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### Observe and explore: empirical studies about learning in creative writing and the visual arts

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# OBSERVE AND EXPLORE

Empirical studies about learning  
in creative writing and the visual arts

Talita Groenendijk



Talita Groenendijk Observe and Explore. Empirical studies about learning in creative writing and the visual arts



UNIVERSITY OF AMSTERDAM

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OBSERVE AND EXPLORE  
EMPIRICAL STUDIES ABOUT LEARNING IN  
CREATIVE WRITING AND THE VISUAL ARTS



UNIVERSITEIT VAN AMSTERDAM

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OBSERVE AND EXPLORE

EMPIRICAL STUDIES ABOUT LEARNING IN  
CREATIVE WRITING AND THE VISUAL ARTS

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## **PREFACE**

I was familiar with participant observation and observation in life drawing classes, but observational learning was new to me when I started working on this research project in September 2006. I had little experience with experimental, quantitative research and writing processes. I am glad that Gert, Tanja and Huub introduced me to this research area. First I want to thank my promotor, Gert, for his support and trust. I guess it was not always easy to coach me, but you were always positive, warm and helpful. Without your support and feedback this dissertation would not have been finished. You were involved in every part of the research process: you and Tanja developed the research plan, you gave me helpful feedback and valuable advice concerning the experiment design, the intervention, data collection, data analyses and the resulting papers. I would also like to thank Tanja who was always very quick in reviewing my documents, I am grateful for the advice and feedback. I would like to thank Huub, who was indispensable for the analyses and who was always prepared to answer my endless number of questions. The Shadish, Cook, & Campbell reading club would have been nothing without you!

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A special group is the ‘Kenniskring’ at the Amsterdam School of the Arts. It is very nice to be part of such a warm group of arts education researchers. You have shown me another side to arts education and arts education research, which has left its traces in this dissertation. Above all I am very grateful to Folkert who gave me valuable advice, contributed to symposia and offered me the opportunity to develop myself broader in arts education research. Emiel’s enthusiasm and positive attitude inspired me. Working with Marike and Robert on the altermodern project is a pleasure and certainly contributes to the development of my ideas about arts education and arts education research. I would like to thank Marjo for always being interested and giving me good advice!

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My squash friends: Sophie, Catherine and Marieke, it was nice to play squash after a day of work. You could always notice the progress of the day; does she hit the ball hard, softly, does she see the ball at all? Sameena, Judith, Noelia, Nicole, Liselotte, Marieke, Anna, Carla, Kirsten, thank you for listening and understanding, for being positive and providing me with very nice distractions from work! Noelia, I needed those yoga classes!

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## Chapter 1

### INTRODUCTION

#### 1. MINI-C CREATIVITY

Beghetto and Kaufman (2007) predict that mini-c creativity will play a role in new developments in creativity research and theory. Mini c-creativity represents one side of the continuum ranging from mini-c creativity via little-c creativity towards Big-C creativity. Big-C creativity is creativity by eminent persons who have produced extraordinarily creative products in, for example, music, science or the visual arts. Little-c creativity is everyday creativity, which can be acquired by almost anyone after some schooling or experience. Mini-c creativity is even smaller, everybody has experienced mini-c creative moments while engaged in the execution of tasks. It is micro level creativity, taking place in the context of a process, at the cognitive level.

A product can be considered creative if it is both novel and appropriate (Amabile, 1982). Whether something is creative in a Big-C sense or in a little-c sense depends on judgments by others. Creative performances can be compared and evaluated for originality and appropriateness. Mini-c creativity, however, relies on intrapersonal judgment. It is a very personal creativity, located within the work process. Whereas Big-C and little-c creativity are product qualifications, mini-c creativity is a more dynamic, process-based understanding of creativity. A mini-c creative moment can be a single decision in the process of making a painting. Because of this process focus, there is a strong link between mini-c creativity and learning. Learning as personal knowledge development through interpretation, transformation and reorganization of new and existing knowledge involves mini-c creativity.

According to Beghetto and Kaufman (2007) it is interesting to study when, why and how a new discovery in a learning process takes place. It allows one to study what cognitive behaviour preceded a discovery and what behaviour followed after the discovery. Transitions from mini-c creativity to little-c creativity and sometimes

even to Big-C creativity are interesting learning processes, which may be studied through microgenetic methods such as process tracking.

From an educational perspective, these mini-c creative moments are important, because they are related to learning. In this dissertation we included an empirical study on the writing of poetry, which provides insight into these mini-c creative processes in poetry writing by secondary school students. Insight into mini-c creative processes enabled us to design experimental lessons to support artistic creativity via observational learning. The other two empirical studies in this thesis describe and discuss the effects of observational learning on students' creative processes and creative products. Observational learning is learning through observing others, peers in our case, at work. We studied the effect of having students observe, compare and evaluate mini-c creative moments of peers. We showed these mini-c creative moments by using videos with peer models who thought aloud while being engaged in creative work. We hypothesized that students would learn from observing these mini-c creative processes.

In Figure 1 we present a mini-c creative case from our observational learning videos (experiment chapter 4). First the context of the video is described: the task the video model works on (designing a bag for a foundation for cardiovascular diseases). Then we present the thought steps of the model in the video: the student model does not know yet what he will do with colour. At first he thinks the background and the handles of the bag he is designing need to be the same colour: green, but then he abandons this idea. The work-in-progress cues him to make the handle resemble a 'neck', which he had not planned before. After colouring he sees that the pink and blue handles resemble a real blood circulation system in which oxygen rich blood and oxygen poor blood meet, as he learned in his biology classes. This is an appropriate solution as he is designing a bag for the Dutch Foundation for Cardiovascular Diseases. The student decided to keep this idea and elaborate the final product as shown in Figure 1. The observational learning videos we used included such 'good models' as well as weak examples. We assumed that especially the contrast between approaches of weak and strong models stimulates students to pay attention to the relevant mini-c creative processes.

## 2. OBSERVATIONAL LEARNING IN SECONDARY ARTS EDUCATION

In upper secondary education, art education aims at developing students' creative processes. As part of their final examination in visual art, students have to demonstrate a creative process characterised by investigation, many sketches and seeking alternatives. Ideally, the final collection consists of many half products and try outs and some final products. Moreover, students have to be able to verbalize their work process and compare it to the work process of artists. How can we teach students effectively to demonstrate this type of processes and reach this level of reflective competence?

Figure 1: Video case- experiment Chapter 4

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#### Context of the video

The model in the video is designing a bag for the Dutch Foundation for Cardiovascular Diseases. He is working on a sketch. The design briefing states that the foundation has a special campaign to reach women. Therefore, the student started to sketch male and female silhouettes. The video starts when the model starts to think about the colour he will use.

#### Thought steps of the video model

- 1) What can I do with colour?
- 2) The female silhouette will be pink, that is more feminine
- 3) The male silhouette will be blue, that is more masculine
- 4) The background will be green
- 5) Maybe the handle can be another colour than the background
- 6) Maybe I can make the handle the neck of the silhouette.
- 7) So then I will make half of the handle pink, the other half blue
- 8) Hey! It is just like a real heart, as in biology!

#### Sketch



#### Final design



#### Task for the observing students:

The student in the video discovers something.  
Please, arrange the thought steps of the student in the video in the right order.

(the 'thought steps' above were presented in random order)

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Many teachers provide students with direct instruction about fixed process steps ('strategies'), such as brainstorming and making a collage, towards the production of a final work. Sometimes, students even have to produce a fixed number of sketches at certain stages in the creative process. Usually students have to keep process logs during their work with the purpose of reflecting on their processes. But in our experience this reflection is not always meaningful to students, as it is generally known that in some cases students write a completely fictitious process report and produce the missing sketches afterwards. The question is whether simply *telling* students to take certain process steps actually *teaches* them how to do this. We assumed that students may learn from observing others, who talk and think aloud while at work. This observation may provide them with information of what a certain creative sub process actually entails. We hypothesized that observation of others leads to better results on both product and process than practice only or practice guided by process steps.

In this thesis we focus on students in the 9th and 10th grade<sup>1</sup> as they are about to start learning about the creative process. Does observation help them to engage in more effective processes and make more creative products? Does it work similarly for visual arts, which are taught in school, and poetry writing, which is not taught in Dutch schools?

### 3. ORGANIZATION OF THE THESIS

Chapters 2,3 and 4 of this thesis are based on published or submitted articles. We chose to present the text of these chapters in this article format, which makes the chapters independently readable. However, for this reason, the theoretical sections of the chapters overlap to a certain extent.

As we described above, the aim of this research project was to examine the effects of observational learning for creative, artistic tasks. Observational learning is a form of (cognitive) modelling. Students learn from observing and evaluating overt behaviour and thought processes of others. Following Braaksma, Rijlaarsdam, & Van den Bergh (2002) we decided to implement observational learning through video modelling. So, students observed and evaluated others, peers in this case, by watching videos. To produce observational learning videos, we first needed to examine the behaviour and cognitive processes of students when engaged in creative work. This was the purpose of the first experimental study: we studied students' creative processes while working on poetry tasks.

In chapter 2 we describe the poetry writing processes of students in secondary education. We relate these processes to the quality of their final poems. The writing processes of the students were recorded with a keystroke logging program called 'Inputlog'. This enabled us to virtually replay the writing sessions and code the actions of the students. The composition process was described with regard to frequency and organization of text production, pausing and various revision activities.

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<sup>1</sup> US grade 9 and 10 are equivalent to Dutch grade 3 and 4 of secondary education.

We found that different students distribute their writing activities differently over the writing process. The stronger poems were preceded by a lot of text production at the start of the writing session and many revisions on a large scale at the end of the writing session. Although Inputlog only enabled us to study overt behaviour (and no cognitive processes), we experienced that the work-in-progress in combination with the students' actions provided us with useful insights into creative processes of secondary school students when they are writing poetry.

In chapter 3 we report on a second empirical study. In this experimental study we examined the effect of observational learning on the production of poems and collages by secondary school students. Findings from the poetry study in chapter 2 and actual student behaviour were combined with findings from the literature about creative processes to produce observational learning videos. We conducted two experiments, one in the domain of creative writing and one in the domain of visual arts and tested whether students learned more from observing these videos than from practising the tasks. Effects were measured on creative performance, creative processes and attitudes (intrinsic motivation, task value and self-efficacy). We included two observation conditions: observation with a focus on a relatively strong model and observation with a focus on a relatively weak model. In both conditions the same videos were shown: pairs of weak and strong students at work, but the focus for comparison differed. We hypothesized an interaction effect: stronger students would learn more from focusing on a strong model and weaker students would learn more from focusing on a weak model (model similarity hypothesis, Braaksma et al., 2002). Positive results of observation were found on creative performance, processes and attitudes for collage making. For poetry writing, positive results of observation were found only on the process. We did not find evidence in support of the model similarity hypothesis.

In chapter 4 we report on the second empirical study on observational learning. As the results of the first experiment in the visual domain were promising we decided to deepen and extend our understanding of observation in this domain. We also chose to use another type of task: graphic design tasks. Two conditions were compared: learning from observation and learning from practice with direct process instruction. Effects were measured on product creativity and on creative processes. We demonstrated that observation was beneficial for product creativity as well as for certain creative sub processes. In addition, open learner reports (De Groot, 1980) were written. The results showed that students were more process oriented after observation while students in the comparison condition were more product oriented. Finally, we examined the process-product correlations at the pre-test and the post-test. Different correlations for the pre-test and the post-test were found. We concluded that the underlying processes changed as a result of the intervention.

Chapter 5 and 6 are both discussion chapters. In chapter 5 we summarize our main findings and we compare the two experiments (chapter 3 and 4) with regard to the methodological decisions we made. Furthermore, we make suggestions for future research on observational learning in arts education and on creativity in arts education.

In chapter 6 we discuss unresolved issues. First, we elaborate on creative processes of students in visual art production. Our descriptions are based on literature and have been enriched with empirical material. It is explained that especially the interactivity with the work-in-progress is essential for creative performance. Hence, this should be the content of observational learning videos. Finally, we describe in detail the relevance of our findings for educational practice and possibilities for implementation.

## Chapter 2

# HOW DO SECONDARY SCHOOL STUDENTS WRITE POETRY? EXPLORING THE RELATIONSHIP BETWEEN CREATIVE WRITING PROCESSES AND FINAL PRODUCTS

Do different creative writing processes lead to qualitatively different writing products? In this study we examined how Dutch speaking secondary school students (16-years old, 11th grade) wrote two poems. Students' on line writing processes were recorded by a keystroke logging program: Inputlog. Text production, pausing and several types of revision activities were coded. Each poem was rated holistically for quality by seven judges. Next, we examined the relationship between students' writing processes and the quality of their poems. We found that much text production in the beginning of the writing process and many high level revisions towards the end of the writing process, influenced the final text positively. Pausing and other types of revision were negatively related to the quality of the poem, at least in some of the phases of the writing process.

*Key words:* writing process, creative writing, creativity, secondary education

### 1. INTRODUCTION

Carey and Flower (1989) describe creative tasks as ill-defined problems, which means that these tasks have many possible solutions. Some tasks are more ill-defined than others. In the case of artistic work, the problem itself is often not completely (or not at all) formulated, nor are strategies to solve the problem, or the nature of the solution given (Getzels & Csikszentmihalyi, 1976). We know very little of how secondary school students solve these types of problems, and even less about the relationship between the creative writing process and the final product. Therefore, we carried out a small scale study of students' creative writing processes and the relation to the quality of the final texts.

In the following sections we will first present a theoretical framework, combining findings from two different domains: creativity research and writing research. Creativity research has provided interesting theories of creative processes with regard to a variety of tasks. In writing research, sophisticated methodologies have

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been developed to study students' (writing) processes. In both domains, the relationship between process and product has been examined.

### *1.1 The Creative Process*

The creative process is traditionally described as consisting of four stages: preparation, incubation, illumination and verification. According to Lubart (2001), creativity research has moved away from such a stage-model with a fixed sequence of activities, putting more emphasis on the sub processes engaged in creative work. Various models have been proposed to describe the sub processes of creative work. Finke, Ward and Smith (1992), for instance, proposed a model of creative cognition called 'Geneplore'. In this model, generative and exploratory cognitive processes are emphasized. Generative processes involve the initial creation of an idea, whereas in the exploratory processes the idea is examined and interpreted in different ways. The two sets of processes are combined in cyclical sequences that lead to creative products.

In several empirical studies a relationship was found between particular creative processes and the creativity of the resulting product. Getzels and Csikszentmihalyi (1976) examined the problem finding process in art making. They concluded that creativity requires problem finding, because in artistic tasks no clear-cut problem is presented to the solver. As a consequence, the artist first needs to discover his own problem. Getzels and Csikszentmihalyi (1976) studied problem finding behaviour in a real life situation; they observed fine art students' still life drawing activities under experimental conditions. They included both students' problem finding behaviour before they started drawing, while composing the still-life arrangement (problem formulation stage), and after they had started drawing (problem solution stage). Problem finding during the problem formulation stage was operationalised as the number of objects manipulated, interaction with the objects while composing the still life arrangement, and uniqueness of chosen objects. Problem finding during the problem solution stage was operationalised as openness of the problem (length of time the problem remained open: not structured in its final form), exploratory behaviour (switching medium, making sketches), and changes made from the still life arrangement to the final product. This was studied by examining the sequence of photographs of the drawings-in-progress (taken every six minutes), observing students at work, and comparing the still life arrangement with the final product. Finally, students were interviewed to study their awareness of their discovery oriented behaviour.

For problem finding behaviour during both stages, a positive correlation with creativity was found. Students who were engaged in an extended problem-formulation process, exploring while drawing, produced work that was evaluated as more creative and original than that of the students who defined the artistic problem soon after drawing commenced. The interviews revealed that students with high problem finding scores interpreted the task in terms of their own problem (giving personal meaning to the still life objects). Besides, they did not have a representation

of the final drawing visualised before starting to draw. The ‘colours and shapes unfolding before their eyes’ changed the meaning of the work (Getzels & Csikszentmihalyi, 1976, p. 95).

Getzels and Csikszentmihalyi (1976) demonstrated the importance of problem finding in the creative process, not only in the initial idea generation stage, but also during the creative process. Besides, they have shown that we can study problem finding behaviour by studying the work in progress (snapshots) and students’ manifest behaviour. However, this study did not deal with students from secondary education. Oostwoud Wijdenes (1983) studied secondary school students working on artistic tasks and concluded that some of them do not engage in problem finding activities at all.

### *1.2 The Writing Process*

Flower and Hayes (1980b) developed an influential model of the writing process. This model describes the writing process as iterative and composed of three main processes: planning, translating and reviewing. A monitor manages, controls and regulates the activation of processes and sub processes.

Bereiter and Scardamalia (1987) presented a developmental model of the writing process. This model consists of two main strategies: knowledge telling and knowledge transformation. The former, a novice model of writing, depends to a large extent on retrieval of content from the Long Term Memory without reorganizing. The latter, an expert model of writing, is a problem solving model that makes readjustments to retrieved content according to rhetorical and pragmatic goals.

Galbraith (1999) proposes a dual process model of writing, consisting of a knowledge transforming component and a knowledge constituting component. The latter component differs from the one mentioned before, because it supposes that writing involves finding out what to say, rather than being a matter of translating preconceived ideas into text. According to this model, text production happens in successive cycles: feedback on an initial utterance adds a new source of input to a network of conceptual features, which alters the pattern of activation of this network and produces a new idea. This succession of ideas leads towards discovery during writing.

These models of the writing process describe the presence of various sub processes within the writing process, their cyclic nature and the developmental aspect involved. Cognitive activities, as described by these models, have been studied in different ways. Think aloud protocol analysis has been used as a way to study these processes directly (Breetvelt, Van den Bergh, & Rijlaarsdam, 1994; Van den Bergh & Rijlaarsdam, 1999; Van den Bergh, Rijlaarsdam & Breetvelt, 1993). Other researchers have studied writing processes indirectly, for example by analysing the final product or by examining traces of the writing process from computer records of the work in progress. In the case of expository genres, typical patterns of writing behaviour have been identified for different writers, based on computer records of the writing process (Levy & Ransdell, 1996; Van Waes & Schellens, 2003). In these

studies, researchers have focused on pausing behaviour, revision and text production.

### *1.3 Experts and novices*

Much research on writing processes has been carried out within the expert-novice paradigm (focusing on expository texts). Novices differ from experts in their task representation and goal setting (Flower & Hayes, 1980a). For instance, novices tend to depart from task constraints, while experts re-represent the task for themselves. Experts and novices seem to solve different problems.

Revision behaviour also tends to differ between experts and novices, older and younger writers. Taxonomies have been developed to analyse revision behaviour (Faigley & Witte, 1981; Lindgren & Sullivan, 2006; Van Gelderen & Oostdam, 2004). For expository texts, it was found that older or more competent writers revise more and make more revisions to the meaning of the text and on a more global level than younger, less competent writers (Faigley & Witte, 1981).

Carey and Flower (1989) found that expert writers revise more globally (dealing with larger text segments). In their study, they relate this to problem finding. In fact, revision problems can be seen as ill-defined problems, because the writer first has to define a problem (there is no clear-cut problem that needs to be revised), before being able to solve it. Therefore, Carey and Flower found that expert writers define their revision problems more globally. This research shows that we should take the level of revision into account when analysing the revision processes.

Linearity of writing seems to be related to competence as well. Linear writers compose their text in the order of its final presentation (Severinson Eklundh, 1994). In most instances they were found to be the weaker writers (Williamson & Pence, quoted by Severinson Eklundh, 1994).

### *1.4 Relation between process and product in writing*

Van den Bergh, Rijlaarsdam and Breetvelt (1993) and Breetvelt, Van den Bergh and Rijlaarsdam (1994) did not study the differences between writing behaviour of experts and that of novices, but instead examined the writing behaviour of novices and the variability within a group of novices in relation to the quality of their final products. Van den Bergh et al. (1993) found that in essay writing, revision behaviour is related to the quality of the final text. Rereading of the last part of the text written at that moment, evaluating text passages and changing sentences are related to better final texts.

Breetvelt et al. (1994) found that good and weak writers differed, not in the frequency of cognitive activities, but in the stage of the writing process at which they were engaged in a cognitive activity. It was found that revision behaviour only differed significantly between students who were in the last phase of the writing process and only contributed to better texts when performed in the last phase. This research shows us the importance of timing of activities in the writing process.

### *1.5 Research questions*

Whereas students' writing processes of expository texts and their relation to the final product are well-documented (Rijlaarsdam et al., 2005), there are few studies on the processes involved in the writing of literary or creative texts. Most research about creativity in writing is about creativity in writing of expository texts (Carey & Flower, 1989; Flower & Hayes, 1980a; Galbraith, 1999). These studies examine idea generation processes and initial task definition (Carey & Flower 1989; Van den Bergh & Rijlaarsdam, 1999). These processes are generally studied by using think aloud protocol analyses. Getzels and Csikszentmihalyi (1976), however, studied problem finding behaviour during the problem solution stage by examining manifest behaviour.

In the present study we examine the manifest poetry writing activities of novices. We assume that differences in poem quality are a result of different processes or a different organization of sub processes, reflected in observable patterns of writing behaviour (Levy & Ransdell, 1996; Van Waes & Schellens, 2003). Furthermore, we assume that different writing activities have a different impact depending on the moment in the writing process when they are employed (Breetvelt et al., 1994).

Our research questions are:

- How do secondary school students compose a poem, in terms of the frequency and organization of their text production, pausing and revision activities while composing?
- Is there a relationship between characteristics of the writing process and the quality of the final product?

## 2. METHOD

### *2.1 Subjects and design*

The raw data were collected in a previous study (Janssen, Broekkamp, & Smallegange, 2006) focused on the relationship between literary reading and creative writing abilities. In this study, nineteen students from different schools (pre university level) in Belgium and the Netherlands (16-years old, 11th grade, 13 girls and 6 boys) participated. The students were selected by their teachers and the researchers on the basis of their literary reading abilities; they were either very good or poor readers of literature. Each student completed two poetry writing tasks. The tasks were as follows:

- 1) "Write a poem that contains the following words: music/ bicycle/ shiver/ green/ resembles. Each line should contain one of these five words (each word can only be used once) (available time: 10 minutes)"
- 2) "Write a cinquain, starting with the word 'summer'.  
This is the form of a cinquain:  
Line 1: First word (summer)  
Line 2: Two adjectives about the first word  
Line 3: Three verbs about the first word

Line 4: A sentence about the first word (decide about the length yourself)

Line 5: Repeating the first word

(available time: 5 minutes)”

Each student worked individually on a computer, using MS Word. The writing sessions were recorded by Inputlog, the keystroke logging program we will describe below. After the students performed the writing tasks, open attitude interviews were held with each participant about their attitudes towards creative writing in general and about the tasks carried out in particular.

Seven experts rated the poems independently and in random order, in accordance with the consensual assessment technique (Amabile, 1982; see Janssen et al., 2006). In previous research, this technique proved to provide reliable and valid creativity scores. It requires a group of experts who rate the creative products individually and subjectively, based on a personal definition of creativity and without being trained by the researcher. The experts in our study were five teachers of Dutch language and literature and two experts. The raters were instructed to provide a ‘holistic judgment about the students’ *creative* writing performance’ and to assess each poem in relation to the other poems by the other students. They assigned overall creativity scores (rank order) to the poems. The inter-rater reliability was high (Cronbach’s alpha .87 for the five-line poem, and .82 for the cinquain task).

## 2.2 Keystroke logging

Keystroke logging was used for recording and analysing the students’ writing processes. Keystroke logging programs register all the subjects’ physical writing activities on a computer and enable the researcher to reconstruct the complete composing process: the continuous shaping and reshaping of the text. Text production activities, pauses, mouse movements, revisions and the course in time of these activities in the writing process are recorded.

Keystroke logging is an on line (or synchronous) method to collect data. This means that data are collected while the process develops, in real time. It is an indirect way of collecting data; it studies the text production process in order to uncover some of the underlying cognitive processes. In other words, it does not deal directly with the writer’s cognitive, mental operations, but studies the traces of cognitive processes. In contrast to thinking aloud protocol analysis or interview analysis, keystroke logging is a non-reactive and non-intrusive way of obtaining information on writing processes (Leijten & Van Waes, 2005).

In this study we used Inputlog to record the writing sessions, because, in contrast to other keystroke logging programs, this program is word processor independent. Inputlog produces a general logging file (storage of session information), statistical analyses and linear output. In addition, it has a replay function (it replays the writing session).

### 2.3 Coding

The linear output of Inputlog was coded manually per 5-second time interval. In the coding system (presented in Table 1) four main activities were distinguished: text production, pausing, mouse movements and revision. Revisions were further classified in precontextual and contextual revision, based on Lindgren and Sullivan's taxonomy (2006). Precontextual revision takes place at the point of inscription (at the end of on-going text), while contextual revision takes place in a context, followed and preceded by text. Precontextual revision cannot be classified further, because what the writer had in mind is unknown. We do not know if the writer decided to use another word at the beginning of the line or if he/she decided to use a completely different sentence. Contextual revision was classified, based on Lindgren and Sullivan (2006), in micro and macro level revision: character level (letters, punctuation), word level and sentence level (or line in the poem).

Table 1. Coding scheme of writing activities

Writing Activity	Description	Example
1. Text production	Production of new text that is not part of a revision.	
2. Pausing	Only the longer pauses (of 5 seconds and more), visible when splitting up the process in 5-second intervals.	
3. Mouse movements	Mouse movements and other activities on the keyboard that cannot be classified as text production, pausing or revision	
4. Revision		
4.1. Precontextual	Revisions made at the point of inscription (we do not know what the person intended to write, so we cannot classify these further).	everything [Backspace 1][BS 1][BS 1][BS 1][BS 1] the sun is (writer revises at the point of inscription; directly after writing 'everything', he/she erases it and starts writing again).
4.2. Contextual Revision		
4.2.1. Character level	Revision of one (or more) character(s) (punctuation mark or capitalization) which occurs within a word.	<i>summer</i> becomes: <i>Summer</i>
4.2.2. Word level	One or two entire words are de-	

	leted/added/substituted/permutated, without causing another (grammatically necessary) revision (in verb or subject) in the rest of the sentence.	<i>Even music is at play becomes: Even tinkling music is at play</i>
4.2.3. Sentence level	Revision of an entire line in the poem or substitution of one word that causes other revisions in the same line. In both cases we coded one sentence level revision.	<i>He gives a shiver without an end becomes: A shiver before taking the final swimming test or with music that pleases me is replaced by: with music that I please</i>
4.2.4. Other Revision	All contextual revisions we could not classify further.	

Typing errors were not included in the analysis because these errors are not relevant to creative processes; besides, they would bias the frequency of text production activities. We coded the pauses that became visible by coding the 5-second intervals. Empty intervals were coded as pauses. Students' final texts and the replay function of Inputlog were used to trace and classify the revisions. To examine the intra-coder reliability, the data were recoded by the same coder, after several months. The reliability was acceptable (Cohen's kappa = .83). See Table 2 for coded fragment.

Table 2. Example of a coded fragment

Final poem		Legend	
Summer		T = text production	
Sunny, warm		P = pause	
Swimming, tanning, partying		M = movements (mouse and other) in text	
Enjoying with friends on holidays		R-CW = Revision-contextual: word level	
Summer		BS 1=back space, one character	
		UP 1= movement upward, one line	

Interval	Activities	Description	Coding
1	summe	Text production Line 1	T
2	r[ENTER 1]	Text production Line 1	
3	sunny,	Text production Line 2	
4	cost[BS 1] y[ENTER 1]	Text production Typing error Line 2	

5		Pausing	P
6	swimming,	Text production Line 3	T
7	tanning	Text production Line 3	
8	, pa	Text production Line 3	
9	rtyinf[BS 1] g	Text production Line 3 Typing error	
10	[UP 1] [BS 1] [BS 1] [BS 1] [BS 1]	Moving back to Line 2	M
11	[BS 1] [BS 1] [BS 1] [BS 1] warm	Deleting “cosy” Inserting “warm” Contextual, word level revision	R - CW

---

#### 2.4 Analysis

To answer the first research question, two kinds of data were collected: inputlog protocols and interview data. To describe the writing process, protocols from Inputlog were coded as described above. The writing process was divided into three equal parts, based on total session time. The frequencies of different writing activities in the three phases of the writing process were computed, and weighted by the session time. A factor analysis was used to reveal patterns of writing behaviour.

Subsequently, the linearity of the writing processes was considered; plots were derived from the coded intervals. These plots show the line (or verse) the student worked on and the interval in the process. We plotted all productive and revision activities, following Severinson Eklundh (1994), excluding punctuation and capitalization revisions. Based on the linearity plots, we made a distinction between linear, intermittent and non-linear writers. Linear writers show a purely linear writing process. Intermittent revisers proceed in a linear fashion, but show one or two non-linear leaps to other lines. Non-linear writers show more than two leaps to other lines. Types of writers were illustrated by quotes from the interviews.

