion simply involved reproducing the items in a computer-based rather than a paper-based format. However, those that had proven to be relatively ineffective in the paper-based format (that is, fewer than 80% of all participants chose the intended answers) were redesigned. The redesigned animations included 3 items: lizard, balloon and scooter items; whereas the equivalent designs included 3 items: unicycle, box and kangaroo items. Being equivalent, these three items had the same animation design in both low-tech and high-tech formats.

The bases upon which the new (redesigned) animations were made were an analysis of the illustration itself and interviews with the subjects. There appeared to be two main reasons why the original designs (in low-tech animations) could cause animations to be less effective.

Visuospatial aspects of the original animation's design. The first reason why the original low-tech animations were less effective was that the visuospatial aspects of the original animation's design likely were more influential than its dynamic aspects. Although the dynamic information was present in the less effective low-tech animations, it might not be acquired by students because the dynamics were perceptually *less* salient than the visuospatial aspects. The lack of perceptual salience of task-relevant dynamic information could be due to the particular visuospatial arrangements used in the original animation's design that resulted in attention being directed to the visuospatial rather than the dynamic aspect. These included the following three factors.

The first of these factors relates to the inappropriate trajectory of the animated

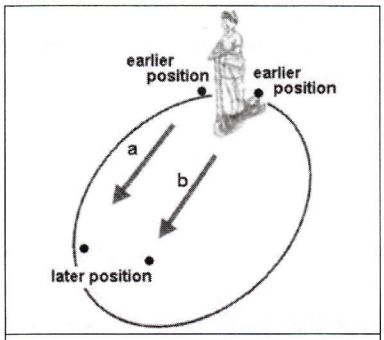
target object. An item having an inappropriate trajectory of the animated target object is *The balloon goes _____ the tree.* In the original design of this item, the trajectory of the animated target object ("the balloon") ran *vertically* above the reference object ("the tree") as indicated by arrow "a" in Figure 4. The alternative answers for this item were "away from," "towards," "towards or away from," and "over." The intended answer was "away from" and the main chosen distractor was "over." For students who chose "over" instead of "away from," the visuospatial aspect of the original design could appear more salient than its dynamic aspect as the position of the balloon was directly over the tree. Consequently, the design could allow these students to build a mental model of the referent situation representing a spatial rather than temporal relation between the target and reference objects. This model then could produce the choice of the inappropriate preposition "over" instead of the intended one "away from." In order for the animation to support the construction of the intended dynamic mental model, the original design with respect to the visuospatial arrangement had to be changed to enable the dynamic aspect to appear more salient than the visuospatial aspect. One possible way to do this was that the trajectory of the animated balloon was changed from *vertically* to *diagonally* above the tree as indicated by arrow "b" in Figure 4. The new trajectory was assumed to help support the construction of a relevant *dynamic* mental model that could produce the choice of the intended change-related preposition "away from."



a. Original trajectory
b. Redesigned trajectory

Figure 4. An Example of Redesigned Animation with Respect to A Change in Trajectory.

The second visuospatial factor concerns the inappropriate positioning of target objects in relation to reference objects, with respect to proximity. In the original design of the item *The boy on the scooter moves _____ in the circle,* the trajectory of the animated target object ("the boy on the scooter") was *close to* the boundary of the reference object ("the circle") as indicated by arrow "a" in Figure 5. The alternative answers were "forwards," "backwards," "forwards or backwards," and "along." The intended answer was "forwards" and the main chosen distractor was "along." For students who chose "along" instead of "forwards," the closeness of the target object to the reference object's boundary could direct their attention to the visuospatial aspect rather than the intended dynamic aspect of the reference situation. Consequently, this arrangement allowed them to build a mental model of the referent situation representing a spatial rather than temporal relation between the target and reference objects. The model then could produce the choice of the unintended preposition "along" rather

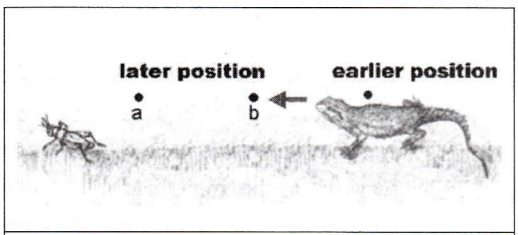


a. Original trajectory
b. Redesigned trajectory

Figure 5. An Example of Proximity Design.

than the intended change-related preposition "forwards." In order for the design to provide more support for the construction of the intended dynamic mental model that could produce the choice of the intended preposition "forwards," the visuospatial arrangement had to be changed in a way that could enable the dynamic aspect to appear more salient over the visuospatial aspect of the animation. One possible way to do this was to change the trajectory of the animated target object, which was originally *close to* the reference object's boundary (see arrow "a" in Figure 5) to *far* from it, as indicated by arrow "b" in Figure 5.

Reference objects used within the depiction. The second reason why the original low-tech animations were less effective was that the reference objects used within the depiction introduced an additional source of ambiguity with respect to the situational dynamics. An item having an ambiguous reference object in terms of the situational dynamics is *The lizard walks _____ the grasshopper*. In the original design of the item, the reference object was "the grasshopper" (asymmetrical) and its head position was in a parallel direction with the target object "the lizard." In addition, the later position of the trajectory of the animated lizard was *close to* the grasshopper as indicated by "a" in Figure 6. The item required the intended preposition "towards." The distractors were "away from," "towards or away from," and "behind;" the most chosen distractor was "behind." For students who chose "behind" instead of "towards," the *closeness* (in position) between lizard and grasshopper could result in the students' attention being directed to the visuospatial aspect rather than the dynamic aspect of the situation. This could allow students to build a mental model of the referent situation representing a spatial relation (rather than a temporal relation) that could produce the choice of the unintended preposition "behind." In order that students' attention was more directed to the dynamic aspect than the visuospatial aspect, the later position of the trajectory of the animated lizard was changed from "*close to*" to relatively "*far*" from the grasshopper as indicated by "b" in Figure 6. In this new design, the relatively *far* distance between the lizard and the grasshopper was assumed to make the visuospatial aspect appear less



a. Original later position of trajectory
b. Redesigned later position of trajectory

Figure 6. An example of Redesigned Animation with Respect toReference Object Ambiguity.

perceptually compelling than the dynamic aspect. Consequently, the design was more likely to help the construction of the intended dynamic mental model of the referent situation that could produce the choice of the intended change-related preposition "towards" rather than "behind."

3.2 Procedure and Data Analysis

Prior to the test, participants were given an introduction to the purpose of the study and how they had to work with animations using the computer. The procedure was essentially the same as used in Study 1, except that participants worked with the animations individually on the computer, and each incomplete sentence and its accompanying animation were displayed on the monitor. As before, students indicated their choices by marking a printed response form.

To determine the effectiveness of the redesigned animations, results from non-problematic and problematic low-tech animation items (in Study 1) were compared with those from the corresponding items in high-tech animations (in Study 2). Only data from participants who passed the test of general proficiency in English prepositions were included in the analysis (N=46 out of 59).

3.3 Results

Figure 7 compares results from the low-tech animations with those from high-tech animations for items that were not problematic versus problematic in low-tech animations. For non-problematic items the designs used in high-tech animations were equivalent with those used in low-tech animations, whereas for problematic items the designs used were different, that is, while low-tech animations used original designs, these original designs were redesigned and used in high-tech animations. The results overall showed that for equivalent designs (that is, for non-problematic items), the rate at which intended responses were chosen for low-tech animations was comparable with that for high-tech animations. In contrast, the choice rate for the redesigned high-tech animations (that is, for problematic items) was more than 10% higher than that for low-tech animations (70.7% original designs; 81.4% redesigned). Thus, although not compared directly via experiment, simply putting animation into high-tech form does not seem to change choice rate over low-tech form.