To answer our second research question, whether there is a relation between process and product quality, we conducted a linear regression analysis, with the quality score of the final product as the dependent variable, and the writing activities in each phase as independent variables (see Breetvelt et al., 1994; Van den Bergh et al., 1993). The regression model obtained provided insight in the influence of individual predictors per phase on the poem scores.

### 3. RESULTS

In this section, we will answer the first research question by describing the writing process in both a quantitative and a qualitative way. Next, we will turn to the second

research question, examining the relationship between writing processes and poem scores.

### 3.1 Students' poetry writing processes

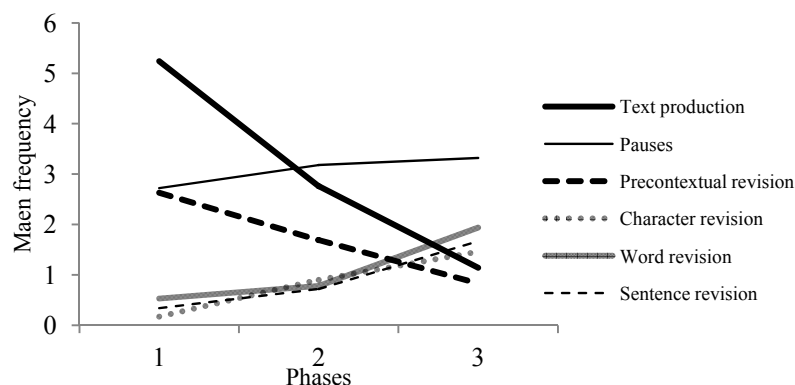
Table 3 shows the mean frequency of students' writing activities during three phases of the writing process. Results represent an average over the two poetry writing tasks. As shown by Table 3, text production is the predominating activity in the first phase of the process. In the second phase, text production, pauses and revision are almost equally frequent, while in the third phase pausing and revision activities dominate. The large standard deviations, especially for revision categories, indicate large individual differences between students in their revision behaviour.

Table 3. Mean frequency of writing activities in the three phases of the writing process

	Phase 1		Phase 2		Phase 3	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Text Production	5.24	2.98	2.76	1.74	1.14	1.27
Pauses	2.72	1.60	3.18	1.86	3.32	1.76
Precontextual revision	2.63	2.77	1.69	1.69	.83	1.04
Character level revision	.17	.37	.90	1.51	1.46	2.15
Word level revision	.53	.78	.78	1.15	1.94	2.17
Sentence level revision	.34	.56	.72	.96	1.67	1.96

Figure 1 provides a visual representation of the results, illustrating the mean course of the various writing activities over the writing process. The figure shows that text production and precontextual revision are similarly distributed over the writing process as a whole; both activities decrease over time. Contextual revision, on the other hand, increases towards the end of the writing process, whereas pausing remains more or less constant.

Figure 1. Distribution of writing activities over three phases of the writing process.



To discover patterns of writing behaviour, we performed a factor analysis. Results of the factor analysis are presented in Table 4. The writing activities we distinguished and the phases in which they occurred are listed in column one and two. The patterns of writing behaviour (factors) are presented vertically in the remaining columns. Factor loadings indicate that an activity occurred often for that particular factor. For example, .842 in column three indicates that the production-phase1-factor is also characterised by many precontextual revisions in phase 1. Higher factor loadings reflect a large influence of that particular activity on a factor.

The factor analysis resulted in 6 factors, explaining 80 % of the variance between the students<sup>2</sup>. The different factors show that writing activities are unequally distributed over the three phases. For example, students who produce much text at the beginning of their writing process, in phase one, produce less in phase two. The factor analysis also shows that task only plays a role in one factor (factor five), which explains only 8 % of the variance. Apparently, the particular writing task does not have a major influence on patterns of writing behaviour.

Factor one represents a writing pattern characterised by much text production in phase one. Text production in phase one is accompanied by much precontextual revision in phase one and contextual revision (low level; character and word level) in phase two and three. Factor two represents a pausing pattern. As we have seen, pausing behaviour is a constant activity that is distributed equally over the three phases (see Figure 1). Pausing in phase one is related to pausing in phase two and three. Factor three is characterised by text production in the middle of the writing process. Again, text production is accompanied by precontextual revision in the

<sup>2</sup> In the study by Janssen et al. (2006), students were originally selected on literary reading ability. We examined whether including 'literary reading ability' as a variable would affect the outcomes of our analysis. This was not the case; including literary reading ability in the factor analysis resulted in a seventh factor, which explained only five percent of all the explained variance.

same phase and revision in the following phase (high level; sentence level). Factor four shows a strong focus on character level revision: punctuation, capitalization and small changes within words. Apart from a main influence of task, the task dependent factor shows a main influence of sentence level revision in the second phase of the process. This is not surprising, since the two poetry writing tasks differ in the required number of lines: of the five verses in the cinquain, only one is a complete line (line 4). Therefore, we would expect less sentence level revision in this task. Factor six is characterised by much text production in phase three, again accompanied by many precontextual revisions in the same phase.

Table 4. Results of factor analysis: Patterns within the writing process (factor loadings)

Phase	Writing activity	Production phase 1	Pausing	Production phase 2	Revision Character level	Task dependent factor	Production phase 3
1	Text	.650			.439		
	Pausing		.905				
	Pre	.842					
	CLR				.919		
	WLR	.405	.531				
2	SLR		.531	.490			
	Text			.783			
	Pausing		.556			.557	
	Pre	.490		.757			
	CLR				.883		
3	WLR	.841				.758	
	SLR						.859
	Text						
	Pausing		.640				
	Pre			.455			.748
	CLR	.772					
	WLR	.503	.647				
	SLR			.748			
	Task					.785	

*Text* = Text production, *Pre* = Precontextual revision, *CLR* = Character level revision, *WLR* = Word level revision, *SLR* = Sentence level revision

The students' processes not only differed from each other in the frequency of activities and the orchestration of their activities during writing, they differed in the linearity of their writing process as well. We observed that some students started writing the first line of what would become their final poem, followed by the second, the third et cetera (composing the poem in the order of its final presentation: Severinson Eklundh, 1994), while other students proceeded in a non-linear fashion, starting with a sentence that would, for example, end up as the third line in the final poem. The following example illustrates a non-linear production process of one writer. Each

step in the process is shown to give an impression of how the poem developed. Production stages are presented as pictures of the developing text:

Step 1: text production

It is like everything around you disappears and only you are still there,	<i>(writes line 4 of final poem)</i>
When you are on your bicycle.	<i>(writes line 5 of final poem)</i>
Floating over grass so green.	<i>(writes line 1 of final poem)</i>
The shiver of your bell, when you make it ring	<i>(writes line 3 of final poem)</i>
The tone, it sounds like music to my ears	<i>(writes line 2 of final poem)</i>

Step 2: substitution of a line

It is like everything around you disappears and only you are still there,  
 When you are on your bicycle.  
 Cycling through pathways and lanes of green  
 The shiver of your bell, when you make it ring  
 The tone, it sounds like music to my ears

Step 3: substitution of a verb

It is like everything around you disappears and only you are still there,  
 When you are on your bicycle.  
 Floating through pathways and lanes of green  
 The shiver of your bell, when you make it ring  
 The tone, it sounds like music to my ears

Step 4: changing the order of lines

Floating through pathways and lanes of green  
 The shiver of your bell, when you make it ring  
 The tone, it sounds like music to my ears  
 It is like everything around you disappears and only you are still there,  
 When you are on your bicycle.

Step 5: rewriting part of a line

Floating through pathways and lanes of green  
 While you feel the shiver of your bell when you make it ring  
 The tone, it sounds like music to my ears  
 It is like everything around you disappears and only you are still there,  
 When you are on your bicycle.

Step 6: substitution of a noun

Floating through pathways and lanes of green  
 While you feel the shiver of your bell when you make it ring  
 The sound, it sounds like music to my ears  
 It is like everything around you disappears and only you are still there,  
 When you are on your bicycle.

Step 7: changing the order of lines

Floating through pathways and lanes of green  
 The sound, it sounds like music to my ears  
 While you feel the shiver of your bell when you make it ring  
 It is like everything around you disappears and only you are still there,  
 When you are on your bicycle.

This writer does not proceed in a linear way, but she goes back and forth in her developing text, rewriting sentences, substituting verbs and nouns and changing the order of lines. Figure 2 illustrates the two types of processes (linear and non-linear). The left-hand panel shows the process of a linear writer; the right-hand panel shows the non-linear process from the example above. The five-second time intervals are presented on the horizontal axes, the line numbers in the final text are presented on the vertical axes. The linear process shows a linear plot, while the non-linear process shows a recursive distribution of activities over line numbers and intervals.

Figure 2. A linear (upper panel) and a non-linear (bottom panel) writing process (time interval on x-axis, line number on y-axis).

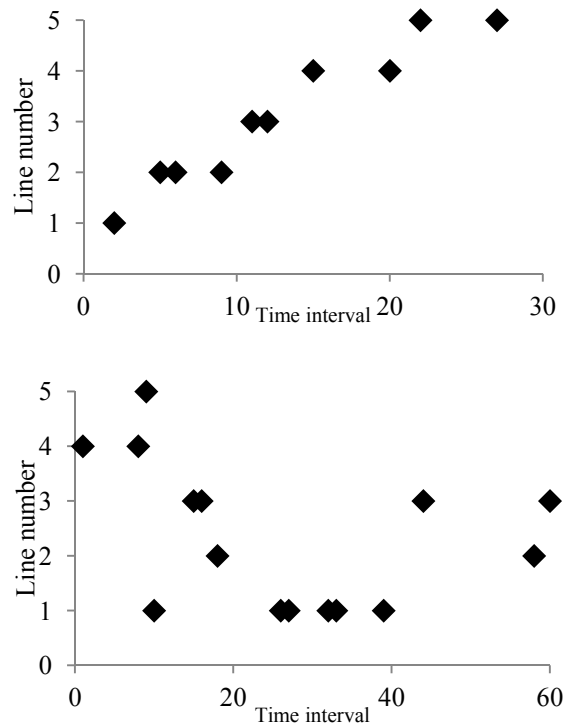


Table 5 presents the number of students who performed the poetry writing tasks in a linear, intermittent and non-linear way. This table shows that there is an effect of task on the linearity of the writing process. The five-line poem task elicited more non-linear behaviour than the cinquain task, which led to more linear and intermittent behaviour. This may be due to the more directional nature (fixed form aspects) of the cinquain task. As shown in table 5, three writers are consistently linear writers (in both tasks), two writers are consistently non-linear and three students are consistently intermittent writers.

*Table 5. Linearity of the writing process (number of students)*

	5-line Poem	Cinquain	Consistent writers in both tasks
Linear	3	4	3
Intermittent	4	13	3
Non-linear	12	2	2

Non-linearity appears to be related to contextual revision; that is, students tended to revise in other lines than the ones they were working on. However, some students produced in a non-linear manner without revising: writing one line, moving to the beginning of that line, and then writing the preceding line. The consistently linear writers produced text in a linear fashion and did not revise. These students were conscious of the fact that they did not revise, as became clear from the interviews: they said they did not think very much about it, but just wrote down whatever occurred to them.

‘(..) I did not think very much about it. I just did something (..), I just thought: word word, word....I don’t really like to do it either.’

‘(..) It was just writing, when a word occurred to me, that should fit, just write it down, because, I am so bad at that, really! Me and poetry, that just doesn’t....Especially with that bicycle, bicycle and shiver and I don’t know what else. Then I was really like: ‘what should I make up?’ Then I just felt like ‘write down whatever comes to you and, ready’. Because, well, I really can’t do that.’

The first fragment shows that the writer is not highly motivated (although, in the same interview, he said that he liked the tasks). In the second fragment, the writer expresses low self-efficacy. Some students provided indications of why they did not revise. One student said he did not know what to write:

‘(..) I don’t know what’s good. I write all kind of things, but I don’t know if that’s the right thing.’

Non-linear writers, on the other hand, tended to revise a lot. They seemed to be very conscious of their revision behaviour:

‘(..) I always think it is easy, but I always correct it a thousand times until a good text emerges.’

‘(..) Sometimes, sometimes an entire story comes out. But what I find difficult, is to write something in one go. That is also a bit of a problem when I don’t get high marks for Dutch writing assignments, because writing at home, I am writing comfortably behind my computer. I let it rest for a few days and I read it again. Then I read it and I think: ‘this is really bad’, so I change it. A good text will finally be written, but I just need more time for that’.

The revising writers seemed to be engaged in another kind of process than the non-revising, linear writers. They expressed more extensive and more profound involvement in the task, than the writers who said they wrote without thinking.

‘(.) Hm.. I found that Japanese poem [the cinquain] quite difficult, because you have to be very good at finding powerful words and words that are expressive. Maybe I needed more time for that, because you have to stick to the number of verbs and adjectives given. And well, the second poem, there were just five lines and each had to include one word, I thought, well, I can just write a poem and try to insert one such word in each line, but I first tried to remember a feeling and then, integrate a word into that and not just focus on the words.’

### *3.2 Relationship between writing process and the quality of the final product*

To examine the relationship between characteristics of the writing process and the quality of the final product, we used regression analyses. The outcome of the regression analysis is presented in Appendix A<sup>3</sup>. The model explains 65% of the variance. All writing activities were found to contribute to the prediction of the quality of the final poem, either in a positive or in a negative direction, depending on the particular phase of the writing process in which the activity took place.

Table 6 shows the direction of the relationship between the occurrence of an activity in a particular phase and the quality of the poem. The phases are presented horizontally. A plus reflects a positive influence of the activity in that particular phase on the final text quality. A minus reflects a negative influence of the activity in that particular phase on the poem quality.

Text production and sentence level revision both have a positive influence on the poem quality: text production more in the beginning and middle of the writing process and sentence level revision more towards the end. Pausing and precontextual revision have a negative effect on text quality in most phases. Character level revision has a positive influence on text quality in the second phase and a negative influence in the first and third phase of the writing process. Word level revision influences text quality positively in the first and second phase and negatively in the third phase.

In conclusion, table 6 shows that revision is an important predictor of text quality. As shown, higher level revisions (word level and sentence level) influence the scores more positively than low level revision (precontextual and character level revisions). In the third phase, only many sentence level revisions seem to predict the text quality positively. In general, the linear writers who did not revise at all, all wrote low quality poems. Apparently, an entirely linear writing strategy without revision is not very effective. However, we cannot conclude that a non-linear strategy is more effective; not all non-linear writers received high scores for their poems.

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<sup>3</sup> Including literary reading ability in this regression analysis does not result in major changes to the model.

*Table 6. Direction of relation between writing activities and quality of final product*

Activity in the writing process	Influence on text quality		
	Phase 1	Phase 2	Phase 3
Text Production	+++	++	
Pausing	---		-
Precontextual revision	--	--	
Character level revision	-	+	-
Word level revision	++	+	-
Sentence level revision		++	+

Positive effect: +=small: .02-.05, ++=moderate: .05-.08, +++=large:>.08  
 Negative effect: -=small: .02-.05, --=moderate: .05-.08, ---=large:>.08

#### 4. DISCUSSION

In this study, we examined the writing processes of students in secondary education who performed two poetry writing tasks. We examined differences in the occurrence of various activities (text production, pausing and revision) over time, in different phases of the writing process. We found that the mean frequency of text production decreases over time, while the mean frequency of various types of revision increases. Pausing behaviour, on the other hand, remains stable over the course of the writing process.

We found individual differences in the way students distributed their writing activities over three phases in the writing process. However, the main patterns of writing behaviour were fairly consistent over the tasks. Students differed in the linearity of their production process. Three students wrote in a consistently linear manner; these students did not revise. They seemed to 'just write what occurred to them', without thinking. The non-linear writers revised much. They seemed to be engaged in a very different kind of process, adding new criteria to the task themselves.

Furthermore, a relation was found between the process and the quality of the final poem. Text production in the beginning of the process and sentence level revision in the end were found to have a positive impact on text quality. This means that students who produced much and revised much on a high level, especially towards the end of the process, wrote better poems. Pausing and precontextual revision influenced the text quality negatively in almost all phases. Low level revision (character level and word level revision) influenced the text quality positively in the middle of the writing process, but negatively in the final stage of writing.

The students who wrote their poems in a linear manner, in both tasks, all received low quality scores. The quality of the poems written by the non-linear and intermittent writers varied. Linearity seemed to be task related. As a consequence, it

was difficult to make claims about the relationship between linearity of the process and text quality.

Our findings are in line with those of Faigley and Witte (1981) and Carey and Flower (1989), who found that better writers revise more on a global level. In these short poetry tasks, sentence level revisions can be regarded as global revisions. Van den Bergh et al. (1993) also found that changes of sentences are related to text quality. Our results confirm findings from Breetvelt et al. (1994) as well; the timing of some of the writing activities matters. Our data could not confirm the negative correlation between revision in the first and second phase of the writing process and the quality of the text, as reported by Breetvelt et al. (1994). This may be due to effects of genre and/or text length: Breetvelt et al. examined essay writing (essays of two pages or more), while we studied poetry writing (very short poems of only five lines).

We found that several students wrote in a non-linear manner, whereas Severinson Eklundh (1994) found very few non-linear writers among novices. The non-linearity we found may be connected to the nature of the tasks. Apparently, the writing of short poems stimulates students more to play with language and words, revising and changing the order of the lines than the writing of prose.

Finally, our findings correspond to findings from research in art education. Getzels and Csikszentmihalyi (1976), for instance, found that exploratory behaviour during drawing was related to the quality scores on the final product. Revision behaviour can be considered exploratory behaviour in our tasks. Sentence level revision is very effective in the last phase of the writing process; these students leave their 'problem' open to discovery until late in the writing process. Flower and Hayes' (1980a) statement that strong and weak students solve different problems was confirmed by the interviews: while some students interpreted the problem in their own way, adding their own criteria to the task, others wrote down immediately what occurred to them in response to the task, without further exploration. This is consistent with Oostwoud Wijdenes' (1983) findings that some students in secondary education do not engage in problem finding at all. These were the writers who did not revise and wrote poems that received low scores.

Our study has several limitations. One limitation is that we focused mainly on observable, externalised processes. Mental processes involved in poetry writing and students' changing task representations were not examined. As Inputlog does not capture mental processes and pre-existing ideas, other methods of data collection, such as think aloud protocol analysis, could be added to supplement keystroke logging data.

Caution is needed in generalising the results of this study. We used few tasks, few students participated and participants were not selected at random. Instead, they were selected on the basis of literary reading skills by Janssen et al. (2006). The participants belonged to two extreme groups: weak readers versus good readers of literature. In our analysis, we controlled for literary reading competence. The inclusion of this variable did not alter our findings considerably.

Despite these limitations, we succeeded in uncovering meaningful differences between students' creative writing processes. We contributed to the development of research on writing processes by examining poetry writing -an artistic creative genre that has not received much attention in writing research- and by applying research methods that have not been applied before to artistic-creative tasks.

We believe that a better understanding of students' creative processes may contribute to the development of instruction methods for creative tasks. Our findings give some indications of successful poetry writing processes. This knowledge may be useful in designing process-oriented writing instruction.

#### ACKNOWLEDGEMENTS

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## APPENDIX A

*Linear regression analysis, URC=Unstandardized regression coefficient, SE= standard error*

Activity	Phase 1		Phase 2		Phase 3	
	<i>URC</i>	<i>SE</i>	<i>URC</i>	<i>SE</i>	<i>URC</i>	<i>SE</i>
Text	.267*	.007	.287*	.006	.035*	.005
Pausing	-.437*	.007	-.069*	.005	-.087*	.004
Pre	-.170*	.009	-.304*	.006	-.109*	.010
CLR	-.886*	.036	.146*	.008	-.106*	.004
WLR	.495*	.009	.137*	.012	-.069*	.004
SLR	.243*	.015	.394*	.010	.166*	.004

*Text = Text production, Pre = Precontextual revision, CLR = Character level revision, WLR = Word level revision, SLR = Sentence level revision*

*\*p<.001*

## Chapter 3

# **THE EFFECTS OF OBSERVATIONAL LEARNING ON STUDENTS' PERFORMANCE, PROCESSES, AND MOTIVATION IN TWO CREATIVE DOMAINS**

Previous research has shown that observation can be effective to improve learning in various domains, e.g. argumentative writing and mathematics. The question in this paper is whether observational learning can also be beneficial when students are learning to perform creative tasks in visual and verbal arts. We hypothesized that observation has a positive effect on performance, process and attitudes (intrinsic motivation, task value and self-efficacy). We expected similarity in competence between the model and the observer to influence the effectiveness of observation. A total of 131 Dutch students (10th grade, 15 years old) participated in two experiments (one for visual and one for verbal arts). Participants were randomly assigned to one of three conditions: two observational learning conditions and a control condition (learning by practising). The observational learning conditions differed in instructional focus (on the weaker or the more competent model of a pair to be observed). We found positive effects of observation on creative products, creative processes and task value in the visual domain. In the verbal domain, observation seemed to affect the creative process, but not the other variables. The model similarity hypothesis was not confirmed. Results suggest that observation may foster learning in creative domains, especially the visual arts.

### 1. INTRODUCTION

Before the introduction of formal education apprenticeship was the most common means of learning (Collins, Brown, & Newman, 1989). Apprenticeship includes modelling: an expert demonstrates his work process to an observing apprentice. Observational learning, as examined in the present study, is also triggered by a form of modelling; students learn by watching, interpreting and evaluating peers carrying out a task. In formal education, observational learning proved to be an effective learning activity in various domains, such as mathematics (e.g. Schunk & Hanson, 1985), reading (Couzijn & Rijlaarsdam, 2004), argumentative writing (Braaksma, Rijlaarsdam, & Van den Bergh, 2002; Couzijn, 1999; Raedts, Rijlaarsdam, Van

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Waes, & Daems, 2007; Rijlaarsdam, Braaksma, Couzijn, Janssen, Raedts, Van Steendam, Toorenaar, & Van den Bergh, 2008; Van Steendam, Rijlaarsdam, Sercu, & Van den Bergh, 2010; Zimmerman & Kitsantas, 2002), learning to collaborate (Rummel & Spada, 2005) and learning argumentation skills (Schworm & Renkl, 2007).

It is generally believed that creative skills should be nurtured in the classroom. We expect secondary school students to display creative and independent thinking when working on projects, writing papers, or participating in classroom discussions. In arts education, teachers aim at stimulating students' creative processes. As far as we know, there are no experimental studies examining the effectiveness of interventions that aim at enhancing creative processes in secondary arts education. Implementing observational learning tasks may be an effective approach for stimulating students' creative processes and improving their creative products. In the following sections, we will describe the potential for learning from observation for creative tasks.

### *1.1 Observational learning*

The rationale of observational learning is based on Bandura's (1986) social learning theory. It explains learning as a continuous interaction between cognitive, behavioural and environmental influences. For effective modelling, several conditions need to be fulfilled: students need to pay attention to relevant elements in the learning environment, to store and transform information in memory, to be able to translate mental conceptions into actions and be motivated to do so. Schunk and Zimmerman (1997) elaborated Bandura's theory into a social cognitive model of self-regulation in reading and writing. According to this model, the learning of a new task occurs in four phases: observation, emulation, self-control and self-regulation. Observation is a first step in the learning process. Then the learner emulates the model's general style. Encouraged by feedback, the learner can internalize the skill and finally use the strategy independently and in various contexts. Here we focus on the first phase: observation.

Observational learning is closely related to cognitive apprenticeship. In cognitive apprenticeship, an expert model verbalizes thought processes. Collins et al. (1989) describe how observation, as an element of cognitive apprenticeship, provides strategic knowledge to the learner and changes students' understanding of the modelled skill. For example, in writing students may not realize that experts organize their ideas, elaborate their goals and think about their audience. Observation may enhance this awareness about the task. Couzijn (1999), Braaksma et al. (2002) and Raedts et al. (2007) found that observation is effective for writing argumentative or synthesis texts. In these studies a multimedia learning environment was used; students watched videos of peer models performing a writing task while thinking aloud. Students who observed peer models performing a learning-to-write task wrote better texts afterwards than students who practised this learning-to-write task. Rummel and Spada (2005) proved the effectiveness of observation for learning to collaborate in

computer mediated settings, Schworm and Renkl (2007) found beneficial effects in the domain of argumentation and Van Steendam et al. (2010) for cooperative revision tasks. It seems that modelling is beneficial for various types of tasks.

Several elements may influence the effectiveness of observational learning, such as the competence level of the models. Zimmerman and Kitsantas (2002) found that college students who observed a coping model who gradually improved her writing technique on a sentence-combining task did better than students who had observed a mastery model. In Braaksma et al.'s study (2002), the models in the videos performed short tasks about argumentation structures in writing. All students watched the same videos, but Braaksma asked students either to focus on the weaker model or on the more competent model of the pair ('which model did best and why?' vs. 'who did worst, and why?'). Evidence in support of the similarity hypothesis was found: when confronted with a new task, weaker writers learned more from focusing on the weaker model of a pair, while better writers learned more from focusing on the more competent model.

Observation should include evaluation. Braaksma, Rijlaarsdam, Van den Bergh and Van Hout-Wolters (2006) analysed students' observation processes and found that evaluation and elaboration are essential for the effectiveness of learning from observation. Sonnenschein and Whitehurst (1984) studied the effect of observation and evaluation compared to observation only for preschool children who acquire communication skills. The observation-evaluation condition performed better on speaking and listening tasks than the observation only condition. The additional evaluation task explains the transfer effects on listening and speaking according to Sonnenschein and Whitehurst. They describe evaluation skills as 'superordinate' skills since these skills transferred to speaking and listening, whereas increased performance on speaking and listening tasks did not transfer to evaluation skills. It seems advisable then to stimulate students to evaluate models and to elaborate on the models' behaviour after observation.

All in all it appears that observational learning is an effective approach in various domains. Attributes of the model (such as initial performance level) and students' thinking activities (evaluation and elaboration during and after observation) may influence the effect of observational learning.

### *1.2 Creative tasks and modelling*

From the preceding section it can be concluded that observational learning is effective for structured domains such as mathematics as well as for ill-structured domains such as writing. The question arises whether observation can also be effective for creative tasks, which involve divergent thinking skills. High performance on artistic creative tasks requires original and novel responses. This means that the problem space in creative tasks is large; there are many possible solutions. Artists even have to discover their own task, the artistic problem, before they can start solving it (for example, finding out what to draw) (Getzels & Csikszentmihalyi, 1976). Therefore, creative tasks are extremely ill-defined.

Few studies have focused on modelling in a domain which requires students to formulate their own original problem. One explanation may be that using observation of models to enhance students' creativity may seem paradoxical. Creative work involves the generation of original ideas, while observing models may lead to imitation of products (the 'conformity effect'; Finke, Ward & Smith, 1992). However, observation of cognitive models is directed at developing a clear idea of how a task can be performed as demonstrated by Braaksma, Rijlaarsdam, Van den Bergh, and Van Hout-Wolters (2004). In their study the observation of peer models affected students' writing processes; the students who had learned to write by observing engaged in metacognitive activities during writing, such as planning, analysing and goal-orientation more often than students who had learned by practising writing. Therefore, we expect that the observation of someone who is thinking aloud while engaged in creative work affects the observer's future activities.

Studies in the area of worked examples have examined the effect of examples for learning in ill-defined domains (e.g. Rourke & Sweller, 2009; Van Gog, Paas, & Van Merriënboer, 2004; 2006; 2008). Worked examples differ from modelling examples (e.g. observational learning), since they involve 'ideal' problem solution steps presented as text. The underlying mechanisms, however, seem to be similar: students learn new procedures for problem solving and abstract general rules from the examples (Van Gog & Rummel, 2010). Rourke and Sweller (2009) found that students who studied worked examples of a task about recognizing designers' styles perform better than students who practised this task themselves. They concluded that process examples are as effective in ill-defined domains as they are in well-structured domains.

But what kind of knowledge should students acquire from observing and evaluating models in ill-defined domains? Hilbert, Renkl, Kessler, and Reiss (2008) introduced heuristic (worked) examples for ill-defined tasks, which demonstrate heuristic steps towards a solution. They studied the effect of these examples on mathematical proving skills, which include discovery behaviour. Heuristic knowledge was presented explicitly and self explanation prompts were directed at the heuristic level. This approach proved to foster learning. Van Gog et al. (2004, 2006, 2008) argue that experts' 'how' and 'why' process information enables students to deepen their understanding of solution procedures in ill-structured domains. For tasks with large problem spaces, learners need strategies to narrow the search space and select the most promising solution procedures. Therefore, students need to know why certain solution steps are taken. Van Gog et al. (2008) show that process information is indeed effective in the first phase of learning in electrical circuit troubleshooting.

Few studies examined the effect of modelling examples and artistic creative tasks. Teyken (1988) examined the effects of focused reflection on creative design. He incorporated observational learning tasks in an experimental curriculum for student art teachers. Students watched videos of designers at work. Teyken found that the students' design processes changed as a result of focused reflection, although the quality of their design products was not higher in the experimental condition than in the control condition. Observation was examined as part of an experimental curricu-

lum, therefore it remains unclear which learning activity in the curriculum caused the effects measured. Anderson and Yates (1999) examined the effect of modelling on young children's clay works. They found that the quality of the clay works produced after modelling was higher than the quality of the clay works produced under regular conditions.