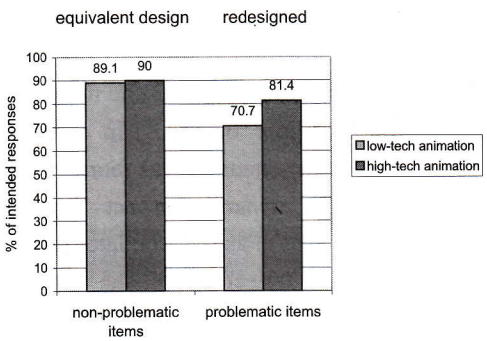


Figure 7. Overall Rate of Intended Responses for Non-problematic vs. Problematic Items Presented Via Equivalent Designsvs. Redesigned Animations.

Closer examination of the

data shows that, for non-problematic items, the choice rates for equivalent designs in low-tech and high-tech animations were comparable. These non-problematic items included "kangaroo," "box," and "unicycle." Concerning problematic items, the results presented in Figure 8 show that not all the intended response rates for the redesigned animations were higher than for the original designs. For most items, the choice rates were higher for the redesigned animations than for the original designs, that is: "scooter" and "balloon." But for "lizard," the choice rate was lower than for the original designs. Thus, the redesigned animations for "lizard" item still remained problematic.

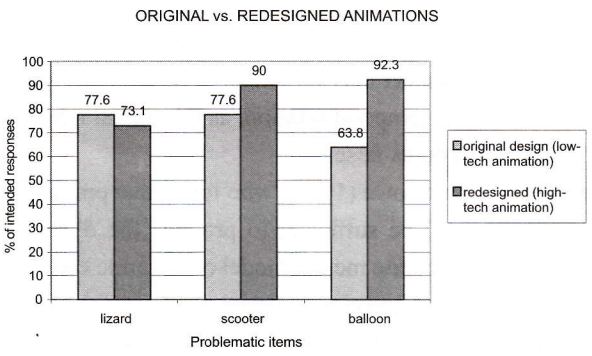


Figure 8. Rate of intended responses for problematic items presented via original designs vs. redesigned animations.

3.4 Discussion and conclusion

The overall findings from these studies are consistent with the verbal-visual processing model proposed by Schnotz, Böckheler and Grzondziel (1999), that is, illustrations in texts facilitate the construction of mental models. An appropriate illustration can support the construction of a mental model and an ambiguous illustration may hamper the construction of an appropriate mental model. The results of the studies show that simply putting animation into high-tech forms does not seem to enhance its effectiveness over low-tech forms in helping learners construct an appropriate dynamic mental model and so directing learners towards the intended choice of change-related preposition for sentence completion. The results indicated that the high-tech animations were not intrinsically superior to low-tech counterparts. These findings suggest that the technological level of animation alone does not determine its effectiveness in supporting learning. Rather, it appeared that the animation's design features (and not the sophistication of the presentation technology) was central to instructional effectiveness.

Effective animation design features are those that are able to make the intrinsic perceptual characteristics of spatial relations less dominant over those of the temporal relations depicted. Some redesigned high-tech animations, however, still cannot make the intrinsic characteristics of the spatial relations appear to be less dominant over those of the temporal relations; consequently, they cannot disambiguate the dynamics of the referent situation, such as a problem with lizard item. For the lizard item, changing the later position of the trajectory of the animated lizard from "*close to*" to "*far*" from the grasshopper still appeared to be unable to minimise the salience of the visuospatial

aspect over the dynamic aspect. The grasshopper's asymmetricality still appeared to be perceptually salient so that learners' attention was directed to the visuospatial aspect rather than the dynamic aspect; as a result they tended to choose the preposition *behind.* As manipulating the trajectory of the animated target object was not an effective solution, other possible redesigns need to be explored for further research, such as replacing the asymmetrical reference object with a symmetrical one (such as "stone"), or changing the trajectory of the target object from horizontal to diagonal, similar to the case of the "balloon." By doing so, the visuospatial aspect may no longer raise the possibility that the spatial relation is more salient than the temporal relation, as the spatial relation showing the *behind* prepositional relation becomes false.

The findings of the two studies support Lowe (1993), who found that providing animation in the depiction, may not, of itself, be sufficient to produce the dynamic information required for learners to build an accurate mental model of dynamic content. The findings suggest that effective animations in learning material need careful design and that an instructional designer may need to consider all features in the depiction, in addition to the animation itself. These features include all the entities (the target object itself and the reference object), their visuospatial arrangement, and the visual context as a whole. These should be arranged to support the effectiveness of animation because, as these studies indicate, animation alone, without the support of other features, can be ineffective.

Because the relative superiority of high-tech animations over low-tech animations is due to their capability in providing more informative designs, the findings of the studies imply that the use of animated illustrations to facilitate the construction of an intended dynamic mental model of a referent situation is not merely a matter of providing visually explicit information. Design features can be of central importance to the effectiveness of animated illustrations and in order to support learning, animations must give emphasis to the salient features of the dynamic information presented.

REFERENCES

Ainsworth, S. 1999. "The Functions of Multiple Representations". *Computers and Education, 33*, 131-152.

Chun, D.M., and J.L. Plass. 1996. Effects of Multimedia Annotations on Vocabulary. *The Modern Language Journal, ii*, 183-198.

Galton, A. 2002. *The Semantics of Motion Prepositions.* [Online]. Available: http: //www.dcs.ex.ac.uk/studyRes/COM3401/ag.html, January 26, 2003].

Lewalter, D. 2002. "Cognitive Strategies for Learning from Static and Dynamic Visuals". *Learning and Instruction, Article in press.*

Lowe, R. K. 1993. "Constructing a Mental Representation from an Abstract Technical Diagram". *Learning and Instruction, 3*, 157-179.

Lowe, R. K. 1999. "Extracting Information from an Animation During Complex Visual

Learning". *European Journal of Psychology of Education, 14* (2), 225-244.

Mayer, R. E., and R. B. Anderson. 1991. "Animations Need Narrations: an Experimental Test of A Dual-coding Hypothesis". *Journal of Educational Psychology, 83* (4), 484-490.

Milheim, W. D. 1993. "How to Use Animation in Computer Assisted Learning". *British Journal of Educational Technology, 24* (3), 171-178.

Park, O., and R.Hopkins. 1993. "Instructional Conditions for Using Dynamic Visual Displays: A Review". *Instructional Science, 21*, 427-449.

Poohkay, B., and M.Szabo. 1995. "Effects of animation and visuals on learning High School Mathematics". [Microfiche]: Available: ERIC Document: ED 380122.

Pramono, H. 2005. "Pictures in Foreign Language Preposition Learning". *Widya Dharma, 15*, 125-139.

Rieber, L. P. 1994. *Computers, Graphics, and Learning*. Madison: Brown and Benchmark.

Rieber, L. P., M. J.Boyce, and C.Assad. 1990. "The Effects of Computer Animation on Adult Learning and Retrieval Tasks". *Journal of Computer-Based Instruction, 17*, 46-52.

Schnotz, W., J.Böckheler, and H.Grzondziel. 1999. "Individual and Co-operative Learning with Interactive Animated Pictures". *European Journal of Psychology of Education, 14*, 245-265.

Schnotz, W., and H.Grzondziel. 1996. "Knowledge Acquisition with Static and Animated Pictures in Computer-based Learning". [Microfiche]: Available: ERIC Document: ED 401 878.

BIODATA PENULIS

Wanty Widjaja, Ph.D.