To conclude: few experimental studies have examined the effect of observation on artistic creativity and no studies have examined the effect of peer modelling in arts education for secondary school students. Therefore, in the present study we focus on creative process modelling through observational learning with peer models.

### *1.3 Creative processes*

Which creative processes should be modelled in observational learning videos? Amabile (1996) proposed a componential model that encompasses three basic components necessary for creativity: (1) domain-relevant skills, (2) creativity-relevant skills and (3) intrinsic task motivation. Domain-relevant skills include basic skills (factual knowledge, technical skills, talent) relevant in a given domain. Creativity-relevant skills refer to an appropriate cognitive style and knowledge of heuristics for generating novel ideas. Intrinsic task motivation refers to motivation related to the task. Based on this model, we assume that observational learning videos should include heuristic strategies and cognitive style independent from the artistic domain. Subsequently, these heuristics are applied to the artistic domains: verbal (poetry writing) and visual (collage making).

Based on the literature available, we choose four activities that are relevant in creative processes to be modelled in observational learning videos: (1) initial and ongoing problem finding activities, (2) generating (large, deep) strings of ideas, (3) exploring generated ideas and (4) critically evaluating product (see method section and Table 1 for operationalisations).

Traditionally the creative process is described as consisting of four stages; preparation, incubation, illumination and verification (Wallas, 1926). During preparation the creator absorbs information and engages in problem finding and definition. During incubation the person is taking a step away from the creative process. During illumination a solution or great idea suddenly comes to mind and during verification the final product is created and edited. However, from recent research on artists and designers at work, it appears that creative processes co-occur throughout the work recursively. Finke, Ward, and Smith (1992) proposed a model of creative cognition called 'geneplore', emphasizing generative and exploratory cognitive processes. Generative processes involve the initial creation of an idea (or in fact a premature idea or 'pre-inventive structure'), whereas in the exploratory processes this pre-inventive structure is examined and interpreted in various ways (examined for emergent properties and implications). After the exploratory stage, pre-inventive structures may be refined and the process may repeat until a final product/idea has been developed. These two processes interact in cyclical sequences leading to creative products.

Runco (2003) describes creativity as the interaction of divergent (generative) and convergent (evaluative, critical) processes. Generating many ideas and many different types of ideas is called ‘divergent thinking’. Divergent thinking has been linked to creativity: those who produce many, diverse and original ideas are thought to be more creative. Divergent thinking can be stimulated through various brainstorming techniques, based on the idea that the presence of more ideas implies ‘more original ideas’ since original ideas are remote, at the end of a chain of associations (Mednick, 1962). Creativity also involves convergent processes, making choices from the wealth of options generated.

Getzels and Csikszentmihalyi (1976) observed that initial problem finding and on-going exploration throughout the work process appear to be important characteristics of creative production. They observed fine art students’ still-life drawing activities under experimental conditions (think alouds and videotapes). First the students had to compose a still life arrangement before drawing it. The students who engaged in an extended problem finding process, exploring many of the still-life objects in detail, produced work that was evaluated as more creative and original than that of the students who quickly took some objects and started drawing. Problem finding takes place in the preparation stage, but also during the production or editing phases (Getzels & Csikszentmihalyi, 1976). The students who produced more original work kept on exploring (for example by sketching) and re-defining their artistic problem (operationalized as many changes to the work-in-progress), whereas the students who produced less creative work hardly changed their initial idea of the final product.

#### *1.4 Research questions*

The aim of the present study is to develop and test a learning arrangement for creative tasks based on the principles of observational learning. We include two artistic domains in the study for reasons of generalizability (visual art, verbal arts). The control condition consisted of learning by practising.

The research questions are:

- Is observational learning more effective than learning by practising for students’ creative products, creative processes and motivation (intrinsic motivation, task value and self-efficacy)?
- Does ‘model similarity’ influence the effect of observational learning?

To test the model similarity hypothesis, two observation conditions were included; observation with a focus on a relatively competent model (observation<sup>strong</sup>model condition) and observation with a focus on a less-competent model (observation<sup>weak</sup>model condition). Participants in both conditions watched the same videos with pairs of models engaged in creative work: one competent model and one weak model. What we varied was the focus during evaluation and elaboration; students were asked to focus either on the weaker or on the more competent model of the pair.

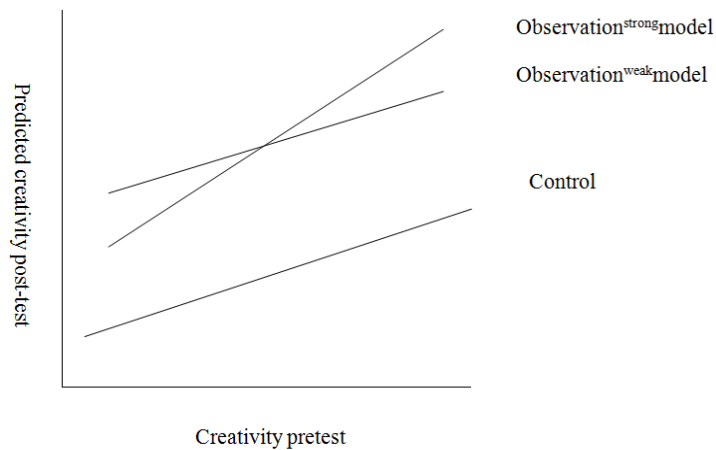
### 1.5 Hypotheses

We formulated the following hypotheses:

- 1) We expect observational learning to be more effective than practising. Concerning student products, we expect that: participants in the observational learning conditions will produce more creative collages and poems than students in the control condition.
- 2) We assume that observation will lead to more problem finding, generative, exploratory and evaluative processes, indicated by longer processes and more re-processing. So we expect that: participants in the observational learning conditions will spend more time and revise more than students in the control condition.
- 3) We expect effects on motivation (intrinsic motivation, task value, self-efficacy), since Amabile (1996) considers motivation an essential component of creative skills. We expect that: Participants in the observation conditions will show higher levels of intrinsic motivation, task value and self-efficacy than students in the control condition.
- 4) Considering the model similarity hypothesis, we expect the similarity between the competence level of the model and the observer to influence the effect of observational learning; students with a low pre-test score will profit more from the condition with a focus on the weaker model, while students with a high pre-test score will benefit more from focusing on competent models. This means that the treatment effect differs for students with different ability. We expect that: treatment effects will interact differently with learner characteristics in the two observation conditions: the higher the scores on the pre-test, the more beneficial the observation<sup>strong</sup>model condition (OSM); the lower the pre-test scores, the more beneficial the observation<sup>weak</sup>model condition (OWM).

Figure 1 illustrates the results expected on product creativity for the different conditions based on students' pre-test scores.

Figure 1. Expected main effect and interaction effect.



## 2. METHOD

### 2.1 Research design

We conducted two experiments successively, one for poetry writing and one for collage making. A pre- and post-test control group design with three conditions was implemented: learning by observation with a focus on a relatively competent model (observation<sup>strong</sup>model, OSM), learning by observation with a focus on a weak model (observation<sup>weak</sup>model, OWM) and learning by doing (Practice). Students in the observation conditions observed the same videos, each showing two models in action, the difference being the instructional focus during evaluation and elaboration of model behaviour. Students from each participating class were randomly assigned to one of the three conditions; they stayed in the same condition for both experiments (poetry writing and collage making).

### 2.2 Participants

Three schools, with two classes each, from different regions in the Netherlands participated. Five teachers volunteered to take part in the experiments. Since the students were randomly assigned to the conditions, one teacher was responsible for all the three conditions within the class. The participants were 153 fifteen to sixteen – years old secondary school students (10<sup>th</sup> grade, pre university and higher general secondary education; 56 boys and 97 girls). 22 Students were excluded from the dataset, because they did not attend all the lessons. In the final data set, there were 44 students who had participated in the OWM condition, 42 in the OSM condition,

and 45 in the control condition. The students participated during their regular ‘Cultural and Artistic Education’<sup>4</sup> classes.

### 2.3 Observational learning materials

We made observational learning videos focusing on various phases of the creative process. In the collage videos, the collage-in-progress and the model’s hands were visible on the screen, while learners heard the model’s thinking aloud as a voice over. In the poetry videos, the ‘poem-under-construction’ was seen on the screen and the voice of the student who was thinking aloud could be heard. We selected four domain independent processes and applied them to both domains: problem finding, generating, exploring and evaluating ideas. In Table 1, we present the content of the observational learning videos for both domains. As shown in the table, the videos contained heuristic information, process information (‘how’ and ‘why’ information) and attitudinal information (flexibility and motivation). Scripts for the videos were based on actual students’ processes, then written in scenario format and role played from the scenarios. We speeded up some parts of the actual student processes or exaggerated a little to make them more attractive learning materials.

During the intervention, the students in the observation conditions did not engage in collage making or poetry writing. Instead, we asked them to watch the videos on the computer and to make notes. To direct students’ attention to the relevant processes and evoke a comparison process, contrasting approaches (rather weak and rather strong) were shown in the videos by two different models. As shown in Table 1, students watched both relatively competent and relatively weak peer models at work.

The models in the videos were not labelled as ‘competent’ or ‘weak’, but after the students had watched each video, we asked them to compare, evaluate and elaborate on the behaviour of the models by answering a question. Following Braaksma et al. (2002), we asked the students in the OSM condition: ‘Which student did better in your opinion? Explain: what did this student do so well?’ The students in the OWM condition considered the question: ‘Which student did less well in your opinion? Explain: what did this student do not so well?’ Most of the students were able to point out which model did better and which model did not do so well: on average 89% of the students ( $SD = 5.58$ ) answered the questions as intended. This means that the students adhered to the instruction (and thus to the conditions they were assigned to). The students could replay the videos if they wanted.

In the control condition, students engaged in collage making and poetry writing, without watching models. The tasks were the same as those shown in the observational learning videos. To ensure that only modelling of the work *process* made a difference between the conditions and not product modelling, students in the control conditions reflected on the same final products as those that were shown in the ob-

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<sup>4</sup> CKV is a compulsory subject in Dutch upper secondary education. It includes: visual arts, music, dance, theatre, literature, architecture etcetera. The focus is on perception and reception, but CKV also includes a productive component.

servational learning videos. We made sure that the total amount of time spent remained the same in both conditions. Students spent one lesson hour on poetry writing and one lesson hour on collage making.

*Table 1. Content of the observational learning videos*

Video	Domain independent Processes	Content of video	
		Collage	Poetry
1	Problem finding vs. Routine solution.	Problem finding, generating various ideas before actual collage making vs. fixation on one first idea (4.23 min.).	Brainstorming and exploring before actual writing vs. directly writing a final version on the basis of first associations (4.09 min.).
2	Generating and exploring many ideas (content) vs. Generating just one idea.	Trying out several ideas, evaluating vs. immediately carrying out first idea without evaluation (5.19 min.).	Using items from the brainstorm for further exploration, forming poetry lines vs. direct copying of the brainstorm into final text (3.23 min.).
3	Exploration of form vs. Blocking.	Solving problems that arise with flexibility by exploration of chosen idea in several visualizations, exploring the material, vs. inflexible approach, inability to solve a problem in a satisfying way (5.21 min.).	Rereading and exploring written text (sound, meaning) vs. fixation on rhyme (3.42 min.).
4	Critical evaluation and revision vs. No evaluation.	Evaluation and revision of essential visual elements vs. revision on very detailed, less relevant level (5.46 min.).	Rereading, evaluation and revision on large scale vs. no rereading, revision of spelling and punctuation (4.29 min.).

#### *2.4 Measures*

The pre- and post-tests consisted of collage and poetry assignments. Amabile (1982) showed that collage tasks are very suitable for measuring creative behaviour since few technical skills are required. At the pre-test, students were asked to make a collage of a human figure, consisting of geometrical shapes (30 minutes). At the post-test, the students were asked to make a collage of a 'strange creature' (60 minutes).

For both tests, all the students received an identical set of materials (scissors, glue, coloured paper, a set of magazines). The students were instructed to be as creative as possible.

The poetry pre-test and post-test each consisted of two short tasks (10 minutes each). Since most students had never written poetry before, we used tasks that were short and structured (see appendix A). Since the tasks were short, it was feasible to administer two tests and therefore raise validity. Pre-test task 1 and post-test task 1 had been used in previous research (Broekkamp, Janssen, & Van den Bergh, 2009; Ruscio, Whitney, & Amabile, 1998). The students were instructed to be as creative as possible.

Art students from the Amsterdam School of the Arts (collages) and university students in linguistics (poems) scored all the products holistically for creative performance on a 0-200 scale with the support of anchor products. These anchors were based on scores from other raters in previous scoring procedures (among others Broekkamp et al., 2009) and illustrated a non-creative, medium creative and highly creative product with fixed scores of 50,100, 150 (see Appendix B and C). First we discussed the degree of creativity of the anchor products with the raters. Then the raters spread the products over three piles (non-creative, medium creative and highly creative) using the anchor products. Subsequently, the raters went through each pile separately, assigning a score to each product. Jury reliability for the collage tests was sufficient (pre-test .77, post-test .72). For the poems we used a design of overlapping rating teams (Van den Bergh & Eiting, 1989), because of the large number of products and the time required to assess these. We obtained four scores per poem. The estimated reliability for the rating of the poems was sufficient ( $\rho = .91$  and  $\rho = .74$  for the pre-tests tasks and  $\rho = .83$  and  $\rho = .74$  for post-tests tasks).

It was hypothesized that observation would lead to more problem finding, generative, exploratory and evaluative processes. Since the classroom setting did not allow for large scale think aloud protocol collection, we collected secondary process measures. We focused on process time and revision behaviour as we assumed that exploration and problem finding activities would result in longer work processes and more production. To collect traces of the collage making processes, we counted the number of images that students cut out of magazines but which they did not use in their final products. We regarded this as an indication of problem finding, exploration and revision in the processes. Since nearly all the students used all the available time, process time was not used as a process variable for collage making.

For the poetry writing process, we used Inputlog, a keystroke logging programme, to register students' processes (Leijten & Van Waes, 2005). Due to technical problems with the installation of the software at one school the processes of only two thirds of the students were recorded. From these keystroke logging data, we calculated the process times and revision ratios. Process time was defined as the total time spent on the task; revision ratio is the number of words in the final text as a percentage of the total number of words produced.

At pre-test and post-test, the Motivated Strategies for Learning Questionnaire (Pintrich, Garcia, & McKeachie, 1991) was administered, adapted to poetry writing

and collage making. The questionnaire consisted of 19 items for each of the two artistic domains; 38 questions in total. Likert scales for students' perceptions on their intrinsic motivation (7 items), task value (5 items) and self-efficacy (7 items) were used. The reliability of the scales varied between .86 and .93. Additionally, to acquire information about the students' capacity level, a verbal IQ test (DAT, 1984) was administered (Cronbach's alpha .72).

### 2.5 Procedure

During the observation sessions, the students worked individually on the computer. For collage making, students in the control group worked in an adjacent room. During the pre- and post-test, the students worked in one large room, creating a collage individually. For poetry writing, the participants from all three conditions were present in the same classroom, guided by worksheets; either watching and evaluating videos or writing poems themselves. The students received a short instruction by the researcher, the teacher's role was that of an organizer, since the materials were largely self-explanatory.

The students worked for six sessions of about 60 minutes. First the students filled in a questionnaire on motivation, task value and self-efficacy and completed the pre-tests on poetry writing (session1). Then they did the pre-test on collage making and the first part of the verbal IQ test. The intervention (about 60 minutes) and the post-tests on poetry writing (about 20 minutes) were completed in session 3. Collage making was the content of the 4<sup>th</sup> session (about 60 minutes). During the fifth session the post-test on collage making was administered, and in the sixth session, the students filled in the post-test questionnaire on motivation and the second part of the verbal IQ test. There were minor differences in procedure between schools due to different class schedules.

### 2.6 Analyses

We cannot test the learning effect from pre-test to post-test, because the level of difficulty of the two tests is unknown and, therefore, we cannot compare the outcomes. Therefore, we can only examine the effect of condition on the post-test.

Figure 1 shows that we expected observational learning to be more effective than practising. It also shows that we expect weaker students to perform better in the OWM condition while stronger students would perform better in the OSM condition. Since we have multiple observations per individual (more than one test) a mixed model analysis was chosen, in which both the variance *within* students and *between* students are estimated simultaneously. Several models were tested. In the first model, the so-called empty model, we estimated an intercept (next to both variances). In the second model we added differences between conditions, whereas in the third model we took initial differences into account as well. Hence, in this model we assume that the relation between pre-test and post-test would not vary between conditions. This assumption is relaxed in the fourth model, which allows differences

in means between conditions as well as differences in regression from post-test on pre-test. The difference in fit between these (nested) models can be tested by comparing  $-2\log\text{likelihood}$ , as the difference in  $-2\log\text{likelihood}$  in nested models is  $\chi^2$ -distributed (with the difference in number of estimated parameters as degrees of freedom).

For poetry writing two learner variables (pre-test level of creativity in poetry writing and verbal IQ) were entered successively into the analysis. So, six models were tested; (0) intercept only, (1) a model without a covariate, (2) a model with pre-test level as a covariate, (3) a model with pre-test level as a covariate and allowing its effect to vary between the conditions, (4) a model with two covariates and (5) a model allowing the influence of the second covariate to vary between the conditions. Subsequently these models were applied to measure effects on products, processes, motivation, task value and self-efficacy.

### 3. RESULTS

We will first report on the effect of observation on the creativity of the students' products (collages and poems). Then, we will report on the process effects, followed by the results for intrinsic motivation, task value and self-efficacy.

#### 3.1 Creativity of the collages

Table 2 provides the mean scores for the students' collages, at pre-test and post-test, for the three conditions. Pre-test scores did not differ significantly ( $p = .752$ ) between the conditions.

Table 2. Mean scores collages, z-scores (rating scale 0-200)

	Pre-test		Post-test	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Observation	-.05	1.01	.18	1.03
Observation <sup>strong</sup> model	-.04	.98	.06	.99
Observation <sup>weak</sup> model	-.06	1.04	.29	1.06
Control group	.09	.99	-.31	.88

In Table 3 the five models analysing the effect of observation on the creativity of the collages are presented. Model 1 (distinguishing between conditions) fits the data significantly better than model 0 (Intercept only). This is shown in the right hand column of Table 3 ( $p=.02$ ). Therefore, we reject model 0 in favour of model 1. Subsequently, model 2, including pre-test as a covariate, fits better than model 1 ( $p<.001$ ), so we must reject model 1 in favour of model 2. Since the difference

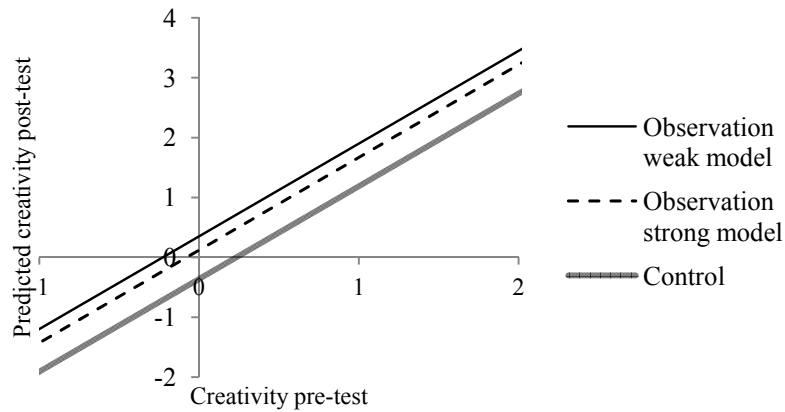
between -2LL of model 3 and -2LL of model 2 is not significant ( $p=.11$ ), we must choose model 2. According to this model, the effect of the pre-test does not differ between the conditions. This implies that, in contrast to our expectation as presented in figure 1, the regression lines for the predicted post-test scores are parallel (Figure 2). In other words; the slopes of the regression lines do not differ significantly between the conditions: the influence of pre-test level is equal for the conditions. This means that we did not observe a model similarity effect.

*Table 3. Comparison of models with creativity of collages as a dependent variable (-2LL)*

Model	-2LL	Models compared	$X^2$	$df$	$p$
0 Intercept only	331.0				
1 Condition as a factor	323.3	0 vs 2	7.7	2	.02
2 Condition as a factor and pre-test as a covariate	303.7	1 vs 2	19.6	1	<.001
3 Condition as a factor and the effect of pre-test differs between the conditions	301.2	2 vs 3	2.5	2	.11

Mixed models analyses with pre-test as a covariate revealed that both observation conditions performed significantly better than the control condition (OSM vs. practice: mean difference= .480,  $se=.226$ ,  $p=.036$ , OWM vs. practice: mean difference= .707,  $se=.221$ ,  $p=.002$ ). This means that at post-test the students who had observed made significantly more creative collages than the students in the control condition. The students in the OSM condition performed .48 standard deviations better than the students in the control condition and students in the OWM condition performed .71 standard deviation better than students in the control condition. The OSM condition and OWM condition did not differ significantly from each other ( $p=.328$ ).

Figure 2. Regression lines for three conditions with z-score pre-test predicting post-test score on collage creativity.



3.2 Creativity of the poems

In Table 4 the indices for the poems at pre-test and post-test per condition are presented. At the pre-test, the creativity of the students' poems did not differ significantly between conditions ( $p = .369$ ).

Table 4. Mean scores of students' poems, z-scores

	Pre-test1		Pre-test2		Post-test1		Post-test2	
	M	SD	M	SD	M	SD	M	SD
Observation	.12	.94	.08	.82	.09	.78	.03	.82
Observation <sup>strong</sup> model	.10	.83	.04	.68	.03	.78	-.20	.68
Observation <sup>weak</sup> model	.15	1.06	.12	.96	.14	.79	.24	.89
Control group	-.19	.71	-.12	.69	-.10	.70	-.09	.71

In Table 5 we present and compare five models for the effect of observation on the creativity of the poems. As shown in this table, model 1 (distinguishing between conditions) fits the data better than model 0 (only intercept). Therefore, we continued to compare model 1 and 2 (including pre-test as a covariate). As -2LL is significantly smaller for model 2, we concluded that pre-test is a significant covariate and that we therefore must reject model 1 in favour of model 2. Subsequently we al-

lowed the influence of the pre-test to vary between the conditions (model 3). This did not lead to a significant improvement of the model, so we rejected model 3. Model 2 was compared to model 4 which takes the second covariate (verbal IQ) into account. Model 4 fits the data better than model 2. Finally we compared model 4 to a fifth model, allowing the influence of verbal IQ to vary between the conditions, which did not lead to a significant improvement of the model. Therefore, model 4 was chosen.

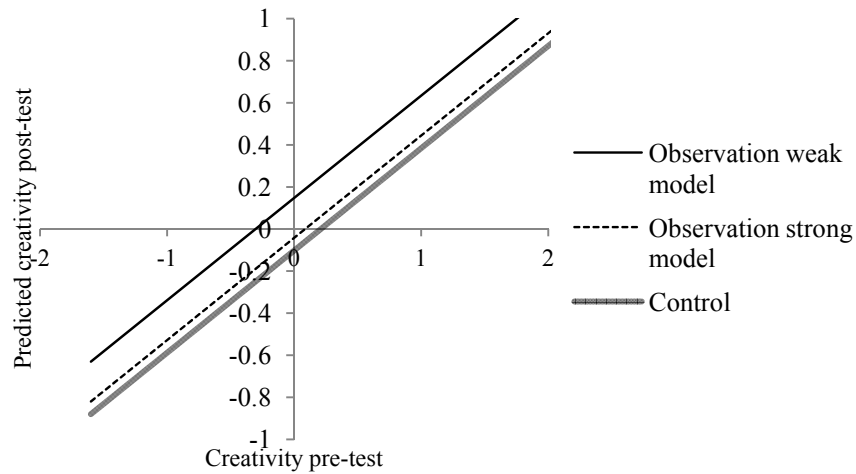
*Table 5. Comparison of models with creativity in poetry writing as a dependent variable (-2LL)*

Model	-2LL	Models compared	$X^2$	df	p
0 Intercept only	588.9				
1 Condition as a factor	583.0	0 vs. 1	5.9	2	.05
2 Condition as a factor and pre-test as a covariate	501.7	1 vs. 2	81.3	1	<.001
3 Condition as a factor and the effect of pre-test differs between the conditions.	498.8	2 vs. 3	2.9	2	.23
4 Condition as a factor and pre-test and IQ as covariates	478.4	2 vs. 4	23.3	1	<.001
5 Condition as a factor and pre-test as a covariate and the effect of verbal IQ differs between the conditions	476.4	4 vs. 5	2.0	2	.37

Pre-test and verbal IQ proved to be valid covariates, but in contrast to our expectation, their effect did not differ between the conditions. This means that the regression lines of the predicted post-test scores on the pre-test scores are parallel (Figure 3), which implies that there is no model similarity effect.

According to our analysis, the students in the OWM condition performed significantly better than the students in the OSM condition (mean difference=.25,  $se=.12$ ,  $p=.034$ ), but not better than the students in the control condition ( $p=.109$ ). The control condition and OSM condition did not differ significantly ( $p=.591$ ). This means that the students in the OWM condition wrote the most creative poems.

Figure 3. Regression lines for three conditions with z-score pre-test predicting post-test score on poem creativity.



3.3 Collage making processes

For the collage task we examined whether the students who had observed revised more than the students in the control group. Table 6 presents the mean number of images that were cut out, but were not used in the final product. No difference between conditions on the pre-test ( $p = .475$ ) was observed.

Table 6. Collage processes, means of unused images, z-scores

	Pre-test		Post-test	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Observation	.06	1.21	.18	1.15
Observation <sup>strong</sup> model condition	.17	1.55	.13	1.01
Observation <sup>weak</sup> model condition	-.05	.75	.23	1.28
Control	-.10	.43	-.30	.57

The same models as used for the collage product analyses were tested (See appendix D1 for a table comparing the different models). The model with pre-test as a covariate was found to fit the data best (model 2). The influence of the pre-test did not vary between the conditions, resulting in regression lines running parallel.

The students in the OWM condition had more unused shapes than the students in the control condition (mean difference= .532,  $se=.222$ ,  $p=.018$ ), while students in the OSM condition did not have significantly more unused images than students in the control condition ( $p=.192$ ). The OSM and OWM condition did not differ significantly in this respect ( $p=.318$ ). This indicates that the students in OWM revised significantly (.53 standard deviation) more than the students in the control condition.

### 3.4 Poetry writing processes

For poetry writing, we examined two process variables (process time and revision ratio) for differences between the conditions (see Table 7). At pre-test, the conditions did not differ significantly in process time ( $p=.410$ ,  $p = .387$ ) or revision ratio ( $p = .385$ ,  $p = .638$ ).

Table 7. Poetry writing processes, means of process time and revision ratio (words in final text/words produced), z-scores

		Pre-test1		Pre-test2		Post-test1		Post-test2	
		<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Process time	Obs <sup>strong</sup> model	-.19	.96	.05	1.02	-.11	1.07	-.01	.86
	Obs <sup>weak</sup> model	.07	1.08	.15	.98	.59	.84	.12	1.09
	Control	.13	.97	-.19	1.00	-.49	.78	-.11	1.04
Revision ratio	Obs <sup>strong</sup> model	.19	.98	-.06	1.11	-.13	.77	-.22	.93
	Obs <sup>weak</sup> model	-.18	1.13	-.09	.92	-.32	1.38	-.14	1.00
	Control	-.05	.91	.14	.99	.44	.46	.33	1.01

For both process variables the fourth model was found to fit the data best: the model with pre-test and verbal IQ as covariates (see appendix D2 and D3). The effect of the covariates did not differ between the conditions. So again, parallel regression lines must be assumed. For process time it was found that OWM differed significantly from the control condition (mean difference=.529,  $se=.196$ ,  $p=.008$ ), but OSM did not differ significantly from the control condition ( $p=.475$ ). Also OWM and OSM differed significantly (mean difference= .392,  $se= .195$ ,  $p=.047$ ). This means that students in the OWM condition had the longest process times of the students in all the three conditions.

For revision OWM and OSM differed significantly from the control condition (mean difference=  $-.576$ ,  $se=.186$ ,  $p=.003$  and mean difference =  $-.567$ ,  $se= .181$ ,  $p=.002$ ). The students from both observation conditions revised significantly more at post-test than the students in the control group. The observation conditions did not differ significantly from each other in this respect ( $p=.961$ ): the students who ob-

served revised more than the students who did not observe. We conclude that the writing processes of the students who observed differed from the processes of the students who did not observe.

3.5 Motivation, task value and self-efficacy

Table 8 presents the mean scores on intrinsic motivation, task value and self-efficacy. At pre-test, there were no significant differences between the conditions (collage making: intrinsic motivation:  $p = .736$ ; task value:  $p = .302$ ; self-efficacy:  $p = .997$ ; poetry writing: intrinsic motivation:  $p = .459$ ; task value:  $p = .484$ ; self-efficacy:  $p = .715$ ).