Dosen Prodi Pendidikan Matematika, FKIP, Universitas Sanata Dharma, Yogyakarta sejak 1996 setelah menyelesaikan studi di Prodi Pendidikan Matematika. Menyelesaikan studi doctoral (Ph.D) dari *Melbourne Graduate School of Education, The University of Melbourne*, Australia pada tahun 2008 dengan thesis berjudul "*Local Instruction Theory on Decimals: the Case of Indonesian Pre-Service Teachers*" dengan beasiswa AusAID. Mendapatkan gelar *Master of Education in mathematics education* dari Boston University, USA pada tahun 2002 dengan beasiswa *Kelly Stephens memorial scholarship*. Bidang penelitian yang menjadi minat meliputi desain pembelajaran untuk memperbaiki pengetahuan calon guru matematika, peningkatan integrasi guru di sekolah dalam peningkatan pengetahuan calon guru matematika dan penelusuran miskonsepsi siswa dalam berbagai topik matematika.

Kaye Stacey

Foundation Professor of Mathematics Education in Melbourne Graduate School of Education, The *University of Melbourne. Kaye Stacey is an internationally renowned researcher, teacher, educator and author. Her books include Thinking Mathematically, Strategies for Problem Solving, and Graphic Algebra, she has written over one hundred and fifty research papers and practically-oriented articles for mathematics teachers and edited several CD-ROM resources for teaching, including Learning and Teaching about Decimals. She was Head of the Department of Science and Mathematics Education from 1992 until 2000, and is now leader of the Science and Mathematics Education Cluster in the Education Faculty.*

Professor Stacey's research interests centre around students' mathematical thinking and problem solving, mathematics curriculum issues, and the impact of new technology on curriculum, assessment and teaching. Graduate students are working in all of these areas. Professor Stacey has a keen interest in teacher education, and teaches in the undergraduate pre-service course for primary teachers. Her research has been funded mainly by the Australian Research Council.

Kaye Stacey has been awarded a Centenary Medal by the Australian Government for outstanding service to mathematics education. She is a Special Professor of Mathematical Education at the University of Nottingham, U.K.

Vicki Steinle, Ph.D.

Dr. Vicki Steinle is a lecturer of mathematics education and researcher in Melbourne Graduate School of Education, The University of Melbourne. Dr Steinle's PhD thesis, "Changes with Age in Students' Misconceptions of Decimal Numbers" reports on a longitudinal study of students' understanding of decimal notation. Over 3000 students, from a volunteer sample of 12 schools in Victoria, Australia, completed nearly 10000 tests over a 4-year period. The number of tests completed by individual students varied from 1 to 7 and the average inter-test time was 8 months. The diagnostic test used in this study, (Decimal Comparison Test), was created by extending and refining tests in the literature to identify students with one of 12 misconceptions about decimal notation. Both teachers and researchers in mathematics education (Australian and international) have shown considerable interest in this research. This research has implications for the teaching of decimal numbers in the primary and secondary school. Dr Steinle is currently in working in ARC research grant "Supporting Personalised Learning in Secondary Schools Through the Use of Specific Mathematics Assessments that Reveal Thinking" with Prof. Kaye Stacey and Dr. Helen Chick.

Y.G. Harto Pramono, Ph.D.

Lahir di Pati, 29 Januari 1960. Lulus dari FKSS (Fakultas Keguruan Sastra dan Seni), Jurusan Pendidikan Bahasa Inggris, IKIP Sanata Dharma Yogyakarta (sekarang Universitas Sanata Dharma) pada tahun 1984. Kemudian ia menjadi dosen pada Program Studi Pendidikan Bahasa Inggris, FKIP, Universitas Katolik Widya Mandala, Surabaya sampai sekarang. Pada tahun 1996 ia menyelesaikan pendidikan S2 dalam bidang Teknologi Pembelajaran pada Program Pascasarjana IKIP Negeri, Malang (sekarang Universitas Negeri Malang) dan pada tahun 2005 ia memperoleh *Doctor of Philosophy* dalam bidang yang sama dari Curtin University of Technology, Australia. Bidang utama penelitian yang ia minati yaitu media pembelajaran bahasa, *visual learning* dan pembelajaran bahasa berbantuan komputer.