For collage making, the model with pre-test as a covariate fits best (see appendix D4-D6) for intrinsic motivation, task value and self-efficacy. We found that for intrinsic motivation and self-efficacy, the students in OWM had significantly higher scores than the students from the control condition (intrinsic motivation: mean difference = .528,  $se = .209$ ,  $p = .013$ ; self-efficacy: mean difference = .573,  $se = .205$ ,  $p = .006$ ). The students in OSM did not differ significantly from the students in the control condition (intrinsic motivation:  $p = .134$ ; self-efficacy:  $p = .129$ ). Scores between both observation conditions did not differ significantly either (intrinsic motivation:  $p = .338$ ; self-efficacy:  $p = .234$ ). For task value, both observation conditions differed significantly from the control condition (OSM: mean difference = .446,  $se = .208$ ,  $p = .034$ ; OWM: mean difference = .528,  $se = .203$ ,  $p = .010$ ), but not from each other ( $p = .693$ ). Task value proved to be higher for the students who observed than for the students who did not. Only the students who focused on the weaker model had higher intrinsic motivation and self-efficacy scores.

Table 8. Observed pre-test and post-test means, z-scores: intrinsic motivation, task value and self-efficacy for collage making and poetry writing (1: strongly disagree, 7: strongly agree)

Variable	Condition	Collages				Poems			
		Pre-test		Post-test		Pre-test		Post-test	
		M	SD	M	SD	M	SD	M	SD
Intrinsic motivation	Obs <sup>strong</sup> model	.09	1.06	.05	1.02	.13	.97	.15	.90
	Obs <sup>weak</sup> model	.01	.96	.19	.79	.02	.93	.09	.88
	Control	-.09	.99	-.24	1.13	-.14	1.09	-.25	1.17
Task Value	Obs <sup>strong</sup> model	-.07	1.04	.11	1.05	.13	1.00	.24	.95
	Obs <sup>weak</sup> model	.22	.98	.15	.87	-.14	.88	-.10	.91
	Control	-.12	.97	-.28	1.02	.01	1.10	-.17	1.09
Self - efficacy	Obs <sup>strong</sup> model	.01	.99	.03	1.06	.11	1.14	.18	1.02
	Obs <sup>weak</sup> model	-.01	1.00	.22	.81	-.05	.84	-.05	.85
	Control	-.00	1.03	-.25	1.08	-.05	1.01	-.15	1.09

For poetry writing, the model with pre-test and verbal IQ as covariates (see appendix D7-D9) was applicable for intrinsic motivation and task value. For self-efficacy, condition as a factor did not improve the model significantly. In other words, we observed no effects of condition on self-efficacy. Closer examination of the results on intrinsic motivation and task value did not reveal any significant difference between the conditions (intrinsic motivation: OSM vs. control:  $p = .250$ , OWM vs. control:  $p = .562$ ; task value: OSM vs. control:  $p = .241$ ; OWM vs. control:  $p = .287$ ). For poetry writing, the students who observed were not more motivated, nor did they have higher task value or self-efficacy scores than the students who did not observe.

#### 4. DISCUSSION

We investigated the effect of observational learning on students' performance on creative tasks in the visual and verbal domain. We aimed at answering two questions: is observational learning more beneficial than learning by practising for creative products, processes and motivation (intrinsic motivation, task value and self-efficacy)? And does the 'model similarity effect' influence the effect of observational learning? We expected the students who observed to produce more creative products than the students who did not observe. Concerning the processes, we hypothesized that observation would result in longer session times and more revision than learning by practice. We expected intrinsic motivation, task value and self-efficacy to be higher after observation. Regarding model similarity, we hypothesized that the effect of pre-test and verbal IQ (in the case of poetry writing) would differ between the conditions.

For collage making, our hypotheses for main effects were largely confirmed. The students who observed others at work produced collages that were rated as more creative than the students who learned by practising. The students' processes of collage making differed between conditions at the post-test: the students revised more (in terms of more unused but cut out shapes) in the observation<sup>weak</sup> model (OWM) condition than in the control condition. This difference was not significant for the observation<sup>strong</sup> model (OSM) condition. For OWM, intrinsic motivation, task value and self-efficacy were significantly higher after the intervention than for the students in the control group. For OSM, this was only the case for task value. For none of the variables did we find evidence in support of the model similarity hypothesis.

For poetry writing we found that OWM resulted in better poems than OSM, although the observation conditions did not score significantly better than the control condition. For processes, OWM resulted in longer processes than the control condition, while both observation conditions resulted in more revision than the control condition. No effects were observed on intrinsic motivation, task value and self-efficacy. We conclude that the hypotheses regarding effects on products and motivational variables must be rejected, but that poetry writing processes were affected significantly by observation. For none of the variables did we find evidence in favour of the model similarity hypothesis.

In general, we found indications that the students who focused on the weaker model performed better in both domains (products and processes). Initially we did not expect differences in the mean performance between the two observation conditions. Instead, we expected different students to behave differently in the conditions. Possibly, the task of evaluating the videos of the relatively more competent model was too difficult for the students. The stronger model might have served as a frame of reference when the students had to explain why the weaker model did worse (Braakma et al., 2002), which is easier than explaining what a good model does well. Creative processes of the majority of the students might have been more similar to those of the weaker student in the poetry videos, since Dutch students generally have little experience in poetry writing. Possibly a 3 x 2 design with condition (practice; observational learning from weak model only; observational learning from strong model only) and student ability (weak versus strong) as factors would have provided more information on differential effects of student ability.

Some validity concerns about the present study must be discussed. One limitation concerns the measurement of creativity of products. We did not score the products on technical qualities and therefore we can only assume that the judges were able to distinguish between creative performance and technical quality. Although raters seemed to be able to distinguish levels of creativity, validity might be warranted in future studies by adding non-creative dimensions to the rating procedure as well.

Another concern is the measurement of processes. The process measures we used are only indirectly related to cognitive processes. For example, the ratio of words in the final text and the number of words produced does not distinguish between prewriting activities, ongoing exploration and actual revision behaviour. However, our measures proved to be sensitive enough for detecting condition effects. Currently, the setting in real classrooms prevented us from measuring processes in a more direct way (e.g. by using think aloud methodology). In future studies process measurement could be optimized, attempting to get closer access to the actual processes. An interesting procedure seems to be a secondary task procedure as installed in classroom settings in writing process studies (Torrance, Fidalgo, & Garcia, 2007) which can be adapted to visual tasks.

Another issue is that the procedures in the two experiments (collage making and poetry writing) were different in time and order. The poetry experiment was the first to take place, so this may have affected the collage experiment and its outcomes. Moreover, for practical reasons the duration of the tests and the test moments differed between experiments, which hampers generalizability across domains. More convincing results were found for the visual domain. Possibly using a visual medium (video) is more effective in a visual domain, collage making, than in a non-visual domain such as poetry writing. More research is needed to clarify this issue.

Furthermore, external validity is an issue which deserves attention. External validity can be promoted by implementing several versions of a treatment. In the current experiment we implemented two versions of a treatment (focus on weak and strong model). In future studies diverse treatment operationalisations could be fur-

ther explored. Using different operationalisations may complicate the interpretation of the results, as we have seen, but generalizability would benefit from it. To satisfy experimental requirements, the setting in the current study was not completely realistic. The students had little freedom; they had to finish their creative products in one session, within a time limit. In a more realistic context, they might have opportunities to leave the products for some time and return to them for further elaboration at later moments. The control condition consisted of practice guided by a workbook, without teacher involvement. In art education, however, the teacher usually plays a crucial role. In future studies, it will be interesting to study the effect of observation in real educational practice. Implementing observational learning in actual art classes requires embedding observational learning videos in a lesson series (accompanied by feedback and practice).

All in all, the results suggest that it is worthwhile to implement observational learning in arts education. At least for visual arts we have demonstrated positive effects. We certainly do not suggest replacing artistic practice by observation as we did in the experiment. Instead, we recommend enriching the arts classes with observational learning. From a theoretical perspective, it can be concluded that observational learning is an effective learning tool, not only for structured tasks, but also for ill-defined creative tasks in arts education. Even when students are asked to produce original work, modelling examples may support them. In addition, we think that this study shows a new direction of studying interventions that foster creativity, taking both effects on process and product into account.

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## APPENDIX A: POETRY TASKS

*Pre-test 1:*

Write a cinquain that starts with the word 'snow'.

This is the form of a cinquain:

Line 1: first word (given)

Line 2: two adjectives about the first word.

Line 3: three verbs about the first word

Line 4: a sentence about the first word (you may decide about the length)

Line 5: repetition of the first word

Available time: 10 minutes (an example was provided)

*Pre-test 2:*

Write a poem based on the following steps:

- Mention a place in the house
- Make up a line with a colour
- Make up a line with a domestic device and a sound
- Tell something about the weather
- Make up a line that is related to the lines above
- Repeat the first line
- Repeat the second line with a small change

Available time: 10 minutes (an example was provided)

*Post-test 1:*

Write a poem of five lines that contains the following words:

Music, bike, shiver, green, resembles

Each line should contain one of these words (each word should only be used once)

Available time: 10 minutes.

*Post-test 2:*

Write an animal haiku about a lion.

A haiku contains 17 syllables, divided over three lines of the poem. This is the form of a haiku:

- Line 1: five syllables.
- Line 2: seven syllables.
- Line 3: five syllables.

Available time: 10 minutes

APPENDIX B: ANCHORS COLLAGE POST-TEST

Score 50



Score 100



Score 150



## APPENDIX C

Anchors poetry post-test (These anchors are translated from Dutch)

*Score 50*

I went by bike to tennis class  
The music is full of chatter  
I feel a shiver over my back  
The green is from the grass  
Because it looks like a pool [in Dutch this rhymes with the previous line]

*Score 100*

I cycle through the forest  
My ipod plays music  
Leaves from the trees are luminously green  
Suddenly there is a shiver  
It seems to be winter

*Score 150*

Everything that seems normal to you,  
Makes me shiver  
The colour green  
Hearing the music  
That day we were together, you behind me on my bike

## APPENDIX D

Comparison of models with process variables as dependent variables.

*Table D1. Four models analysing effects on revision in collage making (-2LL)*

Model	-2LL	Models Compared	$X^2$	$df$	$p$
0 Intercept only	331.0				
1 Condition as a factor	324.3	0 vs. 1	6.7	2	<.03
2 Condition as a factor and pre-test as a covariate	305.1	1 vs. 2	19.2	1	<.001
3 Condition as a factor and the effect of pre-test differs between the conditions	302.8	2 vs. 3	2.3	2	>.32

*Table D2. Six models analysing effects on process time in poetry writing (-2LL)*

Model	-2LL	Models Compared	$X^2$	$df$	$p$
0 Intercept only	505.1				
1 Condition as a factor	494.0	0 vs. 1	11.1	2	<.004
2 Condition as a factor and pre-test as a covariate	470.5	1 vs. 2	23.5	1	<.001
3 Condition as a factor and the effect of pre-test differs between the conditions.	469.7	2 vs. 3	.8	2	0.67
4 Condition as a factor and pre-test and IQ as covariates	457.8	2 vs. 4	12.7	1	<.001
5 Condition as a factor and pre-test as a covariate and the effect of verbal IQ differs between the conditions	457.8	4 vs. 5	0.0	2	1.0

*Table D3. Six models analysing effects on revision in poetry writing (-2LL)*

Model	-2LL	Models compared	$X^2$	df	<i>p</i>
0 Intercept only	505.8				
1 Condition as a factor	492.1	0 vs. 1	13.7	2	0.001
2 Condition as a factor and pre-test as a covariate	475.7	1 vs. 2	23.6	1	<.001
3 Condition as a factor and the effect of pre-test differs between the conditions.	474.1	1 vs. 3	1.6	2	0.45
4 Condition as a factor and pre-test and IQ as covariates	464.9	2 vs. 4	9.2	1	0.002
5 Condition as a factor and pre-test as a covariate and the effect of verbal IQ differs between the conditions	463.9	4 vs. 5	1.0	2	0.61

*Table D4. Four models to analyse effects on intrinsic motivation in collage making (-2LL)*

Model	-2LL	Models compared	$X^2$	df	<i>p</i>
0 Intercept only	365.1				
1 Condition as a factor	358.6	0 vs. 1	6.5	2	0.038
2 Condition as a factor and pre-test as a covariate	334.8	1 vs. 2	23.8	1	<.001
3 Condition as a factor and the effect of pre-test differs between the conditions	332.8	2 vs. 3	2.0	2	0.37

*Table D5. Four models analysing effects on task value in collage making (-2LL)*

Model	-2LL	Models compared	$X^2$	df	<i>p</i>
0 Intercept only	365.1				
1 Condition as a factor	356.9	0 vs. 1	8.2	2	0.02
2 Condition as a factor and pre-test as a covariate	328.1	1 vs. 2	28.8	1	<.001
3 Condition as a factor and the effect of pre-test differs between the conditions	327.3	2 vs. 3	.8	2	0.67

*Table D6. Four models analysing effects on self-efficacy in collage making (-2LL)*

Model	-2LL	Models compared	$\chi^2$	df	p
0 Intercept only	365.1				
1 Condition as a factor	358.1	0 vs. 1	7.0	2	0.03
2 Condition as a factor and pre-test as a covariate	330.8	1 vs. 2	27.3	1	<.01
3 Condition as a factor and the effect of pre-test differs between the conditions	330.5	2 vs. 3	.3	2	0.86

*Table D7. Six models analysing effects on intrinsic motivation in poetry writing(-2LL)*

Model	-2LL	Models compared	$\chi^2$	df	p
0 Intercept only	365.1				
1 Condition as a factor	358.7	0 vs. 1	6.4	2	0.04
2 Condition as a factor and pre-test as a covariate	331.0	1 vs. 2	27.7	1	<.001
3 Condition as a factor and the effect of pre-test differs between the conditions.	329.1	2 vs. 3	1.9	2	0.39
4 Condition as a factor and pre-test and IQ as covariates	315.6	2 vs. 4	13.5	1	<.001
5 Condition as a factor and pre-test as a covariate and the effect of verbal IQ differs between the conditions	314.5	4 vs. 5	1.1	2	0.58

*Table D8. Six models analysing effects on task value in poetry writing (-2LL)*

Model	-2LL	Models compared	$X^2$	df	p
0 Intercept only	365.1				
1 Condition as a factor	357.2	0 vs. 1	7.9	2	0.048
2 Condition as a factor and pre-test as a covariate	328.6	1 vs. 2	28.6	1	<.0001
3 Condition as a factor and the effect of pre-test differs between the conditions.	327.8	2 vs. 3	.8	2	0.67
4 Condition as a factor and pre-test and IQ as covariates	314.1	2 vs. 4	13.7	1	<0.001
5 Condition as a factor and pre-test as a covariate and the effect of verbal IQ differs between the conditions	312.9	4 vs. 5	1.2	2	0.55

*Table D9. Two models analysing effects on self-efficacy in poetry writing (-2LL)*

Model	-2LL	Models compared	$X^2$	df	p
0 Intercept only	362.2				
1 Condition as a factor	365.4	0 vs. 1	5.8	2	0.055



## Chapter 4

# THE EFFECTS OF OBSERVATIONAL LEARNING ON STUDENTS' DESIGN PRODUCTS AND PROCESSES

Previous research has shown that observation is an effective learning activity in various domains, e.g. argumentative writing and mathematics. The question in this paper is whether observational learning can also be beneficial when learning to be creative. We hypothesized that observation has a positive effect on creativity measured in the product and the divergent activities in the designing process. 61 Dutch students (ninth grade, 14 years old) participated in an experiment with a pre- post-test control group design. The students were randomly assigned to one of two conditions: observational learning versus a direct strategy instruction condition with process guidance and practice. Students in the observational learning condition watched videos of peers doing design tasks while thinking aloud. The students were pre- and post-tested on a design task. We included process measures as well as a measure for perceptions of learning experiences. On average, the designs of the experimental group were rated as more creative at post-test than the designs of the control group. Besides, the students in the experimental group reported to have brainstormed more at post-test than the students in the control group and they reported more process learning experiences. Results indicated that observation had beneficial effects on students' design products and processes compared to the direct strategy instruction. We conclude that observational learning enhances creativity in design products and processes and that students are more process oriented after observation.

Keywords: observational learning, cognitive modelling, art education, creativity, creative process

### 1. INTRODUCTION

Great Renaissance artists such as Leonardo da Vinci and Michelangelo were educated as apprentices in the workshops of their masters. They acquired the art and craft of painting and sculpture through apprenticeship. Apprenticeship includes modelling: an expert demonstrates his work process to an observing apprentice. Observational learning, as examined in the present study, is also triggered by a form of modelling; students learn by watching, interpreting and evaluating peers carrying out a task. Observational learning proved to be an effective learning activity in various domains, such as mathematics (e.g. Schunk & Hanson, 1985), reading (Couzijn & Rijlaarsdam, 2004), argumentative writing (Braaksma, Rijlaarsdam, & Van den

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Bergh, 2002; Couzijn, 1999; Raedts, Rijlaarsdam, Van Waes, & Daems, 2007; Rijlaarsdam, Braaksma, Couzijn, Janssen, Raedts, Van Steendam, Toorenaar, & Van den Bergh, 2007; Van Steendam, Rijlaarsdam, Sercu, & Van den Bergh, 2010; Zimmerman & Kitsantas, 2002), learning to collaborate (Rummel & Spada, 2005) and learning argumentation skills (Schworm & Renkl, 2007).

It is generally believed that creative skill should be nurtured in the classroom. We expect secondary school students to display creative and independent thinking when working on projects, writing papers, or participating in classroom discussions. In art education, teachers aim at stimulating students' creative processes. There are few experimental studies that examine the effectiveness of interventions which aim at enhancing creative processes in secondary art education (e.g. Groenendijk, Janssen, Rijlaarsdam, & Van den Bergh, 2011). Implementing observational learning tasks may be an effective approach for stimulating students' creative processes and improving their creative products. In the following sections, we will describe the potential for learning from observation for creative tasks.

### *1.1 Observational learning*

The rationale of observational learning is based on Bandura's (1986) social learning theory. It explains learning as a continuous interaction between cognitive, behavioural and environmental influences. For effective modelling, several conditions need to be fulfilled: students need to pay attention to relevant elements in the learning environment, to store and transform information in memory, to be able to translate mental conceptions into actions and be motivated to do so. Schunk and Zimmerman (1997) elaborated Bandura's theory into a social cognitive model of self-regulation in reading and writing. According to this model, the learning of a new task occurs in four phases: observation, emulation, self control and self regulation. Observation is a first step in this sequence. Then the learner emulates the model's general style. Encouraged by feedback, the learner can internalize the skill and finally use the strategy independently and in various contexts. Here we focus on the first phase: observation.

Observational learning is closely related to cognitive apprenticeship. In cognitive apprenticeship, an expert model verbalizes thought processes. Collins, Brown, and Newman (1989) describe how observation, as an element of cognitive apprenticeship, provides strategic knowledge to the learner and changes students' understanding of the modelled skill. For example, in writing students may not realize that experts organize their ideas, elaborate their goals and think about their audience. Observation may enhance this awareness about the task. Couzijn (1999), Braaksma et al. (2002), and Raedts et al. (2007) found that observation is effective for writing argumentative or synthesis texts. In these studies a multimedia learning environment was used; students watched videos of peer models performing a writing task while thinking aloud. Students who observed peer models performing a learning-to-write task wrote better texts afterwards than students who practised this learning-to-write

task themselves, without observation. Rummel and Spada (2005) proved the effectiveness of observation for learning to collaborate in computer mediated settings, Schworm and Renkl (2007) found beneficial effects in the domain of argumentation, and Van Steendam et al. (2010) for cooperative revision tasks. It seems that modelling is beneficial for various types of tasks.

Several elements may influence the effectiveness of observational learning, such as the competence level of the models. Zimmerman and Kitsantas (2002) found that college students who observed a coping model, a model who gradually improves her writing technique, did better than students who had observed a mastery model; a model who already masters the skill. Braaksma et al. (2002) found that when confronted with a new task, weaker writers learn more from focusing on the weaker model of a pair, while better writers learn more from focusing on the more competent model. Thus, it seems important to include models of different competence levels in observational learning arrangements.

Observation should include evaluation. Braaksma, Rijlaarsdam, Van den Bergh, and Van Hout-Wolters (2006) analysed students' observation processes and found that evaluation and elaboration are essential for the effectiveness of learning from observation. Sonnenschein and Whitehurst (1984) studied the effect of observation and evaluation compared to observation only for preschool children who acquire communication skills. The observation-evaluation condition performed better on speaking and listening tasks than the observation only condition. The additional evaluation task explains the transfer effects on listening and speaking according to Sonnenschein and Whitehurst. They describe evaluation skills as 'superordinate' skills since these skills transferred to speaking and listening, whereas increased performance on speaking and listening tasks did not transfer to evaluation skills. It seems advisable then to stimulate students to evaluate models and to elaborate on the models' behaviour after observation.

All in all it appears that observational learning is an effective approach in various domains. Attributes of the model (such as initial performance level) and students' thinking activities (evaluation and elaboration during and after observation) may mediate the effect of observational learning.

### *1.2 Creative tasks and modelling*

The question arises whether observational learning can be effective for creative tasks. Creative tasks are 'ill-defined', because they are not entirely formulated and, consequently, there are many possible solutions. This means that the problem space is large, especially since high performance on creative tasks requires novelty and originality. Artists even have to discover their own task (artistic problem), before they can start solving it (for example, finding out what to draw) (Getzels & Csikszentmihalyi, 1976). Therefore, creative tasks in the artistic domain are extremely ill-defined. Students need strategies to deal with this large problem space. Can observation be effective for solving creative tasks?

Few studies have focused on modelling in the domain of creativity. One explanation may be that using observation of models to enhance students' creativity seems paradoxical. Creative work involves the generation of original ideas, while observing models may lead to imitation of products (the 'conformity effect'; Finke, Ward, & Smith, 1992). However, observation of cognitive models is directed at developing a clear idea of how a task can be performed as demonstrated by Braaksma, Rijlaarsdam, Van den Bergh, and Van Hout-Wolters (2004). They found that observation of peer models affected students' writing processes; students who had learned to write by observing engaged in metacognitive activities during writing, such as planning, analysing and goal-orientation more often than students who had learned by practising writing. Therefore, we expect that the observation of someone who is thinking aloud while engaged in creative work affects the observer's future activities.

Studies in the area of worked examples have examined the effect of examples for learning in ill-defined domains (e.g. Rourke & Sweller, 2009; Van Gog, Paas, & Van Merriënboer, 2004; 2006; 2008). Worked examples differ from modelling examples (e.g. observational learning) in that they involve 'ideal' problem solution steps presented as text. The underlying mechanisms, however, are similar: students learn new procedures for problem solving and abstract general rules from the examples (Van Gog & Rummel, 2010). Rourke and Sweller (2009) found that students who studied worked examples of a task about recognizing designers' styles perform better than students who practised this task themselves. They concluded that process examples are as effective in ill-defined domains as they are in well-structured domains.

But what kind of knowledge should students acquire from observing and evaluating models in ill-defined domains? Hilbert, Renkl, Kessler, and Reiss (2008) introduced heuristic (worked) examples for ill-defined tasks, which demonstrate heuristic steps towards a solution. They studied the effect of these examples on mathematical proving skills, which include discovery behaviour. Heuristic knowledge was presented explicitly and self explanation prompts were directed at the heuristic level. This approach proved to foster learning. Van Gog et al. (2004, 2006, 2008) argue that experts' 'how' and 'why' process information enables students to deepen their understanding of solution procedures in ill-structured domains. For tasks with large problem spaces, learners need strategies to narrow the search space and select the most promising solution procedures. Therefore, students need to know why certain solution steps are taken. Van Gog et al. (2008) show that process information is indeed effective in the first phase of learning in electrical circuit troubleshooting.

A few studies examined the effect of modelling examples and artistic creative tasks (Anderson & Yates, 1999; Groenendijk et al., 2011; Teyken, 1988). Anderson and Yates (1999) examined the effect of modelling on young children's clay works. They found that the quality of the clay works produced after modelling was higher than the quality of the clay works produced under regular conditions. Teyken (1988) examined the effects of focused reflection on creative design. He incorporated observational learning tasks in an experimental curriculum for student art teachers.

They watched videos of designers at work. Teyken found that the students' design processes changed as a result of focused reflection, although the quality of the design products did not improve. In this study observation was part of an experimental curriculum, therefore it remains unclear which learning activity in the curriculum caused the effects measured.

Groenendijk et al. (2011) examined the effect of observational learning for poetry writing and collage making. A positive effect on the creativity of products was found for collage making, but not for poetry writing. However, positive effects were found on students' processes in poetry writing. In the current study we would like to gain more insight into the effect of observation on processes in the visual domain by using a different type of process measure and an intervention more strongly focused at creative processes. Videos were used to demonstrate the processes. In the next section we will elaborate on the processes modelled in observational learning videos.

### *1.3 Creative processes*

The creative process – the sequence of thoughts and actions that leads to novel, adaptive productions – is traditionally described as consisting of four stages: preparation, incubation, illumination and verification (Wallas, 1926). During preparation the creator absorbs information and engages in problem finding and definition. During incubation the person is taking a step away from the creative process. During illumination a solution or great idea suddenly comes to mind and during verification, the final product is created and edited.

From recent research on artists and designers at work, it appears that creative processes co-occur throughout the work recursively. Several studies have been conducted to describe the creative process (e.g. Fayena-Tawil, Kozbelt, & Sitaras, 2011; Getzels & Csikszentmihalyi, 1976; Ward & Mace, 2002; Yokochi & Okada, 2005), which resulted in several process models (e.g. Finke, Ward, & Smith, 1992; Ward & Mace, 2002).

Similar studies were carried out in the area of design; designers at work were studied (Cardella, Atmans, & Adams, 2006; Christiaans, 1992; Jaarsveld & Van Leeuwen, 2005; Goldschmidt 1994; Kavakli, Suwa, Gero, & Purcell, 1999; Kokotovich, 2002; Teyken, 1988). Much research on design processes has focused on the role of sketching in design (e.g. Jaarsveld & Van Leeuwen, 2005; Goldschmidt 1994; Kavakli et al., 1999; Kokotovich, 2002). Sketches are generally seen as products of divergence (Jaarsveld & Van Leeuwen, 2005), enhancing the creative process. By externalizing ideas, new aspects of the problem and new ideas can be found (Goldschmidt 1994). Therefore, sketches are regarded, not only as externalizing pre-existing ideas, but as a way of generating ideas. Some researchers see sketches as an external working memory. Kokovic (2002) demonstrated that it is important to consider what types of sketches are made in what part of the process. Sketches made in the beginning of the design process are different from sketches made towards the

end. Other researchers have examined the differences between sketches made by experts and sketches made by novices. The former are more frequent and more detailed (Teyken, 1988). Cardella, Atmans, and Adams (2006) demonstrated that senior designers employ more design activities than 1<sup>st</sup>-year students and that a high scoring 1<sup>st</sup>-year student employs more design activities than a low scoring 1<sup>st</sup>-year student. In general, research on design processes has focused on experts and students in higher education. There is not much research about designing by secondary school students.

To integrate all phases and activities in a model, based on several models of the creative process, Sapp (1995) designed a model for the creative process in art making and adapted it to art and design education (Table 1).

*Table 1. Model for creative problem solving in art education based on Sapp (1995)*

Stages	Description	
1 Problem parameter exploration	Start problem finding	Divergent
2 Transition 1	Problem definition	Convergent
3 Associative exploration	Free flow of ideas based on association is produced and explored within the boundaries of the task parameters	Divergent
4 Transition 2	Decision making	Convergent
5 Multiple focus exploration	Many image clusters are explored simultaneously or in succession	Divergent
6 Transition 3	Decision making	Convergent
7 Primary focus exploration	Divergent process centred around one idea cluster generated during transition 2	Divergent
8 Transition 4	Decision making; 'aha' may occur	Convergent
9 Refinement	Work is refined and finished	Divergent
10 Final image	Evaluation	Convergent

Table 1 shows that divergent and convergent processes alternate. In the original model, it is shown visually that the process starts with a broad problem space, converging into a single solution. Usually, an artist starts with associative exploration. During associative exploration, a free flow of ideas based on association is produced and explored. In art education, problem parameter exploration precedes explorative exploration. During the Problem Parameter Exploration stage, the student explores the task. Associative exploration in art education takes place within the boundaries of the task parameters. Transition stages represent convergent stages of conscious decision making, alternating with divergent stages. The problem parameters narrow in focus and become more defined as the process proceeds. During multiple focus

exploration, many image clusters are explored simultaneously or in succession, usually by the production of several sketches or models. Primary focus exploration is a divergent process centred around one idea cluster selected during transition 2. Often this happens in the selected medium (for example paint) and results in several sketches or models representing several alternatives for one idea. During transition 3, an ‘aha’ moment may occur: one of the explored alternatives seems to be the ultimate solution. Finally the work is refined and finished.