Dr. Paul Suparno

Dosen Pendidikan Fisika pada Universitas Sanata Dharma (USD), Yogyakarta. Ia mendapatkan gelar BA filsafat pada STF Driyarkara, Jakarta 1975; sarjana Ilmu Pasti Alam pada IKIP Sanata Dharma, Yogyakarta, 1982; sarjana Filsafat Teologi pada Institut Teologi Wedabhakti, Yogyakarta, 1982; gelar MST Fisika pada Boston College, 1992; dan doktor Pendidikan Sains pada Boston University, AS, 1996. Pernah menjadi Dekan FKIP, USD tahun 1997 – 2001; dan Rektor USD tahun 2001 – 2006.

Buku Pendidikan yang telah diterbitkannya, antara lain : *Filsafat Konstruktivisme dalam Pendidikan*, penerbit Kanisius (1997); *Roh Baik dan Roh Jahat* (1998); *Teori Perkembangan Kognitif Jean Piaget* (2001); *Problema Manusia Indonesia*, (eds.)(2001); *Menuju Pembelajaran Aktif*, (eds, dkk.)(2001); *Reformasi Pendidikan*, (dkk.)(2002); *Pendidikan Budi Pekerti di Sekolah*, (dkk.)(2002); *Pendidikan Budi Pekerti untuk SMA-SMK*, (dkk.)(2003); *Teori Inteligensi Ganda dan Alikasinya di Sekolah* (2004); *Pendidikan Budi Pekerti di SMP* (2004); *Guru Demokratis di Era Reformasi*, Grasindo (2004); *Miskonsepsi dan Perubahan Konsep Pendidikan Fisika* (2005); *Metodologi Pembelajaran Fisika Konstruktivistik* (2007); *Metode Penelitian Pendidikan Fisika* (2007); dan *Kajian Kurikulum IPA SMP dan MT, USD* (2007).

Fajar Santoadi, S.Pd.

Lahir di Wonosobo, 6 Februari 1976; lulus Sarjana Pendidikan (Program Studi Bimbingan dan Konseling, JIP, FKIP), Universitas Sanata Dharma, tahun 2003; Pernah bekerja di Lembaga Studi Pengembangan Perempuan dan Anak (LSPPA-Divisi Pendampingan Anak Jalanan Perempuan) (2001-2003) dan Anak Wayang Indonesia (AWI), Divisi Pendampingan Anak (2003-2004); Bersama tim pendamping anak AWI Indonesia memfasilitasi 'belajar Menulis' anak-anak kampung Bangunjiwo, Bantul dan menerbitkan buku 'Belajar Dari Kampung' (sebagai editor diterbitkan oleh Anak Wayang Indonesia) akhir tahun 2004; Sejak tahun 2004 mengajar di Program Studi Bimbingan dan Konseling, Universitas Sanata Dharma, Yogyakarta. Penulis berminat pada persoalan pendidikan anak di luar sekolah, bimbingan dan konseling karier, pengelolaan proses kelompok (*group proses*), spiritualitas dan filsafat timur, dan saat ini membantu pengembangan perpustakaan komunitas di Kampung Patang Puluhan, Wirobrajan (Komunitas Baca 'Satu Sembilan', RT 19, RW 04, Patang Puluhan).

Yohanes Maria Vianey Mudayen, S.Pd.

Lahir di Tikul Batu, Kalimantan Barat, 27 Juli 1980. Mendapatkan gelar Sarjana Pendidikan Ekonomi dari Universitas Sanata Dharma Yogyakarta tahun 2002. Saat ini sebagai staf pengajar pada program Studi Pendidikan Ekonomi, FKIP, Universitas Sanata Dharma Yogyakarta.

Drs. Paulus Agustinus Rubiyanto

Lahir di Sleman, 16 September 1944. Mendapatkan gelar Sarjana dari Institut Keguruan dan Ilmu Pendidikan (IKIP) Sanata Dharma, Yogyakarta, Jurusan Ilmu Ekonomi, tahun 1973. Mengikuti Kurus ke-SD-an di La Trobe University, Melbourne, Australia, tahun 1994. Saat ini sebagai staf pengajar pada Program Studi Pendidikan Ekonomi, FKIP, Universitas Sanata Dharma, Yogyakarta.

Prof. Dr. Laurie Bauer

Memperoleh gelar Ph.D. dari Edinburgh University, Skotlandia. Menjadi Staf Pengajar Linguistik di Victoria University of Wellington, Selandia Baru sejak 1979. Telah mengedit, menulis, dan menerbitkan sejumlah karya ilmiah serta buku, antara lain, *English Word-Formation* (1983), *Perspectives on Word: A Workbook for Senior Students (1984),Introducing Linguistic Morphology* (1988, edisi kedua 2003), *Vocabulary* (1998), *Morphological Productivity* (2001), *An Introduction to International Varieties of English* (2003), *A Glossary of Morphology* (2004), *Approaches to Conversion/Zero-Derivation* (2005), *Language Matters* (2006) dan *The Linguistics Student's Handbook* (2007).

Dr. St. Suwarsono

Lahir di Bantul, Yogyakarta, pada tanggal 26 Juli 1949. Pada tahun 1974 lulus Sarjana pada Jurusan Ilmu Pasti dan Alam IKIP Sanata Dharma, Yogyakarta. Pada tahun 1976 meraih gelar Bachelor of Education (B.Ed.) dalam bidang pendidikan matematika, di Monash University, Australia. Pada tahun 1982 meraih gelar Doctor of Philosophy (Ph.D.) dalam bidang pendidikan matematika, juga di Monash University, Australia. Pada tahun 1994 melakukan studi banding di Amerika Serikat, dalam bidang pendidikan matematika. Pada tahun 1996 mendapat kepercayaan menjadi penguji disertasi di University of Newcastle, Australia. Sejak tahun 1975 menjadi dosen tetap pada Program Studi Pendidikan Matematika Universitas Sanata Dharma, dan sejak tahun 1999 juga menjadi dosen dan pembimbing disertasi pada Program S-3 Pendidikan Matematika, Universitas Negeri Surabaya.

INDEKS JUDUL DAN PENGARANG WIDYA DHARMA
VOL. 18, 2007-2008

PERSYARATAN ARTIKEL UNTUK WIDYA DHARMA

PERSYARATAN UMUM

1. Semua naskah yang dikirimkan ke Widya Dharma harus merupakan karya asli, dan belum pernah diterbitkan di media lain.
2. Naskah sebanyak dua tiras (eksemplar) dikirimkan dalam bentuk cetakan, disertai *file* dalam disket, dan dikirimkan ke Redaksi Widya Dharma selambat-lambatnya dua bulan sebelum waktu terbit.
3. Isi pernyataan dalam artikel adalah tanggung jawab penulis.
4. Penulis yang naskahnya layak terbit di Widya Dharma wajib memperbaiki gaya penulisan, isi karangan dan kesalahan-kesalahan tipografis.
5. Naskah yang tidak layak terbit di Widya Dharma tidak dikembalikan, kecuali atas permintaan penulis, dengan menyertakan prangko secukupnya.
6. Naskah dikirimkan ke alamat Redaksi Widya Dharma: FKIP, Universitas Sanata Dharma, Tromol Pos 29, Yogyakarta 55002, Telepon: (0274) 513301, 515352; Fax: (0274) 562383) E-mail : widya_dharma@staff.usd.ac.id
7. Naskah diketik rapi pada dua sisi (kiri-kanan), di kertas kuarto dengan spasi rangkap, dengan jenis huruf *times new roman* ukuran 12, kecuali untuk kutipan langsung yang lebih dari empat baris yang harus diketik satu spasi dan di-*indent*.
8. Panjang naskah sekitar 15-20 halaman, tidak termasuk daftar pustaka.
9. Pengiriman naskah disertai biodata penulis.