The Sapp (1995) model describes an ideal process and may therefore be used in education as a prescriptive, instructional model. For students the divergent phases are most crucial; they often face difficulties exploring alternatives (Van de Kamp, 2010). They often produce one idea that directly becomes the final work of art without considering any alternatives.

In the present study we used Sapp’s model to select and structure the content of observational learning materials. Students’ approaches in each of the stages are shown in the observational learning videos. We elaborate on the content of the videos in the method section.

#### *1.4 Research question and hypotheses*

The aim of the study was to develop and test a learning arrangement for creative design tasks based on the principles of observational learning. The students in the experimental group watched videos of peer-designers at work while thinking aloud and a comparison group practised a design task via a direct instruction of strategies (carrying out the task with step wise process guidance). Our research question was: Is observational learning more effective than learning by practising accompanied by process guidance with regard to creative design products and design processes? Firstly, we expected observational learning to be more effective than learning through guided practice. We expected an effect on the creativity of the students’ designs, not on technical qualities, since the observational learning videos were intended to improve creative ability and not the techniques. Concerning the students’ products, we expected that:

- participants in the observational learning condition will create more creative designs at post-test than students in the comparison condition, but the two learning conditions will not differ with respect to the technical quality of the final products.

Secondly, we assumed that observation leads to more divergent activities than practising with process guidance. As we have shown in the previous section, an ideal creative process in art consists of both divergent and convergent processes (Sapp, 1995). Students are generally thought to have difficulties with the divergent stages. So we expected that:

- participants in the observational learning condition will spend more time on divergent activities (such as brainstorming and sketching) and report more process learning than students in the comparison condition.

Thirdly, Amabile (1996) considers intrinsic motivation an essential component of creative performance. Therefore it seemed important to take this variable into account. We aimed at comparing learning conditions that are equally motivating. Therefore, we measured attitudinal variables (intrinsic motivation, task value and self-efficacy) as implementation measures. We expected that:

- the observational learning condition and the comparison condition are both equally motivating for students, resulting in high scores for motivation.

Possibly the effectiveness of the condition is influenced by student characteristics such as prior knowledge and divergent thinking abilities. While we do not hold firm hypotheses on these variables we decided to take these variables into account.

## 2. METHOD

### *2.1 Research design*

We conducted an experiment with a pre- post-test control group design and two conditions: learning by observation and learning by direct strategy instruction (with extensive process guidance and practice). Students in the observation condition observed videos of peers performing a design task.

### *2.2 Participants*

Participants in the experiments were 61 secondary school students (9<sup>th</sup> grade, on average 14 years old, pre university and higher general secondary education). To select the students, about 250 students were invited to volunteer in the experiment during their holidays in return for a small reward. 70 students volunteered to participate and also received parental permission. 9 students cancelled for various reasons during the weeks before the start of the experiment. Among the remaining 61 students there were 13 boys and 48 girls. The group was diverse with regard to prior knowledge. 45 students chose visual arts as a subject in school, and as a result, had more knowledge and experience. 16 students did not follow visual arts classes. We assigned all students randomly to conditions.

### *2.3 Observational learning intervention*

We selected 17 observational learning videos based on the Sapp (1995) model. The material for the videos consisted of videotaped authentic student practice that we edited. In the videos, the work-in-progress and the model's hands were visible on the screen, while learners heard the model who was thinking aloud as a voice over. In Table 2, we present the content of the observational learning videos. As shown in the table, the videos contained heuristic information (for example, brainstorming and sketching strategies), process information ('how' and 'why' information) and attitudinal information (for example, explorative attitude, motivation, confidence).

*Table 2. Content and duration (in minutes) of observational learning videos based on Sapp (1995)*

Stages	Video	Min.	Different approaches in the videos
Problem parameter exploration	1	1.5	Different approaches to explore the task: Reading assignment and marking important parameters vs. reading assignment.
Transition 1	2	3	Different approaches to deal with problem parameters: Recognizing important problem parameters vs. already thinking about solutions.
Associative exploration	3	2	Different approaches in association: Mind mapping vs. drawing pictures vs. drawing letters.
	4	5	Different approaches in association: Free association combined with drawing of preliminary ideas, including feelings/emotion vs. generating only one cliché idea.
Transition 2	5	2	Different approaching in selecting areas of interest: Selecting areas of interest vs. choosing a fixed final idea.
Multiple focus exploration	6	5	Different approaches in the sketching stage: Sketching many different ideas without thinking about what the final product will be vs. sketching one final product idea.
	7	2	Different approaches in the sketching stage: Quick sketching vs. very neat and detailed sketching.
Transition 3	8		Different approaches in choosing an idea: Selecting ideas based on criteria derived from briefing vs. random decision.
	9	1	Different approaches in choosing an idea: Going back to previous stage in process vs. proceeding while unhappy with current ideas.
Primary focus exploration	10	2	Different approaches in developing alternatives: Starting to draw the frame of the design (2 models) vs. drawing without taking frame into account.
	11	.75	Adding frame and discovering something.
	12	6	Different approaches in developing alternatives: Trying many different options by manipulating composition, colour, style etc. vs. drawing the same thing twice.
	13	5.5	Different approaches in developing alternatives: Two different aha moments and the preceding steps
	14	1	Different approaches in developing alternatives: Perceived lack of drawing skill vs. dealing with lack of drawing skill.
Transition 4	15	3.5	Different approaches in making a final decision: Choosing an idea vs. combining two ideas into something new.
Refinement	16	2	Different approaches in the finishing touch: Adding new elements vs. removing elements.
Final image	17	3	Reflection by reporting to external client.

During the intervention, the students in the observation condition did not engage in design work themselves; instead we asked them to watch the videos and to evaluate the processes shown. To direct the students' attention to the relevant processes and

evoke a comparison process, we showed, where possible, contrasting approaches (rather weak and rather strong performances) or very different approaches. The models in the videos were not labelled as ‘competent’ or ‘weak’, but after the students had watched each video, we asked them to answer a question by evaluating or elaborating on the behaviour of the models in the video. Examples of these questions are: ‘Which student did better in your opinion? Explain: what did this student do so well? or: ‘Which student did less well in your opinion? Explain: what did this student do not so well?’ Sometimes, we asked students to compare the behaviour of the video model to their own approach when performing a creative design task. The students could replay the videos if they wanted.

#### *2.4 Comparison condition: direct strategy instruction*

In the comparison condition, students practised a design task, without watching models. The tasks were the same as shown in the observational learning videos: designing a mouse pad for War Child, a hood for Greenpeace or a shopping bag for the Dutch Foundation for Cardiovascular Diseases. The students were guided step wise through the stages in the Sapp (1995) model. So, students in this condition received an extensive process guidance and were supported to demonstrate an ‘ideal process’, producing many ideas and sketches, as in regular art education. We made sure that the total amount of time spent remained the same in both conditions.

#### *2.5 Measures*

The pretest and post-test tasks were designed to provide room for creativity and therefore variety, but also to allow for comparison and rating (as the products needed to be compared in order to assign creativity scores). The students were asked to design a product based on a simulated briefing from a client: a pair of bath slippers (at pre-test) and a T-shirt (at post-test). We provided identical drawing materials for all the students (pencils, erasers, colour pencils, paper for sketching) and a ‘final design sheet’ with a frame for the final design. The students had 60 minutes to complete their designs. (See appendix A for the briefings as they were presented to the students.)

Three raters, students from the Amsterdam School of the Arts, rated the products on creativity and technical quality in two rounds on a 0-200 scale with the support of anchor products. This procedure worked well in a previous study (Groenendijk et al., 2011). The anchors were selected from a different sample, from a similar population, and illustrated degrees of performance with fixed scores of 50, 100 and 150 (see Appendix B and C). The anchor products are solutions to different design tasks and were intended as task independent anchors, so raters could rate students’ pre- and post-test products on the same scale. The raters did not know which of the tasks was pre-test or post-test. Technical quality of the designs was defined as neatness and drawing skills. Creativity was defined as novelty (originality) and appropriate-

ness (Amabile, 1982). The raters studied the tasks, criteria, anchor products and rating procedure. Then they discussed the degree of creativity/technique of the anchor products, a discussion led by the researcher. Subsequently, raters spread the products over three piles (low, medium and high creativity/technique) using the anchor products. The raters went through each pile separately, assigning a score to each product. Jury reliability was sufficient for creativity (Cronbach's  $\alpha=.76$ ) as well as for technique (Cronbach's  $\alpha=.73$ ).










Creativity and technique were found to correlate significantly but not strongly ( $r=.501$ ), which suggests that creativity and technique are different qualities. In other studies much higher correlations between creativity and technique were found (Amabile, 1982; Fayena-Tawil et al., 2011). The pre-test and post-test ratings correlated significantly for creativity ( $r=.340, p=.007$ ) and for technique ( $r=.609, p<.000$ ).

To gain insight into the creative processes of the students, we used a self-report instrument that we adapted from Torrance, Thomas, and Robinson (1999) and Torrance, Fidalgo, and Garcia (2007). It consists of a list of activities which students may employ during their work process. We adapted this list to a visual design task (see Table 3).

Subsequently, we asked students to indicate which of the activities they were engaged in at randomly selected moments. An electronic bleep produced by a computer and available audio system cued the students to report on their activity. The bleeps occurred on average every 90 seconds, but they were distributed randomly over time intervals between 30 and 150 seconds. The students had record sheets with the activities described and accompanied by a pictogram and empty boxes for each of the bleeps. At the moment of a bleep the students simply had to tick the box representing the activity they were engaged in at that moment. The activities were listed in a random order to avoid suggesting a particular order. To ensure that the students understood the activities well, we trained the students by asking them to fill in an example process consisting of verbalized activities, which was discussed in a plenary session. The students seemed to have little difficulty identifying the accurate activity.

To measure the students' motivation, task value and self-efficacy we administered a questionnaire based on the Motivated Strategies for Learning Questionnaire (Pintrich, Smith, Garcia, & McKeachie, 1991), at pre-test and post-test. We adapted it to graphic design tasks. The questionnaire consisted of 19 items: Likert scales for the students' perceptions on their intrinsic motivation (7 items), task value (5 items) and self-efficacy (7 items) were used. The reliability of the scales varied between .67 (intrinsic motivation, pre-test) and .86 (task value, post-test). As an indicator of prior knowledge, we asked the students whether they attended art classes, which is an optional course in their school. The variable did not seem to be related to score or attitudinal variables.

Table 3. Process measurement tool (based on Torrance, Fidalgo &amp; Garcia, 2007)

Categories	Pictures	What are you doing?
1. I am reading the assignment		You are reading the assignment as presented on your instruction sheets or you are reading the accompanying information.
2. I am thinking about the assignment		You are thinking about the assignment: 'what do I have to do?'
3. I am brainstorming		Brainstorming or gathering ideas; you are thinking about what are you going to do. Maybe you write or draw. There is no complete idea yet.
4. I am sketching		You are drawing an idea on paper
5. I am choosing		You are choosing between ideas; which one do you want to develop further? or you choose between sketches.
6. I am improving		You are thinking about how to improve your sketch
7. I am working on my final design		You are working on your final product (design).
8. I am finished		You have finished your design
9. Other		You are doing something else or thinking about something else (for example about what you will do tonight)

Additionally, we measured initial differences between the students in divergent thinking ability. A divergent thinking test (verbal and visual), based on Torrance (1974) was adapted to a six minutes task. Students were asked to list as many as possible unusual uses for a match box and they were asked to finish as many drawings as possible of a diamond shape and give it a title. Verbal and visual fluency and originality scores were treated as items of one divergent thinking scale. The reliability of the scale was alpha .75. The divergent thinking score correlated significantly with the post-test score on creativity ( $r=.267, p=.037$ ), but not with the technique score ( $r=-.021, p=.872$ ). This demonstrates that divergent thinking is indeed a relevant covariate for creativity, but unrelated to technique.

To acquire some information about the students' perceptions of their learning experiences, we asked the students to report these in a learner report (De Groot, 1980). The questions in the learner report are presented in appendix D as well as the coding scheme. The students' statements were coded twice: first, for the categories we induced from the data (learning experiences about product, process, own skills, graphic design, subject visual arts in school, other) and then for the difference between general learning experiences and learning experiences about the self. Two independent coders reached a reliability of .94 and .91 (Cohen's kappa). About six percent of the statements were classified as 'other' and were excluded from the analysis, since these statements were no answers to the questions about learning experiences.

### *2.6 Procedure*

The students were asked to come to the research institute for three 150 minutes sessions: pre-test, treatment and post-test. The group was split into four sub groups: two experimental groups and two comparison groups. During the pre-test and the post-test sessions, one experimental group and one comparison group were put together, working in the same room. During the first session, the students completed the divergent thinking test and the MLSQ questionnaire, they were trained for the drawing log instrument and they completed the pre-test design task. During the second session we presented an introductory Powerpoint presentation containing examples of designs to all students in order to establish a common background knowledge. Then students received the treatment and during the third session, the students completed the post-test assignment, MLSQ questionnaire and learner report.

The learning materials were largely self explanatory and the tasks were carried out individually, after the researcher (the first author of this paper) had introduced the materials; she also led the sessions. The students in the observational learning condition watched the observational learning videos individually on their computers in a class with 25 computers.

### *2.7 Analyses*

First, we analysed the results of the MLSQ questionnaire as an implementation check. We used the same instrument at pre-test and post-test, therefore repeated measures analyses were applied. We entered the divergent thinking score into the model as a covariate; condition and prior knowledge (whether or not students attended art classes in school) were entered as between subject factors.

For the product and process analyses we applied univariate analyses with pre-test score and divergent thinking score as covariates, post-test score as a dependent variable and condition and prior knowledge as fixed factors. The learner reports were analysed in the same way, although there was, of course, no pre-test variable as it can only be administered afterwards.

### 3. RESULTS

#### 3.1 Preliminary analyses

In Table 4 we present the pre- and post-test scores for intrinsic motivation, task value and self-efficacy. We aimed at having conditions that were sufficiently and equally motivating for the students, therefore we expected no significant interaction of time (from pre-test to post-test) and condition.

For intrinsic motivation no significant result was found for the development over time ( $F(1,56)=.877, p=.353$ ), nor for the interaction of time and condition ( $F(1,56)=.038, p=.847$ ), or the interaction between time, condition and prior knowledge ( $F(1,56)=.098, p=.756$ ). In general, the high level of motivation (mean of 5.3,  $SD=.7$ , on a 7 point scale) was not affected by any of the factors. The mean self-efficacy score was 4.8 on a 7 point scale ( $SD=.9$ ). For self-efficacy we found similar results as for intrinsic motivation: no significant change over time ( $F(1,56)=3.248, p=.077$ ), no condition effect ( $F(1,56)=.463, p=.499$ ) and no difference for students with more or less prior knowledge ( $F(1,56)=.078, p=.675$ ).

In general, task value was also high (5.4,  $SD=.8$ , on a 7 point scale). For task value there was no significant change over time either ( $F(1,56)=.235, p=.630$ ), nor was the interaction with condition significant ( $F(1,56)=2.386, p=.128$ ). So, overall task value did not increase and there was no difference between the conditions in task value. However, the effect differed for prior knowledge ( $F(1,56)=6.341, p=.015, \eta^2=.102$ ): the students with little prior knowledge had higher task value scores after observation than after guided practice (Figure 1).

While randomly assigned to conditions, multivariate analyses reveal a significant difference between the conditions at pre-test in favour of the experimental condition (Wilks' Lambda:  $F(3,57)=3.214, p=.029$ ). This difference is significant for intrinsic motivation towards the visual arts subject ( $F(1,59)=8.515, p=.005$ )<sup>5</sup>, but not for task value ( $F(1,59)=.063, p=.802$ ), or self-efficacy ( $F(1,59)=1.304, p=.258$ ).

In sum, the conditions were fair as the students in both conditions were equally motivated by the conditions. The experiment did not affect the students' intrinsic motivation for visual art making or self-efficacy. However, we demonstrated that task value is higher for students with less prior knowledge who observed and students with more prior knowledge who practised. The effect we observed is medium in size.

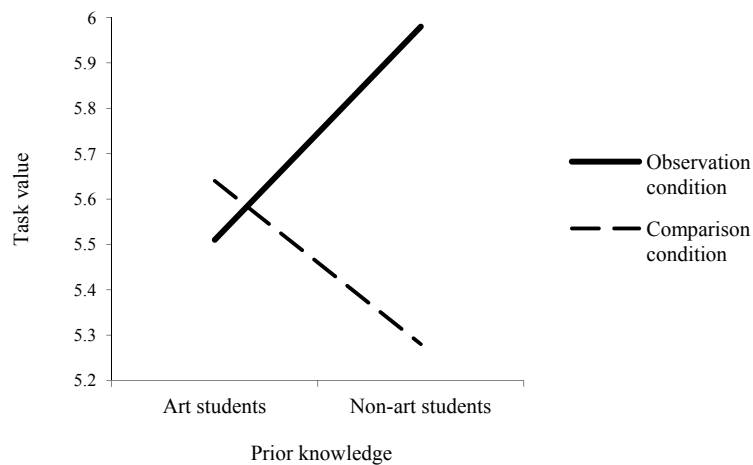
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<sup>5</sup> *Intrinsic motivation was not a significant covariate in any of the subsequent analyses, therefore, we did not include it.*

Table 4. Observed pre-test and post-test means : intrinsic motivation (IM), task value (TV) and self-efficacy (SE) (7-point scale: 1 = strongly disagree, 7 = strongly agree)

	Experimental condition						Comparison condition						
	Prior knowledge						Prior knowledge						
	Total	High		Low		Total	High		Low				
	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	
Pre-test	IM	5.5	.5	5.5	.6	5.5	.3	5.0	.7	5.0	.7	5.0	.8
	SE	4.9	1.0	5.0	1.0	4.6	1.1	4.6	.8	4.6	.9	4.6	.8
	TV	5.5	.8	5.4	.9	5.6	.7	5.4	.7	5.3	.7	5.6	.7
Post-test	IM	5.6	.7	5.7	.8	5.6	.3	5.1	.7	5.1	.7	5.1	.5
	SE	5.2	1.0	5.3	1.0	4.9	1.0	4.8	.9	4.9	.9	4.7	1.1
	TV	5.6	.9	5.5	1.0	6.0	.6	5.5	.9	5.6	.9	5.3	.9

Figure 1. Task value scores at post-test for students with more or less prior knowledge.



### 3.2 Creativity and technical quality of the products

In Table 5 the creativity and technique scores of the students are presented for both conditions and for pre- and post-test. The difference between pre-test and post-test is

significant for creativity ( $t(60)=7.869$ ,  $p<.001$ ,  $d=1.157$ ), but not for technique ( $t(60)=-1.821$ ,  $p=.074$ ). This means that overall the creativity of the products improved from pre-test to post-test, but not the technical quality.

Table 5. Mean scores creativity and technique (rating scale 0-200)

	Creativity				Technique			
	Pre-test		Post-test		Pre-test		Post-test	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
All students	92.1	25.3	121.1	24.7	107.6	28.7	113.0	23.2
Experimental condition	97.8	23.7	127.9	22.1	112.7	30.2	116.9	24.7
Comparison condition	85.9	25.9	113.5	25.5	102.0	26.3	108.8	20.9

At pre-test, the difference in creativity and technique between the conditions was not significant (Wilks' Lambda:  $F(2,58)=1.932$ ,  $p=.154$ ). In a model with pre-test score and divergent thinking score as covariates and condition and prior knowledge as between factors, prior knowledge did not contribute significantly, nor as between factor, nor as interaction component with condition. Therefore, we eliminated prior knowledge from the model. Univariate analysis revealed a significant effect of condition for creativity ( $F(1,57)=5.311$ ,  $p=.025$ ,  $\eta^2=.085$ ). Pre-test creativity and divergent thinking scores are significant covariates ( $F(1,57)=4.621$ ,  $p=.036$  and  $F(1,57)=6.247$ ,  $p=.015$ ). For technique, condition did not have an effect at post-test ( $F(1,57)=.349$ ,  $p=.557$ ). As expected, students in the observational learning condition scored significantly higher on creativity than students in the comparison condition, but the learning conditions did not result in an effect on technique. The effect size for the effect of observational learning on creativity is medium (Cohen, 1988).

### 3.3 Creative processes

In Table 6 the process data for all students are shown. Students spent most of their time on their final designs (about 60% of the time). A considerable amount of time was also spent on sketching (about 24%). Less time was spent on the other activities such as reading the assignment, thinking about the assignment, brainstorming, choosing, improving and other. On average students worked for about 30 bleeps, which is about 45 minutes.

T-tests reveal that for the percentage of time spent on brainstorming, sketching and final product, the difference between pre-test and post-test is significant (Brainstorming:  $t(60)=2.0$ ,  $p=.049$ ,  $d=.283$ ; Sketching:  $t(60)=3.7$ ,  $p<.001$ ,  $d=.431$ ; Final

product:  $t(60)=3.0$ ,  $p=.004$ ,  $d=.300$ ). On average the students brainstormed and sketched more after the intervention, and spent less time on their final products.

Table 6. Process results: mean percentage of time spent on activities at pre-test and post-test

	Experimental condition						Comparison condition					
	Total		Prior knowledge				Total		Prior knowledge			
			High N=24		Low N=8				High N=21		Low N=8	
	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Pre-test												
Read	4.1	2.1	4.4	1.9	3.0	2.5	4.2	2.1	4.4	2.3	3.6	.8
Think	2.3	3.7	2.4	4.2	2.0	2.2	2.6	4.8	2.7	5.1	2.3	4.2
Brainstorm	3.4	4.4	3.2	3.9	3.8	5.8	3.2	3.8	3.4	4.1	1.3	1.8
Sketch	24.1	16.1	25.1	17.6	21.2	10.8	23.2	13.8	25.3	14.5	17.4	10.0
Choose	1.7	2.9	1.0	2.1	3.8	4.1	1.3	1.9	1.5	2.1	.8	1.5
Improve	3.5	4.2	2.8	4.0	5.8	4.1	6.1	6.7	6.4	7.2	5.4	5.4
Final work	59.1	20.0	59.2	21.4	58.8	18.6	56.7	17.0	53.6	16.6	65.0	16.3
Other	1.8	4.3	1.9	4.6	1.6	3.7	2.6	4.5	2.0	3.6	4.3	6.2
Duration	31.8	6.8	32.3	6.2	30.0	8.4	29.7	6.8	30.0	7.0	29.0	6.3
Post-test												
Read	3.5	2.7	3.1	2.1	4.6	3.9	3.7	2.3	3.6	2.7	3.9	.6
Think	1.5	2.4	1.6	2.4	1.2	2.6	1.5	2.7	2.0	3.0	0.0	0.0
Brainstorm	5.9	6.1	5.6	5.0	6.6	8.9	3.2	4.0	3.7	4.4	1.8	2.6
Sketch	30.3	17.3	31.9	18.6	25.3	12.3	30.5	15.2	27.8	12.7	37.5	19.8
Choose	1.4	2.5	1.4	2.5	1.4	2.7	.8	1.5	1.0	1.7	0.0	0.0
Improve	3.4	3.8	3.8	4.0	3.0	3.3	4.1	6.3	4.6	7.0	2.7	4.1
Final work	51.8	18.3	50.4	18.3	56.2	18.6	53.3	16.3	53.4	13.6	53.2	23.2
Other	1.9	2.6	2.0	2.2	1.7	3.8	2.9	6.8	3.7	7.8	1.0	1.8
Duration	29.8	5.8	29.9	5.2	29.5	7.9	27.3	5.7	27.8	6.3	26.3	4.0

The scores for the majority of the activities are not normally distributed. We chose to apply univariate analyses of variance to estimate condition effect although it underestimates the effect as a consequence of the overestimation of the variance. Univariate analyses with the post-test activity as a dependent variable and the corresponding pre-test variable and divergent thinking score as covariates, and condition and prior knowledge as fixed factors showed significant main effects of condition on brainstorming ( $F(1,55)=4.550$ ,  $p=.037$ ,  $\eta^2=.076$ ) and on sketching (interaction between prior knowledge and condition  $F(1,55)=6.609$ ,  $p=.013$ ,  $\eta^2=.107$ ).

Students who observed performed significantly more brainstorming activities at the post-test than students who practised. In Figure 2 we present this result visually. For sketching the interaction effect means that students with more prior knowledge were encouraged to sketch more after observation than after practice. However, the students with less prior knowledge were encouraged more by practice and explicit instructions to sketch. This is shown in Figure 3. The effects are medium in size.

Figure 2. Percentage of time spent on brainstorming at post-test for students with more or less prior knowledge.

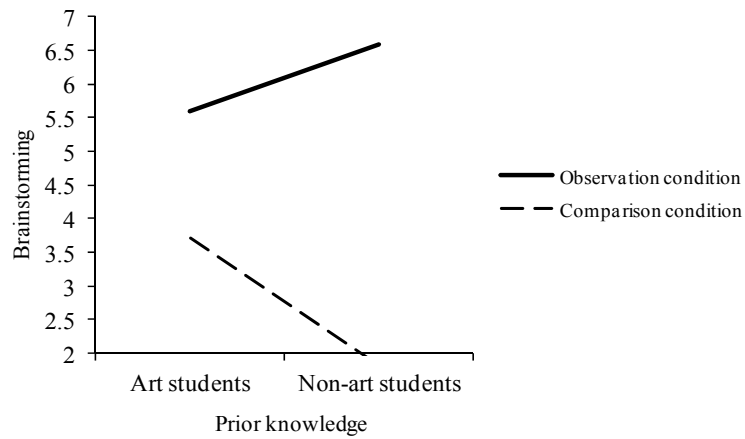
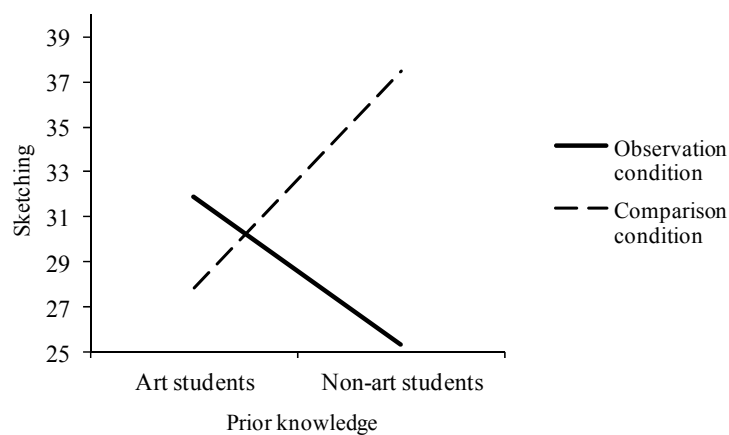


Figure 3. Percentage of time spent on sketching at post-test for students with more or less prior knowledge.



### 3.4 Students' learning experiences

Table 7 shows the results from the learner reports. We report proportions of the total number of student statements, since the conditions differed slightly in number of statements reported.

*Table 7. Results from learner reports:  
mean percentage and standard deviation of statements per condition and category*

	Experimental condition		Comparison condition	
	<i>M%</i>	<i>SD</i>	<i>M%</i>	<i>SD</i>
Mean number of statements per student	4.2	1.9	4.9	1.5
Mean % statements				
Process knowledge	60.2	25.9	41.3	21.6
Product knowledge	12.2	17.5	30.3	22.9
Knowledge about graphic design	4.3	11.4	8.2	13.1
Knowledge about own skills	11.4	16.4	11.2	15.0
Knowledge about the subject visual art	8.7	15.2	9.0	13.4
About the world	62.2	26.2	64.0	19.9
About the self	34.7	24.4	36.0	19.9

About 51% of the students' statements are about process learning experiences:

- 'I learned not to be too fast and take details into account'
- 'I did not know how to start a design task, now I know I start sketching'
- 'I learned that you have to think very well about the target group'.

21% of the statements deal with learning about products:

- 'I learned how many things you can do with fonts'

Students reported less about learning of design concepts (6%), their own skills (11%) or about the subject visual arts in general (9%).

- 'I learned about myself that I should not think that I cannot draw, because if you do what you are good at, the result will be nice'

About 35% of students' statements deal with learning experiences about the self (characterised by first person use), the other statements deal with more general learning experiences about the world (about 63%).

We used univariate analyses to examine differences between the conditions and possible influence of students' prior knowledge. A significant result was observed for process and product learning. The students in the experimental group reported significantly more process learning experiences than the students in the comparison condition ( $F(1,56)=5.706, p=.020, \eta^2=.092$ ). The students in the comparison group reported significantly more product learning experiences than the students in the experimental condition ( $F(1,56)=4.776, p=.033, \eta^2=.079$ ). There seems to be no influence of prior knowledge. We conclude that the students in the experimental group are more process oriented and the students in the comparison group are more product oriented after the experiment.

### 3.5 Additional analyses: process-product relations

At pre-test, the creativity scores correlate significantly with process length ( $r=.285, p=.026$ ) and time spent on the final product ( $r=.267, p=.038$ ). At post-test, creativity scores were correlated negatively with time spent on improving ( $r=-.262, p=.042$ ).

At the pre-test, scores for technique correlate positively with process length ( $r=.498, p=.00$ ) and time on final product ( $r=.321, p=.012$ ). They correlate negatively to time spent on sketching ( $r=-.292, p=.023$ ) and time spent on improving ( $r=-.283, p=.027$ ). Scores for technique at the post-test correlate significantly with process length ( $r=.291, p=.023$ ).

These results indicate that the relationship between process and product has changed considerably from pre-test to post-test. Therefore, we conclude that the learning conditions changed underlying processes that affect product creativity and technique. Unfortunately, we cannot examine the differences between the conditions for process-product correlations because the sample size is too small.

## 4. DISCUSSION

We examined the effects of observational learning on creative products and processes. First we checked whether the two interventions we implemented motivated the students to the same extent. We measured several attitudinal variables: intrinsic motivation, self-efficacy and task value. There was no effect of the interaction of condition and time on intrinsic motivation and self-efficacy. We conclude that we ran a fair experiment with two competing conditions.

In general, the creativity of the students' products was higher at post-test than at pre-test. Since the pre-test and post-test tasks were different, we have to be cautious with this conclusion. More importantly, at post-test the designs produced by the students in the observational learning condition were more creative than those of the students in the comparison condition. For technical quality of the design, no differences between pre-test and post-test or between the conditions were found. We conclude that observation enhances creativity and that technical quality was not affected, as expected.

Concerning the creative processes, we found that the students in both conditions brainstormed and sketched more after the intervention, while they spent less time on the final product. Here again, task effect may interfere with the learning effect. Subsequently, we have shown a main effect of condition on time spent on brainstorming: the students in the observation condition brainstormed significantly more than the students in the comparison condition. For sketching the effect seemed to differ for students with more or less prior knowledge. The students with more prior knowledge were more encouraged to sketch by observation, while the students with less prior knowledge were more encouraged to sketch by practising the design task through explicit stepwise process instructions.

From the students' learner reports, we learned that the students in the observational learning conditions reported significantly more process learning experiences than the students in the comparison condition, whereas students in the comparison condition reported significantly more product learning experiences. One may think this result is a product of the manipulation, but this is not the case as the learning content was exactly the same for both conditions. We conclude that our hypotheses were largely confirmed for both product and process results. It appears that prior knowledge is an interesting variable, which explains different effects for different groups of students.

Finally, the relationship between process and product was examined. We have shown that for the pre-test, time spent on the final product and process length are related to creativity and even more strongly to technical quality. Divergent processes such as sketching and improving are negatively related to technical quality. It seems that because of the time limit, the students who employed many divergent activities did not have enough time for working on their final products. Therefore, their final products were technically less neat. In that sense there seems to be a trade-off between divergent exploration and technical quality. At the post-test there was no negative correlation between sketching and technical quality. Possibly, the students sketched differently at post-test: different types of sketches or sketches with different purposes. Time spent on improving correlated negatively with creativity scores at the post-test. Possibly students who were not satisfied with their products, because these were in fact weak products, applied this process more regularly. All in all, we managed to change process-product relations, which suggests that we changed underlying processes, but we cannot be completely certain about the effect of the task. The relationship between process variables and product scores makes us reconsider the intervention. The intervention was based on literature that promotes divergent activities for enhancing creativity. But we found that other variables were related to creativity of the product, at least at pre-test. Time spent on the final product and process length seem to be related to creativity and technique. Secondary school students seem to make better products while spending much time on their final products. Perhaps, students tend to explore while working on their final products rather than during sketching stages.

Another point for consideration is the participation at the research institute. Since participation was voluntary, we expected relatively motivated students to apply. However, we offered a small reward, which may have attracted other students to apply as well. About 25 % of the students who were informed about the experiment applied for participation. It is possible that these students were the most motivated students. This means that we cannot generalize our findings to all students. At pre-test the students who participated in the experiment were already quite motivated (mean=5.3 on a 7 point scale) and they already engaged in making sketches quite often (24 percent of their time).

We found a significant pre-test difference for intrinsic motivation towards visual arts in favour of the observation condition. Therefore we have to be careful with our conclusions. However, the correlation between initial intrinsic motivation and post-test score was low ( $r=.308$ ,  $p=.016$ ). Besides, intrinsic motivation was measured in relation to the subject visual arts in school in general, not to the specific task (graphic design) taught in the intervention. We measured task value to examine the attitude towards this specific task and we have shown that at the pre-test the conditions were not different in this respect at all.

Another limitation of this study is that, to satisfy internal validity constraints, the setting in the current study posed threats to external validity. The students had little freedom; they had to finish their creative products in one session, within a time limit, at the research institute. In a more realistic context, they might have opportunities to leave their products for some time and return to them for further elaboration at later moments. The students did not seem to be bothered by the bleeps during the tests; at least they did not say so. However, we cannot be completely sure that this instrument did not influence the processes. Since the students already sketched much at pre-test, it is possible that the instrument itself encouraged the students, for example, to sketch. We are aware of this lack of external validity, but at least both conditions dealt with the same circumstances.

All in all, the results suggest that it is worthwhile to implement observational learning in art education. We demonstrated positive effects on students' design products and processes. We certainly do not suggest replacing artistic practice by observation in art classes. Instead, we recommend enriching the art classes with observational learning. From a theoretical perspective, it can be concluded that observational learning is an effective learning tool, also for ill-defined creative tasks in art education. Even when students are asked to produce original work, modelling examples may support them. In addition, we think that this study shows a new direction of studying interventions which foster creativity, taking both effects on processes and products into account.

#### ACKNOWLEDGEMENTS

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## APPENDIX A: PRE-TEST AND POST-TEST TASK

The organization *Sun4youth* orders a design (Pre-test).

Who? *Sun4youth* helps youth with a winter depression. Many young people seem to have problems with a lack of daylight, they have problems with the rain, the cold and the grey skies in Dutch winters. These young people are tired, have little energy and have problems to get up in the morning. This can even make them depressed, which results in bad performance in school. One week of sun can be sufficient for them to 'survive' the winter. Therefore, *sun4youth* aims to provide free sun holidays for young people with a winter depression.

What? *Sun4youth* wants to design bath slippers as publicity for their organization. The only text on the slippers will be '*Sun4youth*'. The designer is free to add pictures or images. The design has to be original and attractive!

Why? *Sun4youth* wants to be known among youth. Distributing slippers seems a good way to acquire this brand awareness. If *Sun4youth* manages to get known among youth, commercial companies will be more inclined to fund holidays for depressed youngsters and accordingly invest in the future.

For whom? The slippers are meant for young people. They have to wear the slippers and in that way, provide brand awareness for *Sun4youth*. So, the slippers have to be attractive to youth.

How? *Sun4youth* wants an original and attractive design. It will not get unnoticed! It should be absolutely clear that it is meant especially for youth.

The organization '*Special Guests*' orders a design (Post-test).

Who? *Special Guests* is an organization which helps smuggled animals at the customs at Schiphol Airport. There exists an enormous illegal trade in exotic and often rare animals like tropical birds, fishes, turtles, snakes, monkeys and even crocodiles. Many of these animals are smuggled into the country through Schiphol Airport. Criminals carry the animals in suitcases, under their clothes, inside books or among dirty laundry. If these animals are discovered at the customs, the animals end up in cages at the airport. The circumstances are far from ideal and these animals suffered from a terrible journey. The organization *Special Guests* aims to find a new home for these animals in this cold little country as soon as possible. Sometimes they can even arrange a journey back home.

What? *Special Guests* wants to order a t-shirt design. The only text on the shirt will be the name of the organization: *Special Guests*. The designer is free to use images. It has to be an attractive and original t-shirt!

Why? *Special Guests* wants a happy and funny t-shirt to sell it to passengers on Schiphol Airport. The profits from this sale will be spent on providing hosting for the animals which are caught at the customs.

For whom? *Special Guests* focuses on young people who go on holidays. Young people often choose for tropical destinations, where the smuggled animals come from. Therefore, young people may be interested in supporting these animals.

How? *Special Guests* wants a happy and funny t-shirt that people are willing to buy.

APPENDIX B: ANCHOR PRODUCTS: CREATIVITY

Score 50



Score 100

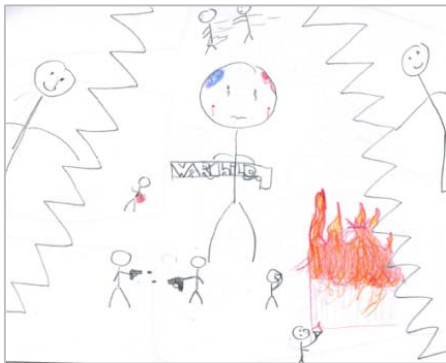


Score 150



APPENDIX C: ANCHOR PRODUCTS: TECHNICAL QUALITY

Score 50



Score 100



Score 150



## APPENDIX D: LEARNER REPORTS

What did you learn during the past lessons? It can be anything. Maybe you were surprised about certain things. Write this down in full sentences. Try to make as many sentences as possible about what you learned or what surprised you. Write down only what you really learned.

*Examples of how to start a sentence:*

General	Surprises/exceptions
I learned that... (something is like..)	I learned that it is not always like...
I learned that... (something works like..)	Etc.
I learned how ..(to do something)	
I learned...	

The second question was formulated in the same way, but there we asked students what they learned *about themselves* during the lessons.

## Coding scheme

Category	Content	Example
Product learning	Learning about product features: colour, composition, relation between text and image	<i>I learned to combine text and image.</i>
Process learning	Learning about the process: how to approach a design task, learning about different approaches, sub processes, consciousness about the own approach, learning about the own attitude towards the process	<i>I learned that through writing many ideas or drawing, a nice design will develop.</i>
Learning about own skills	Learning about what one is good at, not so good at	<i>I noticed that I have nice ideas.</i>
Learning about graphic design	Learning about graphic design (concepts, profession)	<i>I learned that designing things is more difficult than you may think.</i>
Learning about the subject visual arts	Learning about content of the subject visual arts, attitude towards the subject	<i>I learned that I am very interested in visual arts. It is very interesting and nice.</i>
Other	Evaluative remarks about the course or about the tests, all other remarks	<i>I liked to see how others were designing. Some things I liked, other things I would have done differently.</i>
Learning about the world	Learning something (general)	<i>I learned how to approach a design task.</i>
Learning about the self	Learning something about the self (recognized by use of first person after 'I learned')	<i>I learned that I usually use a lot of colours.</i>



## Chapter 5

# **DISCUSSION COMPARISON OF EXPERIMENTS AND SUGGESTIONS FOR FUTURE RESEARCH**

### 1. INTRODUCTION

In this chapter we will summarize the main findings from the empirical studies. The two experiments, which are the central part of this thesis, will be compared with regard to the methodological and other decisions we made and with regard to validity issues. Next, directions for future research will be outlined.

#### *1.1 Three studies: Main findings*

In the study on poetry writing processes by secondary school students (chapter 2), we have shown that students' writing processes consist mainly of new text production. Contextual revision (revision within already written text) is infrequent. The processes of the students differ with regard to the distribution of writing activities over the process, amount of revision and linearity (the order of the lines in the final poem represents the order in which they are written, or not). 'Ideal' processes or processes that lead to good poems are preceded by much text production and many large scale contextual revisions towards the end of the process. This study on poetry writing processes provided us with useful information for designing interventions aimed at supporting artistic creativity.

We carried out two experimental studies to test the effect of observational learning as reported in chapter 3 and 4. In both experiments, we demonstrated the positive effects of observation for visual art production. In experiment 1, two experimental groups did better than the control group on creativity. In experiment 2, the experimental group did better than the comparison group by producing more creative designs. With regard to the creative processes we also demonstrated beneficial effects of observation in both experiments. In experiment 1, no model similarity effects, effects related to the similarity in competence between the model and the observer, were found. For some variables in experiment 2 differences in prior knowl-

edge (due to more or less experience with the visual arts subject in school) evoked different responses to the conditions.

In experiment 1 we also tested the effect of observation in the verbal domain (poetry writing). No effect of observation on the creativity of the poems was found, but students in both observation conditions showed different processes than students in the control condition: the students in the observation conditions revised significantly more than the students in the control condition. Possibly, it takes practice for recently learned strategies to result in good products.

### 1.2 Comparing two experiments

Central in the thesis are two experiments (chapter 3 and 4) testing the effect of observational learning. In Table 1 we present the main differences and similarities between these experiments. The experiments differed with regard to participants, setting, experimental design, treatment and measures. In the following subsections we will compare the experiments on these issues and relate them to internal and external validity concerns.

Table 1. Two experiments on observational learning: similarities and differences

	Experiment 1 (Chapter 3)	Experiment 2 (Chapter 4)
Artistic domains	Verbal and visual	Visual
Participants	All students from 6 classes From 3 schools N=131 10 <sup>th</sup> grade Random assignment to conditions	Volunteers 1 School N=61 9 <sup>th</sup> grade Same
Setting	Regular CKV <sup>6</sup> classes, school	Research institute, during free time
Learner characteristics	Initial skill (pre-test score), verbal IQ	Prior knowledge
Comparison group	Practice condition	Practice with direct strategy instruction
Treatment	2 experimental conditions (observational learning with focus on weak model or on strong model)	1 experimental group (observational learning)
Observational learning videos	Strong and weak models (all presented in pairs)	Strong and weak models (sometimes presented in pairs)

<sup>6</sup> CKV= 'Cultural and Artistic Education', compulsory subject in Dutch secondary education. It includes many artistic domains, such as: visual arts, dance, drama, music, architecture, literature, cinema, etc.

	Experiment 1 (Chapter 3)	Experiment 2 (Chapter 4)
Evaluation task (after watching video)	Role played scripts Scripts based on spontaneous student behaviour Identify strong or weak model by comparison (depending on condition), and elaborate: explain choice	Fragments from authentic videos Videos were collected when students performed guided tasks Various evaluation and elaboration questions
Product measures Assessment procedure	Poems and collages Ratings of creativity	Design tasks Ratings of (1) creativity and (2) technique
Process measures	Use of anchor products Indirect measures, on line (poetry), off line (collages)	Use of anchor products On line, time sampled self report

### 1.2.1 Participants

Participants' characteristics differed between the two studies; in the first experiment students from 10th grade participated, while in the second experiment we chose students from 9th grade as we wanted to offer more challenging tasks. In the first experiment, three schools from different parts of the Netherlands participated, while in the second, individual students from just one school were involved. In the first experiment the students participated during their regular classes, while in the second experiment participation was voluntary and during free time.

In both experiments, the students were randomly assigned to conditions to control for many threats to internal validity, such as teacher influence and difference between classes. Internal validity refers to "(...) inferences about whether observed covariation between A and B reflects a causal relationship from A to B in the form in which the variables were manipulated or measured" (Shadish, Cook, & Campbell, 2002, p.53). In other words: internal validity refers to whether the results of an experiment are indeed an effect of the treatment.

External validity refers to generalizability of results over persons, treatments, outcomes and setting (Shadish, et al., 2002, p.83). At first sight, it may seem that the second experiment was more sensitive to external validity threats than the first, because of selective participation. However, we have no specific reasons to think the students in experiment 1 differed from the larger population of 10<sup>th</sup> grade students: in the first experiment students from three different schools participated and all students in a class participated. In the second experiment, however, possibly only the most motivated students participated: participation was voluntary and the mean intrinsic motivation measured was 5.3 on a 7 point scale (see chapter 4). Moreover, only one school was involved in the second experiment. While the conditions of participation and selection differed for the experiments, similar effects were found. Therefore, we conclude that external validity was not at risk.

### 1.2.2 *Setting*

In experiment 1 (chapter 3), the students from both conditions were working in the same classroom. This could easily lead to treatment diffusion, a threat to internal validity. However, since the students worked individually, this threat was not very likely to occur. Moreover, the test tasks were carried out individually and for the visual task a certain physical distance between the students was realized to prevent the students from seeing each other's work. In experiment 2 (chapter 4) the students came to the research institute, which made it easier to provide physical distance between the students and warrant internal validity. We think that in both experiments we optimized circumstances to increase the internal validity, but, as a consequence, we made sacrifices to external validity: the setting was not authentic in either of the experiments. As we explained above, the students worked completely alone, which is not a common condition in Dutch art education. While students in the first experiment worked in their usual classrooms, in the second experiment, the students even came to the research institute. Therefore, we must conclude that, especially for experiment 2, we cannot generalize our findings to normal classroom situations. However, we have shown that the results hold over two different settings (school and research institute) and there are no specific reasons to believe that condition effects would have disappeared by changing the setting.

### 1.2.3 *Learner characteristics*

In both experiments we took learner characteristics into account. In the first experiment it was our aim to examine model similarity effects, effects related to the similarity in competence between the observer and the model in the video. Therefore, we included two experimental groups (observation with focus on a weak model and observation with focus on a strong model). We examined whether students with different pre-test score or verbal IQ (in the case of poetry writing) responded differently to these conditions. No model similarity effects were found. Possibly, the observation conditions were too similar as students saw the same videos and only the focus of evaluation of the videos differed.

In experiment 2, only one experimental group was involved (observation). Based on previous research (e.g. Braaksma, Rijlaarsdam, & Van den Bergh, 2002) we assumed that learner characteristics might play a role in the effectiveness of observational learning. Therefore, in experiment 2 we took prior knowledge (the decision to take the visual arts subject in school) into account. We assumed that students who chose the subject visual arts generally possess more drawing skills and more knowledge and experience with the creative process. This appeared to make a difference as prior knowledge interacted significantly with condition regarding certain sub processes and task value. As far as task value is concerned, non-art students generally preferred to watch, perhaps because they think they are lacking drawing skill, while art students preferred to draw. Non-art students sketched less and could be encouraged to sketch by explicit instruction, whereas art students already sketched more at the start of the experiment. They were encouraged to increase sketching time by

observing new sketching strategies. From experiment 2, we received clear indications that including learner characteristics in the research design contributes to instructional theory.

#### *1.2.4 Control group*

In the first experiment, we found that task value differed between the conditions at post-test: the students in the observation conditions had higher task value scores than students in the control condition. We wondered whether the positive effect of observation on products and processes could be attributed to this task value difference. Therefore, in the second experiment we aimed at developing an even 'fairer' comparison. We intended to design learning conditions which were equally motivating and, therefore, we provided similar process information to both conditions. So, in experiment 1 we had the students in the control condition practise a task without much process help. In the second experiment, the students in the comparison condition received extensive step wise process guidance based on the model by Sapp (1995). This type of process guidance is not unusual in Dutch art education and it provided process learning for the comparison condition as well.

From the learner reports written after experiment two, we were able to conclude that students in both conditions experienced that they were learning something. While the comparison conditions were different in the two experiments, the results were in favour of the experimental condition(s) for the two experiments in visual art. Such a form of replication contributes to generalizability.

#### *1.2.5 Treatment*

In total three treatment variations were used (two observation conditions in the first experiment and one observation condition in the second experiment). In many educational experiments only one treatment variation is studied. Although there are endless possibilities in constructing observational learning videos and although we tested only three, at least several treatment operationalizations were tested, to increase external validity with regard to generalizability of treatments.

#### *1.2.6 Observational learning videos*

The videos as well as the supporting lesson materials were constructed differently in the two experiments. While the videos in both experiments were based on authentic task behaviour, the videos in experiment 1 were based on task behaviour without teacher interference or any process guidance, while in the second experiment the videos were authentic videos of students who performed a task guided by process instruction as described by Sapp (1995). Sapp (1995) assumes that the creative process consists of several alternating divergent and convergent processes, starting broadly with several vague idea clusters narrowing down towards one final piece. On the one hand we felt the need for a more structured framework as a basis for the

observational learning materials in experiment two. This would enable us to study the effect on students' processes more closely. On the other hand, we ran the risk of oversimplifying the creative process by reducing complexity and ill-definedness (Efland, 2002). The Sapp model is not a blueprint of a creative process which guarantees a creative result, one may even think that the forced step-by-step process may even hinder creativity. However, very similar process steps are actually used by many teachers. Therefore, we thought this would be a valid process instruction.

While the videos were constructed differently in both experiments, the main difference between the weak and strong model in the videos was similar for both experiments and concerned the difference between a dynamic and a static task approach. In chapter 6 we will elaborate more extensively on this issue as we think this is crucial in constructing observational learning videos about creative processes in art education.

#### *1.2.7 Evaluation task*

In the videos we chose to provide contrasting models (strong and weak performers) as often as possible. We thought contrasts would direct the students' attention to the relevant information (Bandura, 1986). We think this was a good decision since reflecting on creative processes is a difficult task. Following Braaksma et al. (2002), we asked students to evaluate the processes shown in the videos by asking them which student of a pair performed better/worse in their opinion. Evaluation as an activity following observation proved to be effective in previous research (Sonnenschein & Whitehurst, 1984). However, in the artistic domain, the issue at stake is whether it is appropriate to ask for qualitative evaluation. Beittel (1972) has shown that there is more than one effective task approach for drawing. We wanted to make students conscious of this variety, avoiding forcing them to use one strategy or the other. Therefore, in experiment 1 we posed the evaluation question in a personal way, asking about the students' own opinion, not about a fixed rule. In the second experiment we varied the questions as well; for instance, we asked the students how they themselves would approach the task or we asked them simply to follow a process more closely (as in Figure 1 in chapter 1). In general, it appeared that the students responded as we intended, as shown by remarks in their learner reports:

'I learned that you do not have to do something in one specific way, but you can apply different approaches' (student quote- learner report experiment 2).

#### *1.2.8 Product measures*

In the first experiment on observational learning we used a collage task, since Amabile (1982) has shown the effectiveness of collage tasks for measuring creative performance. However, collage making requires a specific visual combinational creativity. A graphic design task as was used in the second experiment may require a different creative skill, which is more related to meaning making and conceptual

creativity. We thought the validity would be enhanced by extending our research to this type of creative performance.

In addition, we added 'technical quality', another product criterion, as a validity check. We did not expect to find a significant difference between the conditions on this criterion, but we examined whether the videos did indeed stimulate creativity rather than the technique. Results supported our expectations: observation promotes creativity, not technique.

One may still question the issue of generalizability, depending on the vision of what art education should be. The tasks the students performed in both experiments: -collages, short poems and graphic design- fit in with a modernist orientation in art education (Emery, 2002), focusing on formal aspects of the work. Moreover, the tasks are not as complex and open as the tasks students have to carry out, for example, in their final examinations at secondary school level. The tasks in our experiments are not ideal tasks for educational ends. They were chosen to provide short and workable tests that fit the experimental conditions we had to deal with. As an experimental setting is a highly controlled environment per se, it was quite difficult to find artistic tasks which would fit such an environment. Tasks related to the postmodern orientation to art education, for instance, generally do not start from one medium or technique. Instead, students are only provided with a vague thematic idea and the teacher coaches the students individually in the meaning making, critical and exploratory process. Decisions about the artistic medium and technique arise from this process, so students are free to choose any artistic medium they think is appropriate in their work. Although we assume that this situation is rather an ideal one and is not encountered in the majority of current art classes, it demonstrates the gap between the tasks we used in the experiments and tasks related to contemporary ideas about art education.

Art education based on a postmodern orientation implies much freedom for the students. However, postmodern tasks require much time and much coaching by the teacher. A student in ninth or tenth grade is not able to perform such a task completely by him/herself and an eight-week task is very common for this type of studio work. Consequently and ideally, products resulting from postmodern art education are very different from each other as students choose their own individual paths. Sometimes, students have the freedom to collaborate in small groups. Therefore, an experimental setting without teacher intervention, a pre-test-treatment-post-test structure, within limited time and resulting in products that can easily be compared and assessed is hard to combine with postmodern art education. Problems would arise with time and assessment in the experimental setting. Therefore, we chose rather short and structured tasks, which are still in use at schools, but not so much in line with theoretical ideas about contemporary art education.

The decision to use short and structured tasks may have caused generalization problems. Implicitly, we assumed that effects we would find for short and structured tasks could be generalized to larger and more complex tasks as in use in contemporary art education. It is questionable, however, if we were allowed to do this. Our tasks were relatively open as compared with tasks in structured domains such as math, but

rather structured compared with contemporary art education. As the results of the current experiments suggest no different effect of observation for learning in rather defined and rather ill-defined domains, we may expect similar results for even more ill-defined tasks. More research may shine light on this issue, although, other methods may be used. The methodological concerns we elaborated above may explain the relative absence of experimental studies in contemporary art education research.

### 1.2.9 *Assessment procedure*

In the first empirical study of this thesis, the consensual assessment technique (Amabile, 1982) was used for scoring the poems. Amabile (1982) offers an operational definition of creativity and a reliable subjective assessment technique based on this definition: the consensual assessment technique (CAT):

“A product or response is creative to the extent that appropriate observers independently agree it is creative. Appropriate observers are those familiar with the domain in which the product was created or the response articulated. Thus, creativity can be regarded as the quality of products or responses judged to be creative by appropriate observers, and it can also be regarded as the process by which something so judged is produced.” (p. 1001)

The CAT is based on an understanding of creativity as a social construct, culture and time specific. Something is considered creative if the social domain considers it to be creative; therefore, creativity should be assessed by people who are experts in the domain. These judges have to rate the products independently and in random order, with their own subjective criteria of creativity and without being trained by the researcher. Scores obtained are no absolute measures of creativity, but relative to one another. The technique holds for ordinary levels of creativity. In the case of extraordinary creativity, the social domain may not immediately recognize the creative potential, which will only be recognized later (for example Vincent van Gogh). According to CAT, other qualities of the work, such as aesthetic appeal and technical quality should be assessed as well in order to check whether creativity can indeed be separated from these qualities. Amabile (1982) demonstrated the reliability of the CAT empirically for the rating of collages and poems.

While this technique worked well for the first empirical study, it requires a considerable number of judges: generally, at least seven judges are used per product. Since many products had to be assessed in the first experiment, we decided to diverge from the CAT. For practical reasons we could only use three judges for each product, therefore we developed a rating scale to support the rating procedure. Products from a previous (consensual assessment) scoring procedures were used as anchor products and judges were asked to compare the products to these anchors. The judges were considered experts in the domain; at least they were students in an art academy (collages) or students in linguistics (poems). They were not trained, but we continued only if they could understand and agree with the anchor products. The judges appeared not to have problems. During the scoring, the judges were familiar with the task of the students. Therefore, it is likely that they used novelty (originality) and appropriateness (to the task) as criteria for judgment, but in fact they were

free to use their own subjective criteria for creative performance. Novelty and appropriateness are often used as criteria for assessing creative products (Amabile, 1982).

As the assessment procedure we used for experiment 1 provided us with reliable scores, it was used in the second experiment as well. However, in the second experiment we asked judges to rate both the creativity and the technical quality of the products in order to check whether we could separate these qualities and to check the validity of the creativity scores.

#### *1.2.10 Process measures*

There are several ways of registering task execution processes: during task execution (on line) and afterwards (off line). Some measures are more direct, getting closer to actual cognitive processes and others are more indirect: studying traces of cognitive activities. Some are based on self reports, while others are more objective measures. Each of these measures has advantages and disadvantages.

In the two experiments creative processes were registered and measured differently. In the first experiment poetry writing processes were registered by using Inputlog, keystroke logging software (Leijten & Van Waes, 2005). This program allowed us to register the writing processes of the students on line (while they were at work) without interfering with these processes. Although we told the students their processes were recorded, they did not notice it. A disadvantage of this approach is that we collected only secondary information about cognitive processes. The physical actions on the key board (keystrokes and pauses) of the students were registered but no information was collected about the mental (cognitive) actions of the students. We had the same problem with the registration of visual creative processes in experiment 1. The students were asked to collect shapes and images cut out for use in their collages but left unused in the end. This measure seemed to be related to revision, as we collected traces of this revision, but no actual cognitive processes were captured.

In the second experiment we aimed at acquiring more detailed process information about the visual creative processes by using an online instrument: time sampled self report (based on Kellogg, 1988; Torrance, Fidalgo, & Garcia, 2007). The students were trained to use it and during their creative processes they marked the activity they were engaged in during each cue. The students were cued to tick a box about every 90 seconds. While this method provided us with detailed process information, in contrast with experiment 1, it may have interfered with the students' processes. Yet, the students did not report that they had experienced any difficulty with regard to this instrument and both conditions in the experiment had to deal with the same circumstances. Therefore, we conclude that it appeared to be a feasible method for registering processes of large groups in experimental settings.

In principle think aloud protocol analyses would provide even more detailed process data, but verbal protocols capture verbal behaviour and in the case of visual tasks, we may wonder whether non verbal behaviour should be included as well or

even the interaction between verbal and physical action (Bar-on, 2007). Besides, this method is not feasible when applied in large classrooms or group experiments. It requires individual sessions and time consuming analyses.

We conclude that we found a useful instrument for process measurement in experiment 2. It combines advantages of both think aloud protocol analyses (online measurement) and questionnaires (feasible for large groups and quickly analysed). However, the underlying assumption is that students are able to determine their own (cognitive) activity. Torrance et al. (2007) have shown that even students in primary education are able to do this for simple physical actions. It may be worthwhile to examine more applications and implementations of this instrument in various contexts. In chapter 6 we will elaborate on creative processes and process measurement.