FORMAT KARANGAN

1. Artikel yang berisi lontaran gagasan atau pemikiran harus berisi bab-bab: (1) pendahuluan, (2) bagian isi, yang terdiri dari judul dan jumlah bab-babnya sesuai dengan subtopik dan jumlah sub-subtopik yang akan diuraikan, dan (3) penutup.
2. Artikel yang berisi laporan penelitian harus berisi bab-bab: (1) pendahuluan, (2) metodologi penelitian, (3) temuan penelitian dan pembahasan, dan (4) penutup.
3. Bagian lengkap dari artikel: (1) judul artikel (semua huruf besar, tegak, tebal [*bold*])), (2) nama penulis (huruf besar-kecil, miring, tidak tebal, tanpa gelar), (3) identitas penulis (ditulis sebagai catatan kaki, huruf besar-kecil, miring, tanpa tanda bintang [*] atau angka), (4) abstrak (sekitar 200-300 kata dalam bahasa Inggris; berisi seputar permasalahan, metodologi, temuan-temuan penting, dan kontribusi karangan), (5) kata-kata kunci (sekitar 3-10 kata), (6) pendahuluan (judul bab dengan huruf besar, didahului dengan nomor angka Arab, (7) judul-judul bab bagian isi (semuanya huruf besar, didahului oleh nomor angka Arab), (8) penutup (judul bab dengan huruf besar), (9) catatan, kalau ada (semua huruf besar), (10) daftar pustaka (judul dengan huruf besar), dengan urutan alpabetis, dan hanya memuat literatur yang dirujuk dalam artikel.
4. Penulisan referensi diurutkan: (a) nama penulis (dimulai kata terakhir untuk nama pengarang pertama), (b) tahun terbit, (c) judul artikel (dalam tanda petik) diikuti judul majalah atau harian (huruf miring), tahun (volume), dan halaman; atau judul buku (dengan huruf miring) diikuti tempat terbit, dan nama penerbit. Contoh:

   Soewandi, A.M. Slamet. 1996, April. "Sistem Pendidikan Berdasarkan Pendekatan Kompetensi". *Widya Dharma*, Tahun VI, No. 2.

   Lerner, R.M. dan G.B. Spanier. 1980. *Adolescent Development: A Life-Span Perspective.* New York: McGraw Hill.

5. Kata asing, atau kata daerah yang belum menjadi kata serapan dicetak dengan huruf miring tanpa tanda petik.
6. Catatan referensi dituliskan di dalam teks sebagai *body-notes*, ditulis dengan empat kemungkinan: (1) nama, tahun, dan halaman semuanya di dalam kurung, (2) hanya tahun dan halamannya di dalam kurung, sedangkan nama di luar kurung, (3) nama di luar kurung, dan tahun di dalam kurung, (4) nama dan tahun di dalam kurung. Referensi yang berupa kutipan langsung, atau ringkasannya dituliskan halamannya. Contoh catatan referensi:

   (Winkel, 1997: 97-98); Winkel (1997: 97-98); Winkel (1997); (Winkel, 1997).

7. Catatan yang berupa tambahan informasi diberi nomor urut dengan angka Arab ditulis dengan sedikit diangkat, dan dituliskan pada akhir naskah (pada bagian CATATAN), sebelum daftar pustaka.
8. Kutipan lebih dari empat baris diketik dengan spasi tunggal, di baris baru, dan di-*indent*, tanpa tanda petik (tanda kutip). Kutipan kurang dari lima baris dituliskan sebagai sambungan kalimat teks, dengan diantarai tanda kutip rangkap ("...").