### *1.2.11 Artistic domains*

Can results be generalized across artistic domains? We found rather different results for poetry writing and visual art production in experiment one. For the visual domain, the creativity of the products was higher for the experimental conditions, while for poetry writing only process results were found. In the verbal domain, the students showed more prewriting and revising after the intervention, but this prewriting and revising did not correlate with the creativity of the products. It appears that new strategies are not directly successful for poetry writing. Braaksma et al. (2002) found positive effects of observation on argumentative writing products and processes. Dutch students have very little experience in poetry writing. Possibly, this explains why they may need more training for products to improve. So, not only domain matters, the task is crucial as well. Still, it seems that process learning is a learning goal in itself. It does not guarantee discovery in poetry writing, though it may increase the likelihood of discovery. According to Beittel (1972) it is not easy to change novice processes. Changing the creative process may be an important learning result itself. Possibly the visual nature of the videos resulted in a more positive effect in the visual domain. In sum, we cannot provide a definite conclusion about the effect of observation in the different artistic domains. We will elaborate on this issue in chapter 6.

### *1.3 Future research*

We have demonstrated the effects of observational learning (experiments in chapter 3 and 4). It seems that observational learning is a powerful learning activity. We would like to put forward some suggestions for further research.

Firstly, after carrying out the experiment we believe that through watching videos and responding to evaluative questions students practise verbalizing and reflecting on creative processes. These skills may be considered important learning outcomes in art education as well. In addition to measuring effects of observation on creative products and processes, other learning outcomes could have been measured

as well, for instance: effects on process knowledge, reflection skills and skills in verbalizing about creative processes.

Secondly, our findings can be extended by more research on how student characteristics influence the effectiveness of observational learning for creative tasks. The experiments we carried out did not provide a definite answer to this question. Does model similarity play a role if the observational learning conditions are more different from each other? The characteristics of the models in observational learning videos may be varied as well; are there different effects if peers or professional artists are models in observational learning videos? For which students would this work or not work?

Thirdly, our experiments took place under highly controlled circumstances and with short and structured tasks. A next step might be to examine the use of observational learning videos in regular classroom situations. As a result, this will require other research methods, for example, ethnographic methods to examine various implementations of observational learning in studio practice. For example, Thomas (2009) observed the teaching of creativity in art education ethnographically. This resulted in a deep understanding of how students learn to be creative in the classroom context.

An option would be to let students produce their own process videos. Choosing important moments or incidents from their own (or other's) processes may be an instructive activity as it would require advanced reflection skills (Leijen, 2008). The production of process videos by students themselves can even replace written process portfolios in upper secondary art education. Constructing process videos may be a form of meaningful reflection for students. Besides, students would develop video editing skills and produce learning materials for each other. We think this is one of many options for the implementation of observational learning in art education and it will be worth studying it.

Fourthly, the effect of observational learning for ill-defined tasks should be studied further. There is a continuum ranging from well defined tasks to extremely ill-defined tasks. Maybe we could study the learning effect of observation for (artistic) tasks with different degrees of ill-definedness as suggested by Van Gog (T. Van Gog, personal communication, April 28, 2009). Does the effect of observation vary or remain constant for these types of tasks? How much time should be spent on training? Do the effects last? How many examples are needed to reach effects? A study on the long term effects of observational learning for ill-defined tasks would supplement our studies.

Besides the suggestion to further examine the effectiveness of observational learning for art education, other interventions which enhance creativity could be studied. In general, we think that we lack knowledge of contemporary instruction methods to enhance creative performance. One of the main goals of secondary art education is to prepare students for higher education in the arts and participation in the contemporary creative economy. Art education is no longer considered only a nice and relaxing activity alternating with 'more important' school subjects. The ultimate goal of art education is to stimulate students' creativity. How can this be

done and reliably measured? To our knowledge, there is not much research. Therefore, we think it is important to conduct more experimental research in art education. What interventions enhance creative processes and products? And what role can ICT play in learning creativity in art education? Attention should be paid to the question of how to measure creative processes and process gain.

It seems that tasks and task perception influence the creative processes considerably (we elaborate on this in chapter 6). Therefore, we think studying the interaction of task and creative process would provide more insight in creative processes. We found that tasks which are relatively structured provide students with 'known solutions'. 'Known solutions' are no new discoveries, but in fact stereotypes, which already exist and which may hinder creative performance. How can tasks provide enough openness and at the same time offer enough structure for students? According to Sapp (1997) it should be possible to adapt a task to the competence level of the student. More advanced students may prefer more open tasks, while less competent students may prefer more structured tasks. Flexible task parameters as suggested by Sapp (1997) may form the basis for an interesting intervention. How can we bring flexible task parameters into practice? Or can we teach students to define a (visual) research question as a start of an unknown discovery process? And how does this affect their creative processes as compared to a 'regular' task?

Beghetto and Kaufman (2007) introduced the idea of mini-c creativity as a central concept for linking creativity and learning. Previous theories on creativity used to distinguish between Big-C and little-c creativity. Big-C creativity is the creativity of eminent persons who create something extraordinary, something completely new in the world. Little-c creativity is a more common form of creativity, everyday creativity. Both Big-C and little-c creativity approaches are rather product oriented; it is about the novelty and appropriateness of the product. Mini-c creativity is about creativity at a detailed level, about, for example, a single decision in a poetry writing process. Mini-c creativity is located within a task or learning process. As Beghetto and Kaufman (2007) suggested, we think that mini-c creativity is a very useful concept. It provides a new, micro level perspective on creativity: what decisions, strategies, approaches appear to be effective? Does divergence, the creation of many alternatives, always work? What role does the-work-in-progress play in the development of the process or at separate mini-c creative moments? More research on mini-c creativity and art education may lead to new insights. We hope that this dissertation will stimulate new research on mini-c creativity in art education.

## Chapter 6

### **DISCUSSION AN ESSAY**

If we want to enhance creativity in the artistic production by students, we should focus on both creative processes and creative products. We assume that process learning, results in more creative products. We aimed at designing and testing an intervention which stimulates creative processes: observational learning. In two experiments (chapter 3 and 4) we have demonstrated a gain in creative performance for visual arts. We also demonstrated some changes in the creative processes of the students for both visual arts (experiment 1 and 2) and for poetry writing (experiment 1). In chapter 2 of this thesis we described students' poetry writing processes. It would have been preferable to carry out a similar study on processes in visual arts production, but only small scale informal studies were done. As a consequence, not so much has been said about processes in visual art production, the relationship between students' processes and the creativity of their products, the relationship between processes in the observational learning videos and process learning, or the effect of the intervention on the process-product relationship. In chapter 4 we reported that the correlations between process and product creativity were different from what we expected. Therefore, we would like to elaborate on this issue in this chapter. Furthermore, we wish to link our experiments to current developments in art education theory and practice, as the theoretical frameworks used in the previous chapters discussed creativity theory in general, modelling and example learning. We think this is an appropriate place to discuss the possibilities, chances and challenges for observational learning in educational practice.

#### 1. PROCESSES AND PRODUCTS

So far not much has been said about students' creative processes in visual arts. The second chapter of this thesis deals with student processes in poetry writing, but what about student processes in visual arts? In the preparation of the observational learning videos for experiment 1 and 2 and during the experiments we observed students at work, and in doing so observed differences in processes between students, albeit in informal research circumstances. It seems useful to dwell on the behaviour we observed and the construction of the videos based on this.

Beittel (1972) provided us with clear descriptions of drawing strategies. He distinguished three general strategies of adults: the divergent, the spontaneous and the academic strategy. The difference between the first two strategies is very clear and easily visible at the start of the process. A person using a divergent strategy starts with a small detail seemingly without any preconceived idea of the finished drawing in mind. The drawing develops part by part. A person using a spontaneous strategy quickly starts to sketch an overall picture. This person has a vague idea about the final appearance of the drawing, however, the medium and technique are open to discovery.

Both the divergent and the spontaneous strategy are creative and open to exploration. When using the divergent strategy, the technique does not vary very much, but the theme has to be discovered. When students are using the spontaneous strategy, the theme is fixed, but the technique has to be discovered. It appears that people trained in art can easily switch strategies and this has no consequences for the quality of the resulting product.

The third strategy, the academic strategy, is considered less creative. A person who applies this strategy generally starts with heavy contours that fix the entire work immediately. There is no room for exploration. In fact a preconceived idea of the final work exists in the mind of the person before the process starts and no interaction with the work-in-progress takes place. Beittel (1972) calls this process static. It contrasts with the more creative, divergent and spontaneous, strategies which involve interaction as a dialogic process between the work in progress and the drawing person. Beittel (1972) suggests that children and novices often use the academic, static strategy.

We observed secondary school students using an academic-like strategy. Possibly, we can also call the poetry writing strategy of the linear, non-revising writers as described in chapter 2 an academic strategy, as these writers are not in interaction with the developing poem. Once written, the poem hardly changed and the process was extremely short.

The pre-test in experiment 1 consisted of a collage task. 72 tenth grade students had to construct a human figure out of geometrical shapes within 30 minutes and without any teacher help. They were provided with coloured paper, wall paper, scissors and glue. 40 students started to cut a round head out of coloured paper immediately. From the think aloud protocols we collected we know that they decided beforehand that the shape they were going to cut out was going to represent the figure's head. Then the next part of the body was made. Each shape they cut out, represented one particular part of the body. Once constructed, the work in progress hardly changed. While working on this task and thinking aloud one of the students, Anne, said:

[...] I start with a circle, the upper part of the figure is a head [she cuts out a circle and gives it a place on the background paper]. For the body I am going to use a square [she cuts out a square].

Anne continued like this for the arms, legs etc. until the figure was finished. No changes were made and the process was very short.

This type of process often results in prototypical images (Finke, Ward, & Smith, 1992), see for example Figure 1. We know from developmental studies on drawing that children tend to start with the head when drawing human figures (Freeman, 1980). Does this have any consequences for the creativity of resulting products? In fact the process resembles the poetry writing process of the non-revising, linear writers as described in chapter 2, because it is a short process, linear, step wise and no changes are made to the work in progress. The process seems also similar to the divergent strategy as described by Beittel (1972): the student worked step wise, part by part. In fact this process was not divergent, since the student had a prototype in mind. No discovery took place, the students simply constructed a human figure as they thought it was supposed to be. It appears to be a rather static process: the solution was on the student's mind before the process started. No discovery in medium, technique or theme took place; there was simply no interaction between the student and the work-in-progress. As a result, these students performed rather poorly, they scored 58 (mean score) on a 0-200 scale. Students who did not start with the round head first had a mean score of 82 on the same scale. The difference between the groups was significant ( $F(1,70) = 9.974, p = .002, \eta^2 = .125$ ). So, already the first step in the process (circle head or not) appears to determine the final score to a large extent.

*Figure 1. Stereotypical figure produced by Anne.*



Beittel (1972) found that the task influenced the strategy use of the participants in his experiments. People may have a preference for certain strategies, but use of strategy is also task dependent. A still life task encouraged a divergent strategy, whereas a task to draw from mind elicited a more spontaneous strategy. This differs from what we found in chapter 2 on poetry writing and from what Kieft, Rijlaarsdam, and Van den Bergh (2008) found for writing strategies in expository writing. They concluded that there are at least two effective strategies for writing as well but that these are rather stable personal characteristics in expository writing. Possibly, the diversity in artistic tasks causes one student to apply different strategies for different tasks.

Beittel (1972) has studied performance on different artistic tasks but one specific medium for drawing, namely ink. This medium does not allow for thorough changes once the drawing has been made. This must have influenced the drawing strategies as well. One may wonder then whether and how the strategies Beittel identified can be observed in collage making or design tasks in our experiments.

As we learn from Beittel's subsequent studies, which were published in the same book (1972) one specific drawing strategy does not determine the quality as both the divergent and the spontaneous strategy are effective. It is the interaction between the work-in-progress and the producer which enables creative discovery. So, there is it is not one good strategy, the difference between creative and non-creative performance seems to be the extent to which interaction takes place between the maker and the work in progress. We have seen this interaction in the stronger students in our experiments as shown in the following example.

To give another example from the collage task (pre-test experiment 1: collage of a human figure out of geometrical shapes). Of the students who did not start to make a round head, some started to cut out several geometrical shapes obviously without having their purpose in mind yet. So, these students started by doing: simply making the shapes before thinking what they would represent. After cutting out the shapes, they started composing the human figure by arranging and re-arranging the geometrical shapes. During this arrangement, it became apparent which shape(s) was going to represent which part(s) of the human figure. For example: Marloes (Figure 2):

'I think I just cut some squares and triangles and then I will fit them together'. After cutting the shapes she says: 'Let's see how I will put this together. These two are quite different, so they have to be separated, otherwise it becomes too much, here I have a triangle.' [...] 'The patterns here [on the wallpaper] can be used as a shape, because this is in fact a kind of curl, a kind of circle when I cut it out'.

Chantal started sketching and kept on sketching most of the time. As the sketch developed, just after half of the process time, the central idea of the collage was discovered, Chantal (Figure 2):

'They [the little balls] bubble up from the tows and then it continues, like a chemical kind of thing [...] and then it has to burst, I have an idea!, let's see.'

A third student, Michael (Figure 2), started with the background: a diagonal composition with mirrored shapes in the background. This diagonal and the mirroring inspired him to design the human figure.

The students in these examples were open to discovery; their artistic problem was discovered during their work process. Maybe they even sought discovery, by creating preconditions for discovery: studying materials and working on the background. The material (patterns on wallpaper) and/or the work-in-progress (sketch or background) provided new ideas to continue. So, a dialogue was taking place between the students and the work-in-progress based on what Beittel called 'idiosyncratic meaning'. He calls it idiosyncratic because it is very personal meaning as we see clearly in the case of Chantal. This idiosyncratic meaning inspires transforming actions. Feedback from the work-in-progress in its turn shapes the idiosyncratic meaning and subsequently the new plan.

*Figure 2. Collages by Marloes, Chantal and Michael.*



*Marloes*

*Chantal*

*Michael*

Getzels and Csikszentmihalyi (1976) explained the same process in similar words and provided empirical evidence. According to them we often face 'presented problem situations': the problem has a known formulation, a routine method of solution and a recognized solution. A person follows established steps to meet requirements of the situation. Artists, however, first have to *find* their problem before they can start solving it. They need to find out what their piece of art is going to be about. This process is what Getzels and Csikszentmihalyi (1976) called 'problem finding'. The 'problem' in this sense is not a commonly troublesome situation as we understand the word 'problem' in daily speech, but it is an artistic problem or challenge; an (inner) conflict that needs to be expressed graphically (an example from their study: unresolved feelings about life and death).

Getzels and Csikszentmihalyi (1976) studied the relationship between students' problem finding behaviour and the creativity of the resulting product. They observed fine arts students' still-life drawing activities under experimental conditions (think aloud and videotapes). Students first had to compose a still life arrangement before starting to draw it. Getzels and Csikszentmihalyi found that students who interacted more with the still life objects before the actual drawing started, produced work that was evaluated as more creative and original than the work by students who quickly took some objects and started drawing. This is similar to what we saw in the case of the collages: some students started to explore the geometrical shapes, while other already seemed to know what each shape would represent.

Problem finding did not only take place in the preparation stage, but also during later stages. Students who produced more original work kept on exploring and re-defining their artistic problem, whereas students who produced less creative work hardly changed their initial idea of the final product. According to Getzels and Csikszentmihalyi, problem formulation and problem solution proceed simultaneously. The problem should not be preconceived and the solution not predetermined; the problem should be defined in the solution process.

So, different students solve different problems: presented problems and discovered problems. For example, Anne (Figure 1) solved the problem: how can I produce this human figure that is as realistic as possible while using geometrical shapes? Chantal (Figure 2) started to solve the problem: how can I use geometrical shapes to produce something visually interesting? Halfway the process she found her problem: bubbles are flowing upwards and burst inside the person. There has to be a colour contrast: warm and cold and a certain direction. So, students solve qualitatively different problems and their problems seem to be influenced by task perception or task definition. Anne immediately gave herself the task of producing a realistic figure, while Chantal found her problem by being in interaction with the work; by sketching geometrical shapes she found her artistic problem.

The interaction with the work-in-progress, materials or still life objects seems crucial to find an original artistic problem. We observed that some students shut down all options for discovery by working with very inflexible plans. The artistic problem is known and the solution exists as a preconceived idea in their minds. Then there is no real dialogue between the maker and the work-in-progress. These students immediately start to carry out their idea and the feedback from the work-in-progress consists only of detection of success or failure to conform to their fixed plan. As a result many of these students were quite disappointed with their work; they did not manage to produce a visually realistic figure with geometrical shapes.

The more flexible the plan, the more room there is for dialogue. As soon as students had flexible plans or open, unfinished plans, feedback from the work-in-progress provided them with new ideas to change or complete their artistic problem and as a result their plans. This resulted in discoveries as we saw in the case of Marloes, Michael and Chantal. These students were open to new ideas which sprang from the materials, the technique or the work-in-progress.

Bar-on (2007) described the interaction between the maker and the work-in-progress for the production of clay works. In this case, the interaction consists of thinking strategies on the one hand and doing strategies on the other hand. Bar-on has shown that this interaction leads to meaning making through reflection. She (2007) distinguished a planning and an associative strategy. Participants who used the planning strategy held a mental image of what they were going to make from the start of the process and this plan inspired them to transform the clay. Participants with an associative strategy started with doing. This resulted in a transformation of the clay. In response to this 'emerging form' the creator started to explore the clay in different ways to find meaning. Some participants mixed both strategies and alternated doing and thinking constantly.

Bar-on also found that some participants used one strategy for one product and the other strategy for the other. She suggests that the participants who mix both strategies are the most flexible ones. So, very similar to Beittel (1972), Bar-on concluded that the creator influences the material and he is influenced by the material:

“These dialogues between creator and the material can be seen to exemplify individual ways of ‘making sense’ in the interaction between sensing, feeling, thinking, and doing and the material in which structure, process, content, and meaning intertwine.” (2007, pp. 234-235).

It is likely that this interaction is different for different art forms, as one domain is more physical than the other. As visual work entails working with materials such as paint or clay, this may lead to unexpected results or small ‘accidents’ which may happen to be small discoveries if recognized. These kinds of discoveries seem less likely in writing, according to Beittel (1972):

“The needed flexibility [for dialogue and interaction] is aided by the ambiguity and less collectivized nature of images and visual configurations as compared with verbal symbols.” (p. 51).

However, the interactive nature of the process seems not so different from the writing process, which is also interactive, cyclical and iterative. Flower and Hayes (1980b) describe a Plan-translate (into written text)-review cycle. The text produced forms part of the task environment and influences subsequent actions. This feedback from the text produced is even more important in the knowledge transforming model for writing as designed by Bereiter and Scardamalia (1987). Ideas can be retrieved from the mind (top down), but even more important in creative work seem to be ideas that arise from the materials and the developing work (bottom up). The student has to learn to see his/her own production in several ways and allow for ideas to arise bottom up. Galbraith (1999) presented an interactive model of the writing process, also describing bottom up and top down processes. As the task is more creative and discovery is aimed at, more importance should be attached to bottom up processes. But what is the ideal balance between planning and openness for feedback from the developing product?

Cannot there be an inflexible but good plan from the beginning of the process? Maybe experienced artists hold complete plans, but these seem to be based on previous work. It is likely that the work is no real endpoint, but will lead to new ideas for

new works. So learning and new discoveries may take place from one work of art towards the next as well as within one single work of art (Beittel, 1972). Some people even seem to be able to be in dialogue with a mentally represented 'work-in-progress'. Nothing is externalized for some time and suddenly the complete piece is finished, as goes the famous Mozart story. Mozart seemed to compose a piece of music in one single act without any revision, while Beethoven filled many notebooks. Probably, in the Mozart case, the dialogical interaction with 'the work in progress' has taken place, but in his mind.

We expected students to interact more with the work as they learned during our experiments. However, this interaction is hard to quantify. For this reason Beittel used the case study method. In both experiments (reported in chapter 3 and 4) we aimed at quantifying process learning and we found some differences between the experimental and comparison condition, such as more revision and more brainstorming, but these activities did not correlate with product creativity. The reason may be that it is hard to measure and quantify this interaction. It may take place within one product while it develops, but it may also take place in the sequence from one drawing to the next. The measures we used may have been too rough to grasp this entirely. Besides, there does not only seem to be a difference in quantity of interaction, but also in quality. If a student is only interested in copying, there is interaction, but it is limited to checking whether the copy resembles the original closely enough. This may explain why we did not find a correlation between process results and creativity of products.

In the second experiment (chapter 4) we used the Sapp (1995) model as a starting point for designing the observational learning videos and for analysing the process results. The model describes an ideal creative process in art as an alternation between divergent and convergent stages. This is consistent with the literature on creativity: both divergent and convergent thinking are considered important components of creative behaviour. The model is also consistent with teaching in art education; students are often required to produce a certain number of sketches (divergence) and make deliberate decisions (convergence) before starting to work on the final product. Strict interpretation of the model, however, may overlook the fact that students may explore while working on the final product. Within one single drawing much interaction with the work-in-progress may take place as shown by Beittel (1972). Besides, it seems that it is not just divergent production which guarantees good works of art. Top down generation by itself is not likely to result in discoveries. Processes which inspire the plan bottom up are crucial. Therefore, different directions of divergent thinking (bottom up and top down) should be included in the Sapp model as well as the relative importance of the first stages. It is crucial that the task should not be approached as a 'presented problem', since this problem perception is unlikely to change and will lead to little interaction and, as a result, rather stereotypical images.

## 2. OBSERVATIONAL LEARNING AND EDUCATIONAL PRACTICE

Alexander once used the metaphor of ‘chick sexing’ for learning in ill-defined domains (Alexander, 2011). ‘Chick sexing’ is the work done at large commercial chicken farms: distinguishing new born male and female chickens for different feeding programs. It is difficult to learn this work because the sexual organs of the chickens are located within the body. Therefore, no general rule about the external appearance of male and female chickens can be provided. People learn the skill of chick sexing by observing a senior at work. After seeing many examples, the learner develops a certain ‘feeling’ for chick sexing. So, it seems that for learning in a domain that is not structured by clear rules, observation of many examples may help to develop a certain feeling with it. This may be the case in art education as well.

Intuitively teachers feel the importance of observation and modelling in studio practice. Some teachers encourage students to observe peers and some teachers use modelling to demonstrate exploratory attitudes or activities to students. Observation in real life practice, however, includes mainly observation of overt behaviour. Cognitive activities remain invisible. We believe that observational learning through videos with thinking aloud presented auditorily provides more information as it includes also cognitive activities. Besides, video modelling can show a diversity of approaches by different strong and weak models. This diversity may enlarge students’ strategic repertoire and as a result their cognitive flexibility.

“Cognitive flexibility in complexly structured domains is promoted through exposure to cases, but how is this to be done in formal instruction? In other words, how does one preserve the intrinsic complexity of a domain without overwhelming learners with more detail than they can comfortably handle at their educational level?” (Efland, 2002, p.89).

Observational learning videos can demonstrate individual cases: the interaction between the maker and the work-in-progress, the making and the thinking at any moment in the artistic process, provides rich case material. The dynamic interactions, as described in the previous section, are instructive cases to be included in observational learning videos. There may be various dynamic and effective strategies. The static (or academic) approach can be a contrasting, weak model in observational learning materials. Schön (1983) differentiated between reflection-in-action and reflection-on-action. The models in the observational learning videos demonstrate reflection-in-action while engaged in creative work, whereas observers reflect on the model’s actions (reflection-on-action). This should change students’ knowledge-in-action and subsequently change their own reflective processes in art production.

Contemporary ICT developments allow for many new possibilities in art education. The videos used in the experiments were simple videos which can be filmed and edited by any art teacher or art student in secondary education. An advantage of video for art education is the visual aspect, combined moving image and audio, which allows for detailed process registration.

We do not think observational learning should replace artistic practice. Rather, it can be a supplement to studio work. While students work individually or in collaboration on an artistic task they may occasionally watch the creative process of others.

In the two experiments we have shown that this may change creative processes towards more exploration and it may contribute to more creative products. It may also increase the students' consciousness of their own processes, which may be an important learning result in itself as several students reported in their learner reports:

"I noticed that when I have an idea, I do not really think further to get more ideas."  
(student quote- learner report experiment 2)

"Being conscious of what you are doing during designing was good to experience."  
(student quote- learner report experiment 2)

In general, after seeing many students at work, we feel that having a final product in mind hinders the students and makes them adopt a more static task approach. Beittel (1972) and Getzels and Csikszentmihalyi (1976) studied adults. Adolescents, as in our experiments, seemed to have more difficulty in holding flexible plans and being in dialogue with the work-in-progress. Therefore, we wonder why teachers often tell students 'what they have to make' or what the final product will be like (a human figure, a still life drawing or a landscape in a specific technique and/or medium). Recent developments in art education propose more open tasks allowing more freedom for students in the choice of theme, medium and technique, without telling them 'what to make'. Can observational learning be effective for this type of art education as well? Can we extend our findings to new practices in art education?

According to several art education theorists, the modernist orientation on art education resulted in the development of a typical 'school art style' (Efland, 1976; Haanstra, 2010). Students learn to perform 'tasks' very different from creative work they make at home and different from what happens in the contemporary professional art world. New approaches to art education aim at bridging the gap between art in school and informal learning in art. Informal learning happens at home or in a specific community such as a graffiti artist community, a band, etc. It is closely related to the students' world and to the way professional artists educate themselves. Very often this type of learning is characterised by apprenticeship and observation (Meewis, 2011). Contemporary ideas about art education promote the inclusion of informal learning practices in formal education (Heijnen, 2011). Observational learning may provide a possibility to implement an informal learning strategy in formal art education. Students can watch the communal artistic process in, for example, street art production through observational learning videos.

Emery (2002) clearly summarized modernist and postmodern orientations on art education. The modernist orientation includes the idea of 'art for art's sake':

"(...) students are encouraged to explore visual imagery without the need to depict narrative content." (Emery 2002, p. 34).

Furthermore, western principles such as the theory of composition and colour are assumed to be universal. In contrast, the postmodern approach stimulates pluralism, critical thinking and art for meaning:

"(...) postmodern artists are concerned with meaning rather than formalist composition or technique." (Emery, 2002, p. 70).

New approaches to art education, such as Visual Culture Art Education (Duncum, 2002) and altermodern art education (Donders, 2010; Klatser, 2010), place more emphasis on meaning making aspects in art education. Can observational learning be effective for this new art education?

Postmodern and other, 21<sup>st</sup> century, orientations in art education are accompanied by very open and complex tasks and student directed learning. Students may define their own tasks and have the option to collaborate in a creative process. Some orientations are very process oriented as the creative process is valued more than its outcome. Students are free to choose what they want to do, where they will work and what materials they will use. It is suggested that students should learn to work like professional artists and engage in a process without having specific goals and experimenting playfully. For example, in the case of an altermodern art education project titled ‘D. out of the blue’ (Donders, 2010), the only stimulus was a poem:

*Help, D. out of the blue.  
He is from a virtual world.  
Give him a real life  
in this world.*

In this project, students were allowed to work outside the school building, on the streets, interacting with the audience. As art education turns more towards meaning making combined with a process oriented and student centred approach, it seems that new methods of instruction have to be developed. How can we teach students to work like artists? How can we teach them to be critical in a postmodern sense? How can we teach students to perceive a product as a temporary stage in an ongoing artistic process? And this is even more complicated: how can we teach students to do so without imposing it on them? Beittel (1972) argued that especially self discovered feedback and evaluation criteria enhance learning in art. Observational learning helps students to develop evaluation criteria and process consciousness necessary to develop their own feedback. We believe that observational learning may work well in contemporary art education which fosters process approaches and meaning making, as students are confronted with many such processes (Efland, 2002). Observational learning is a way to demonstrate processes, strategies and attitudes without telling students explicitly what they have to do.

The videos we created (and mentioned in chapters 3 and 4) were closely related to the post-test tasks. In actual art classes and more open and complex tasks, the processes in the videos and the processes of the students will diverge more in for example, theme, artistic medium or technique. We do not think this is problematic, because what students need to learn is rather abstract: interacting with work-in-progress. However, there is more transfer and more cases may be needed to reach effects.

It is not necessarily so that a producer of educational materials or the teacher should produce observational learning videos; it may be a useful experience for stu-

dents to produce their own process videos. Editing and selecting important moments (critical incidents) in the process may foster process learning and enhance consciousness of the creative process. It may even replace the writing of process reports, which students sometimes need to make in Dutch art classes. Making short process documentaries may be a more visual and logical reflection on the artistic process than writing.

In the two experiments (reported in chapter 3 and 4) we used peer models. Possibly artists' processes may function in observational learning videos as well. In many art classes, works of art are studied, but not the process of the artist. It can be interesting to ask artists to register their work process for educational ends. Contemporary art is sometimes considered 'difficult'. It is quite conceptual and as a result both teachers and students have difficulty in dealing with contemporary art works. Maybe the creative process helps to reach understanding of contemporary thinking in art.

Figure 3 shows a video still of a situation we encountered in a studio art class. It shows that observing models is not an unusual activity for students these days. A girl is at work in an art studio class situation and decided by herself to search for a video on the internet. She was working on a finger camera project with a self-chosen theme (she chose 'the swan lake') and decided she needed an origami swan. She walked to the computer, searched for a video about the making of an origami swan and imitated the steps demonstrated in the video. In this case the student used observation to learn a specific technique through imitation. When students are involved in their own individual artistic processes and in need of a specific technique, it seems obvious for them to use instructive videos. Young people are producers and observers of such videos. It is only a small step then to include cognitive process videos in the art curriculum.

*Figure 3. Video still: student uses observation to learn a technique<sup>7</sup>.*



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<sup>7</sup> Photograph by Christine Breeveld.



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## SUMMARY

The creative process as reported in this thesis refers to all cognitive and physical activities (including pauses) taking place between the moment one starts reading the creative assignment and the moment the final product is considered finished. We focus on secondary school students' creative processes in doing art work (poetry writing, collage making, designing), the quality of their creative products (poems, collages, designs), and on the effectiveness of observational learning for improving both students' creative processes and creative products.

The thesis contains 6 chapters: an introductory chapter (chapter 1), followed by three reports of empirical studies (chapters 2, 3 and 4), and two discussion chapters (chapters 5 and 6).

### CHAPTER 1

In chapter 1 we introduce the thesis with a short description of the mini-c creativity perspective (Beghetto & Kaufman, 2007). Mini-c creativity is a process understanding of creativity; it is about creativity taking place at the cognitive level and includes, for example, decision making processes or discovery processes located within a task execution process. Mini-c creative processes are the bases for observational learning videos.

In the thesis we describe two experimental studies on observational learning. Observational learning is learning by observing others, peers in this case, at work. We presented the thought processes of peer models to the students by means of video. The peer models in the videos thought aloud, externalizing their thought processes during the production of artistic creative work. An example of such an observational learning video is presented in chapter 1.

Subsequently, we briefly discuss the relevance of implementing observational learning in secondary art education. We argue that observational learning may stimulate both creative processes and creative products. Learning to engage in creative processes and learning about the creative process are the central learning content in upper secondary art education. As observational learning is a process oriented instruction method, it may offer an alternative to having students write reflection re-

ports. Reflection reports are generally thought to enhance process awareness, but they are sometimes considered meaningless by students.

In chapter 1, we outline the organization of the thesis and the content of the chapters.

## CHAPTER 2

In chapter 2 we report on an empirical study about students' creative processes in poetry writing and the relationship between students' writing processes and the quality of the final poems. As the final purpose of the thesis is to test the effectiveness of observational learning, we first needed to examine the effective components of the creative process to be modeled in observational learning videos. From this perspective the study in chapter 2 was carried out.

In the study we describe the creative processes of 19 eleventh grade students in secondary education who write two different poems. The writing processes of the students were recorded by Inputlog, keystroke logging software which registers all keyboard and mouse activities. Afterwards, the students were interviewed about the tasks and about their task approach.

The process data were coded per 5 second time interval for text production, pausing and several types of revision. A factor analysis revealed different patterns of writing behaviour: different students distributed their writing activities differently over the writing process. In addition, processes differed with regard to linearity. A process was considered to be linear if the text was written in the same order as it was presented in the final poem. We found that non-linear writers were often students who revised their poem extensively. Linear writers produced the text in a linear way and appeared to revise less. Linear and non-linear writers verbalized their approach and task definition differently. It seemed that the writers who revised and wrote in a non-linear way, solved a more complex problem than the writers who wrote in a linear fashion and wrote down directly whatever occurred to them without further revision.

Subsequently, we related the processes to the quality of the poems. The poems were scored for holistic quality by seven independent raters in accordance with the principles of the consensual assessment technique (Amabile, 1982). Better poems were generally preceded by much production of text at the start of the writing process and many large scale revisions (entire verses) at the end of the process. Pausing and small revisions (character level) did not appear to contribute to the quality of the poem.

## CHAPTER 3

In chapter 3 we describe the first (double) experiment on observational learning, carried out in two different domains: verbal and visual: poetry writing and collage making. We hypothesized that observation would have a positive effect on performance, creative process and intrinsic motivation, task value and self-efficacy. Fur-

thermore, we expected similarity in competence between the model and the observer to influence the effectiveness of observation positively.

Two experiments with a pre-test post-test control group design were set up to test our hypotheses. A total of 131 Dutch students (10th grade, 15 years old) participated in both the poetry and the collage experiment. Participants were randomly assigned to one of three conditions: two observational learning conditions and a control condition (learning by practising). The observational learning conditions differed in instructional focus (students were asked to focus either on the weaker or on the more competent model of a pair to be observed). In the experimental conditions, students watched videos and answered evaluation questions about the behaviour of the models in the videos. In the control condition students practised the same tasks as the students in the experimental condition watched in the videos.

We constructed observational learning videos on the basis of literature of creative processes, our first study on poetry writing and actual student behaviour. Pre- and post-tests included poetry writing and collage making tasks. The poems and collages were scored for creativity by three independent judges. Students' poetry writing processes were registered by using keystroke logging, software which records all keyboard activities. The number of images cut out from magazines but unused in final products was used as a revision measure in the collage processes. We used a questionnaire to measure intrinsic motivation, task value and self-efficacy.

We found positive effects of observation on creative products, creative processes and task value in the visual domain. In the verbal domain, observation appeared to affect the creative process, but not the other variables. Students revised more at post-test, but this did not result in more creative poems. The model similarity hypothesis was not confirmed: we did not find a significant interaction of students' initial capacity and the effectiveness of the condition for any of the domains. The results suggest that observation fosters learning in creative domains, in particular the visual arts.

#### CHAPTER 4

In chapter 4 we report on a second experiment on observational learning. In this experiment just one domain was involved (visual art making): students were asked to produce a product design for a charitable organization (for example Greenpeace). We hypothesized that observation has a positive effect on creativity measured in the product and the divergent activities in the designing process.

61 Dutch students (9th grade, 14 years old) participated in an experiment with a pre-test post-test control group design. The students were randomly assigned to one of two conditions: observational learning versus a direct strategy instruction condition with process guidance and practice (based on Sapp, 1995). Students in the observational learning condition watched videos of peers solving design tasks while thinking aloud. Both relatively weak and strong peer models were shown in the observational learning videos.

The students were pre- and post-tested on a design task. The process measure used in this experiment was based on Torrance, Fidalgo, and Garcia (2007), a self-reporting instrument based on time sampling. We used learner reports (De Groot, 1980) to measure students' learning experiences. Furthermore, a questionnaire on intrinsic motivation, task value and self-efficacy was used as an implementation measure in order to check whether the conditions were equally motivating for students.

Three raters scored the designs created by the students for creativity and technique. We expected a positive effect of observation on creativity, but not on technical quality of the designs. Results indicated that observation had beneficial effects on creativity of students' design products and some divergent processes, compared to the direct strategy instruction approach. In general, students in the experimental condition brainstormed more and produced more creative but not technically better designs at post-test than students in the comparison condition. Students with more prior knowledge had higher task value scores after practice, whereas they tended to sketch more after observation. Students with less prior knowledge had higher task value scores after observation, but they were encouraged to sketch more by practice. Students in the experimental condition reported more process learning experiences, while students in the comparison condition reported more product learning experiences. We conclude that observational learning enhances creativity in design products and processes. After observation students are more process oriented.

## CHAPTER 5

In this discussion chapter we summarize the main findings from the empirical studies and compare the two experiments (described in chapter 3 and 4) with regard to methodological decisions and implications for internal and external validity. Subsequently, we discuss opportunities for future research.

The main differences between the experiments in chapter 3 and 4 are summarized in table 1. We conclude that, in general, internal validity was higher in the second experiment as it took place in a very controlled environment: at the research institute. However, external validity was secured better in the first experiment as a more diverse group of students participated in regular classrooms. As the results of both experiments point in the same direction, the two studies appear to reinforce each other with regard to validity.

In both experiments, different decisions were made regarding tasks, video construction and assessment procedure. These decisions and the implications are made explicit in the chapter. We elaborate on measurement of creative performance throughout the dissertation. In general, measuring creative performance is seen as very complex. The consensual assessment technique (Amabile, 1982), however, provides a workable methodology. We indicate for what reasons and in what ways we decided to diverge from the consensual assessment technique. We conclude that the assessment of creative products was feasible.

Then we describe how research on observational learning in arts education could be extended by studying other outcome variables such as process knowledge, reflection skills and skills in verbalizing about creative processes. It can also be extended by studying learner characteristics and implementation in real classrooms. We conclude that intervention studies aimed at enhancing creative processes and products in art education are rare. We hope that this dissertation may provide inspiration for more such studies.

*Table 1. Two experiments on observational learning: similarities and differences*

	Experiment 1 (Chapter 3)	Experiment 2 (Chapter 4)
Artistic domains	Verbal and visual	Visual
Participants	All students from 6 classes From 3 schools N=131 10 <sup>th</sup> grade Random assignment to conditions	Volunteers 1 School N=61 9 <sup>th</sup> grade Same
Setting	Regular CKV <sup>8</sup> classes, school	Research institute, during free time
Learner characteristics	Initial level (pre-test score), verbal IQ	Prior knowledge
Comparison group	Practice condition	Practice with direct strategy instruction
Treatment	2 experimental conditions (observational learning with focus on weak model and focus on strong model)	1 experimental group (observational learning)
Observational learning videos	Strong and weak models (all presented in pairs)  Role played scripts Scripts based on spontaneous student behaviour	Strong and weak models (some presented in pairs)  Fragments from authentic videos Videos were collected when students performed guided tasks
Evaluation task (after watching video)	Identify strong or weak model (depending on condition), and elaborate: explain choice	Various evaluation and elaboration questions
Product measures	Poems and collages	Design tasks
Assessment procedure	Ratings of creativity	Ratings of (1) creativity and (2) technique
Process measures	Use of anchor products Indirect measures, on line (poetry), off line (collages)	Use of anchor products On line, time sampled self-report

<sup>8</sup> CKV= 'Cultural and Artistic Education', compulsory subject in Dutch secondary education. It includes many artistic domains, such as: visual arts, dance, drama, music, architecture, literature, cinema, etc.

## CHAPTER 6

In this final chapter we elaborate on the processes in visual art production which should be rendered in and stimulated by observational learning videos. We observed that stronger students worked more dynamically: they were more in interaction with the work-in-progress. Their ideas influenced the work-in-progress and feedback from the work-in-progress, in its turn, influenced the maker's ideas.

Several different effective dynamic task approaches may exist, depending on the task. Weaker students generally have a more static approach. They have a fixed plan in mind, which is often stereotypical and unlikely to change during the process. Observational learning videos should demonstrate contrasting approaches: dynamic and static.

Then we describe possibilities for implementing observational learning in contemporary art education. At present, some art teachers apply modeling strategies. Peer models on video may provide more diverse material and additionally they demonstrate cognitive processes. Contemporary ICT developments provide possibilities for working with observational learning videos, such as having students produce their own process videos instead of written process reports. We believe that observational learning is not only effective for short and structured tasks such as the ones we used in experiment 1 and 2, but also in open and more complex tasks. Observational learning is a process oriented instructional method which seems to fit in well with the process oriented nature of tasks in upper secondary art education.

# SAMENVATTING

Het creatieve proces in het onderzoek dat in dit proefschrift beschreven wordt omvat alle cognitieve en fysieke activiteiten (inclusief pauzes) die leerlingen uitvoeren tussen het moment waarop zij beginnen met het lezen van de creatieve opdracht en het moment waarop het eindproduct af is. We focussen op creatieve processen van middelbare scholieren die kunstzinnige producten maken (gedichten schrijven, collages maken en ontwerpen), de kwaliteit van deze creatieve producten (gedichten, collages en ontwerpen) en de effectiviteit van observerend leren voor het verbeteren van zowel de creatieve processen als de creatieve producten van leerlingen.

Het proefschrift bevat 6 hoofdstukken; een inleidend hoofdstuk (hoofdstuk 1), gevolgd door drie empirische studies (hoofdstuk 2, 3, 4) en twee discussie hoofdstukken (hoofdstuk 5 en 6).

## HOOFDSTUK 1

In hoofdstuk 1 wordt het proefschrift geïntroduceerd aan de hand van een korte beschrijving van het mini-c perspectief op creativiteit (Beghetto & Kaufman, 2007). Bij mini-c creativiteit gaat het om een procesopvatting ten aanzien van creativiteit; het gaat over creativiteit die plaatsvindt op cognitief niveau en gelokaliseerd is binnen taakuitvoeringsprocessen, zoals beslis- of ontdekkingsprocessen. Mini-c creatieve processen vormen de basis voor observerend leren films.

In het proefschrift beschrijven we twee experimentele studies over observerend leren. Observerend leren is het leren door het observeren van anderen, leeftijdsgenoten in dit geval, terwijl ze aan het werk zijn. De gedachteprocessen van de modellen werden aan leerlingen getoond door middel van videofilmmpjes. De modellen in de filmmpjes dachten hardop, waarbij ze hun gedachten bij het maken van een artistiek creatief werkstuk verbaliseerden. In hoofdstuk 1 wordt een voorbeeld van een dergelijk gedachteproces beschreven.

Vervolgens bespreken we kort de relevantie van observerend leren voor het secundair kunstonderwijs. We gaan er van uit dat observerend leren zowel creatieve processen als creatieve producten zou kunnen stimuleren. Leren om een creatief proces door te maken en leren over het creatieve proces zijn centrale leerinhouden van het bovenbouw curriculum in het voortgezet onderwijs. Observerend leren is

een procesgerichte instructiemethode, het zou daarom een alternatief kunnen zijn voor het schrijven van procesverslagen. Over het algemeen zijn procesverslagen bedoeld om het procesbewustzijn bij de leerling te vergroten, maar soms worden ze door leerlingen zelf als betekenisloos ervaren.

Tenslotte beschrijven we in hoofdstuk 1 de indeling van het proefschrift en de inhoud van de hoofdstukken.

## HOOFDSTUK 2

In hoofdstuk 2 beschrijven we een empirische studie over de creatieve processen van middelbare scholieren bij het schrijven van poëzie en over de relatie tussen de schrijfprocessen en de kwaliteit van de uiteindelijke gedichten. Het uiteindelijke doel van het proefschrift is het toetsen van de effectiviteit van observerend leren. Daarom wilden we eerst inzicht verkrijgen in de werkzame elementen van het creatieve proces, dat we via observerend leren filmpjes wilden demonstreren. Vanuit dit perspectief werd de studie in hoofdstuk 2 uitgevoerd.

We beschrijven in deze studie creatieve processen van 19 vijfde klas leerlingen uit het voortgezet onderwijs die twee verschillende gedichten schreven. De schrijfprocessen van de leerlingen werden opgenomen met behulp van Inputlog, toetsregistratie-software die alle toetsaanslagen en muisactiviteiten vastlegt. Naderhand werden de leerlingen geïnterviewd over de taken en hun aanpak.

De procesdata werden gecodeerd op tekstproductie, pauze en verschillende soorten revisie per 5 –seconde tijdsinterval. Een factoranalyse legde verschillende patronen in het schrijfgedrag bloot: verschillende leerlingen verdelen hun schrijfactiviteiten op verschillende manieren over het schrijfproces. Daarnaast verschilden de schrijfprocessen in lineariteit. Een proces werd beschouwd als lineair als de tekst geschreven werd in de dezelfde volgorde als waarin het in het eindproduct terecht kwam. Het bleek dat de niet lineaire schrijvers vaak leerlingen waren die hun gedicht behoorlijk reviseerden. Lineaire schrijvers produceerden hun tekst op lineaire wijze en bleken minder te reviseren. Lineaire en niet lineaire schrijvers bleken ook hun aanpak en taak verschillend te verwoorden. Het bleek dat reviserende schrijvers die niet lineair schreven een complexer probleem oplosten dan schrijvers die lineair schreven en zonder te reviseren direct opschreven wat er bij hen opkwam.

Vervolgens werden de processen gerelateerd aan de kwaliteit van de gedichten. De gedichten werden holistisch beoordeeld op kwaliteit door zeven onafhankelijke beoordelaars met behulp van de Consensual Assessment Technique (Amabile, 1982). Betere gedichten werden over het algemeen vooraf gegaan door veel tekstproductie aan het begin van het proces en veel grootschalige revisie (hele versregels) aan het einde van het proces. Pauzes en kleinschalige revisies (op letterniveau) bleken niet bij te dragen aan de kwaliteit van het gedicht.

## HOOFDSTUK 3

In hoofdstuk 3 beschrijven we het eerste (dubbele) experiment naar observerend leren, uitgevoerd in twee domeinen: verbaal en visueel; gedichten schrijven en collages maken. De hypothese was dat observerend leren een positief effect heeft op creativiteit van het product, het creatieve proces en de intrinsieke motivatie, taakwaardering en geloof in eigen kunnen (*self efficacy*) van leerlingen. Daarnaast verwachtten we dat overeenkomst in competentie tussen model en observator de effectiviteit van het observeren positief zou beïnvloeden (*model similarity* hypothese).

Twee experimenten met een voortoets-natoets controle groep design werden uitgevoerd om de hypothesen te toetsen. 131 Nederlandse leerlingen (4<sup>e</sup> klas, 15 jaar oud) namen deel in zowel het poëzie- als het collage-experiment. De deelnemers werden random toegewezen aan één van de drie condities: twee observerend leren condities en een controle conditie (leren door doen). De observerend leren condities verschilden met betrekking tot de focus van de instructie (leerlingen werd gevraagd om ofwel op het zwakkere model ofwel op het sterkere model van een paar te focussen). In de experimentele condities bekeken de leerlingen filmpjes en beantwoordden evaluatieve vragen over het gedrag van de modellen in de filmpjes. In de controleconditie oefenden de leerlingen met dezelfde taken als de andere leerlingen in de filmpjes zagen.

We hebben de observerend leren filmpjes geconstrueerd op basis van literatuur over creatieve processen, onze eerste studie over poëzie schrijven en geobserveerd leerlinggedrag. De voor- en natoetsen bestonden uit poëzie schrijven en collages maken. De gedichten en collages werden beoordeeld op creativiteit door drie onafhankelijke beoordelaars. De schrijfprocessen van de leerlingen werden opgenomen met toetsregistratie-software; software die alle toetsbordactiviteiten registreert. Het aantal uitgeknipte plaatjes dat niet gebruikt werd in de uiteindelijke collages werd gebruikt als revisiemaat voor de collageprocessen. We hebben een vragenlijst afgenomen om intrinsieke motivatie, taakwaardering en geloof in eigen kunnen te meten.

We vonden positieve effecten van observeren op de creatieve producten van leerlingen, hun processen en taakwaardering in het visuele domein. In het verbale domein bleek observeren wel de creatieve processen te beïnvloeden, maar geen effect te hebben op de andere variabelen. Leerlingen die geobserveerd hadden reviseerden meer tijdens de natoets dan leerlingen die niet geobserveerd hadden, maar dit resulteerde niet in creatievere gedichten. De *model similarity* hypothese kon niet bevestigd worden: we vonden geen significante interactie tussen de vaardigheid bij aanvang en de effectiviteit van de observatie-conditie, voor geen van de domeinen. De resultaten suggereren dat observeren het leren in creatieve domeinen positief beïnvloedt, met name voor het beeldende, visuele domein.

## HOOFDSTUK 4

In hoofdstuk 4 beschrijven we een tweede experiment over observerend leren. Dit experiment betreft slechts één domein (beeldende kunst): leerlingen ontwierpen pro-

ducten voor goede doelen (bijvoorbeeld een muts voor Greenpeace). De hypothese was dat observerend leren een positief effect zou hebben op de creativiteit van de leerlingproducten en op hun divergente activiteiten in het ontwerpproces.

61 Nederlandse leerlingen (3e klas, 14 jaar oud) namen deel aan een experiment met een voortoets-natoets controle groep design. De leerlingen werden random toegewezen aan één van twee condities: observerend leren of een conditie met directe procesinstructie en oefening (gebaseerd op Sapp, 1995). De leerlingen in de observerend-leren-conditie bekeken filmpjes van leeftijdsgenoten die hardop denkend ontwerptaken uitvoerden. In de observerend leren filmpjes werden zowel relatief zwakke als relatief sterke modellen getoond.

De leerlingen maakten een ontwerptaak als voor- en natoets. De procesmeting die we in dit experiment gebruikten was gebaseerd op Torrance, Fidalgo en Garcia (2007); een zelfrapportage-instrument gebaseerd op *time sampling*. Daarnaast hebben we *learner reports* (De Groot, 1980) gebruikt om leerervaringen van de leerlingen in kaart te brengen. We hebben een vragenlijst afgenomen over intrinsieke motivatie, taakwaardering en vertrouwen in eigen kunnen als implementatiemeting, om te controleren of de condities even motiverend waren voor de leerlingen.

Drie beoordelaars hebben de ontwerpen van de leerlingen beoordeeld op creativiteit en techniek. We verwachtten een positief effect van observatie op de creativiteit van de producten, maar niet op de technische kwaliteit van de ontwerpen. De resultaten lieten zien dat observeren inderdaad positieve effecten heeft op de creativiteit van de producten van de leerlingen (en niet op de techniek) en enkele divergent processen vergeleken met de directe strategie instructie benadering. Over het algemeen brainstormden de leerlingen in de experimentele conditie meer tijdens de natoets en maakten zij creatievere, maar niet technisch betere producten dan leerlingen in de vergelijkingsconditie. Leerlingen met meer voorkennis hadden een hogere taakwaardering na directe strategie instructie, terwijl ze meer bleken te gaan schetsen na observatie. Leerlingen met minder voorkennis hadden een hogere taakwaardering na observatie, maar zij werden meer aangemoedigd tot schetsen door directe strategie instructie. Leerlingen in de experimentele conditie rapporteerden meer leerervaringen over processen, terwijl leerlingen in de vergelijkingsconditie meer leerervaringen rapporteerden die betrekking hadden op eindproducten. We concluderen dat observerend leren creativiteit in ontwerpproducten en -processen bevordert. Na observatie zijn leerlingen meer procesgeoriënteerd.

## HOOFDSTUK 5

In dit discussiehoofdstuk vatten we de voornaamste bevindingen uit de experimentele studies (zoals beschreven in hoofdstuk 3 en 4) samen en we vergelijken de twee experimenten met betrekking tot methodologische beslissingen en implicaties voor interne en externe validiteit. Vervolgens beschrijven we de mogelijkheden voor vervolgonderzoek.

De voornaamste verschillen tussen de experimenten in hoofdstuk 3 en 4 staan samengevat in tabel 1. We concluderen dat over het algemeen de interne validiteit

hoger was in het tweede experiment, omdat het plaatsvond in een gecontroleerde omgeving; namelijk op de universiteit. Echter, de externe validiteit was beter gewaarborgd in het eerste experiment, omdat een meer diverse groep van leerlingen deelnam tijdens reguliere lessen op school. Gezien het feit dat de resultaten van beide experimenten in dezelfde richting wijzen, versterken de experimenten elkaar met betrekking tot validiteit.

Tabel 1. Twee experimenten naar observerend leren: overeenkomsten en verschillen

	Experiment 1 (Hoofdstuk 3)	Experiment 2 (Hoofdstuk 4)
Artistieke domeinen	Verbaal en visueel	Visueel
Deelnemers	Alle leerlingen uit 6 klassen Van 3 scholen N=131 4e klas Random toewijzing aan de condities	Vrijwilligers 1 School N=61 3e klas Idem
Context	Reguliere CKV lessen op school	Op de universiteit in vrije tijd
Leerlingenkenmerken	Aanvangsniveau (voortoets score), verbaal IQ	Voorkennis
Vergelijkingsgroep	Doe-conditie	Doe-conditie met directe strategie-instructie
Interventie	2 experimentele condities (observerend leren met focus op zwak en focus op sterk model)	1 experimentele groep (observerend leren)
Observerend leren filmpjes	Sterke en zwakke leerlingen, (allen gepresenteerd in paren)  Rollenspel op basis van scripts  Scripts gebaseerd op authentiek leerlinggedrag	Sterke en zwakke leerlingen, (soms gepresenteerd in paren)  Fragmenten uit authentieke filmpjes De filmpjes werden verzameld terwijl leerlingen geleide taken uitvoerden
Evaluatie taak (na het bekijken van het filmpje)	Identificeer sterk of zwak model (afhankelijk van de conditie) en leg de keuze uit	Verschillende evaluatie- en verwerkingsvragen
Productmetingen	Gedichten en collages	Ontwerptaken
Beoordelingsprocedure	Beoordeling op creativiteit	Beoordelingen op (1) creativiteit en (2) techniek
Procesmetingen	Gebruik van ankerproducten Indirecte metingen, on line (poezie), off line (collages)	Gebruik van ankerproducten On line, zelfrapportage gebaseerd op <i>time sampling</i>

In beide experimenten werden verschillende keuzes gemaakt met betrekking tot de taken, constructie van de filmpjes en de beoordelingsprocedure. Deze beslissingen en de implicaties hiervan worden expliciet gemaakt in het hoofdstuk. We gaan in op

het meten van creativiteit in dit proefschrift. Over het algemeen wordt het meten van creativiteit als moeilijk gezien. Echter, de Consensual Assessment Technique (Amabile, 1982) is een werkbare methode. We bespreken op welke punten van deze methode zijn afgeweken. We concluderen dat het beoordelen van creatieve producten geen grote problemen opleverde.

Tenslotte beschrijven we hoe onderzoek naar observerend leren in kunsteducatie verder uitgebreid kan worden door het bestuderen van andere afhankelijke variabelen zoals proceskennis, reflectievaardigheden en vaardigheden in het verbaliseren van creatieve processen. Tevens zou de invloed van leerlingkenmerken op de effectiviteit van observerend leren bestudeerd kunnen worden en implementatie in echte klassen. Interventiestudies die bedoeld zijn om creatieve processen en producten in kunsteducatie te stimuleren zijn zeldzaam. We hopen dat dit proefschrift een inspiratie vormt voor het uitvoeren van meer van dergelijke studies.

## HOOFDSTUK 6

In dit laatste hoofdstuk gaan we verder in op processen bij beeldende kunst productie die in observerend leren films verwerkt kunnen worden en gestimuleerd zouden kunnen worden door deze films. We merkten dat sterkere leerlingen dynamischer te werk gaan: meer in interactie zijn met hun werkstuk-in-wording. Hun ideeën beïnvloeden het werkstuk-in-wording en feedback vanuit het werkstuk-in-wording beïnvloedt op zijn beurt de ideeën van de maker. Verschillende dynamische, effectieve benaderingen kunnen bestaan, afhankelijk van de taak. Zwakke leerlingen hebben over het algemeen een meer statische taakbenadering. Ze hebben een vaststaand en vaak stereotype plan in hun hoofd dat vaak ook niet meer verandert gedurende het proces. Observerend leren films zouden contrasterende taakbenaderingen moeten laten zien: dynamisch en statisch.

Vervolgens beschreven we de mogelijkheden voor het implementeren van observerend leren in het hedendaagse kunstonderwijs. Momenteel passen veel kunstdocenten al modelleren toe, maar films van leeftijdsgenoten die aan het werk zijn zouden meer divers materiaal kunnen bieden en daarnaast ook cognitieve processen kunnen laten zien.

Hedendaagse ICT ontwikkelingen bieden vele mogelijkheden voor het werken met observerend leren films, zoals de mogelijkheid om leerlingen hun eigen procesfilms te laten samenstellen in plaats van het produceren van geschreven procesverslagen. We geloven dat observerend leren niet alleen effectief is voor korte en relatief gestructureerde taken zoals gebruikt in experiment 1 en 2, maar ook bij meer open en complexere taken. Observerend leren is een procesgerichte instructiebenadering die goed lijkt te passen bij de procesgeoriënteerde aard van taken in de bovenbouw van het voortgezet kunstonderwijs.





## CURRICULUM VITAE

Talita Groenendijk (1979) studied Art and Education at ArtEZ Institute of the Arts in Arnhem (1999-2003). Then she studied Social and Cultural Anthropology at the VU University in Amsterdam (2003-2005). She wrote a Master's thesis about intercultural and bilingual education in Bolivia. Talita worked as an art teacher at the Haarlemmermeer Lyceum and she worked as a research assistant at ISIM-International Institute for Study of the Islam in the Modern World (2005-2006). In September 2006 she started her PhD research on observational learning in arts education at the Research Institute of Child Development and Education of the University of Amsterdam, under supervision of Tanja Janssen and Gert Rijlaarsdam. In 2009 Talita did research on media literacy and visual culture in arts education in collaboration with the Amsterdam School of the Arts. In 2011 she worked as a teacher at the Graduate School of Child Development and Education of the University of Amsterdam. Currently she works on a research project on altermodern art education, commissioned by the Amsterdam School of the Arts, the Arts Education Research Group.



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