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Cover Page Footnote

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How to Measure the Effectiveness of Teachers: Validation of an Instrument based on the Creative Action Methodology

Paul V.A. Delnooz¹ and Eti W. de Vries²

Abstract

Creative Action methodology brings together nature (how our brains function) and nurture (the way we educate). When using Creative Action methodology as a didactical method in vocational and primary education, students become more motivated to learn, perform better, and show less oppositional behavior (Boeijen et al., 2013; Delnooz et al., 2012). In this way, the Creative Action methodology adds to the effectiveness of teachers. We describe the development of an instrument to measure teachers' effectiveness and the research around its validation. Results suggest that the instrument has internal and predictive validity.

Keywords: pedagogy, teachers' effectiveness, measuring behavior

Introduction

Literature suggests that in education, nature (the way our brains function) and nurture (the way we educate our children) play an important role (for example Howard-Jones, 2014; Plomin et al., 2007; Thomas et al., 2015). Several researchers identified a gap between the two (for example Dehaene, 2007; Sigman et al., 2014).

In this paper, an attempt to build such a bridge is described. In the model of Creative Action methodology both aspects are addressed, leading to a new pedagogy to be used in various classrooms. The Creative Action methodology is a didactical approach, developed by Delnooz (2008), who describes how students develop their critical, analytical, and creative skills. By using the Creative Action methodology, students are encouraged to challenge their presumptions and empirical and theoretical knowledge, while solving a real-life problem from a multidisciplinary perspective. By doing so, they develop creative skills to look for solutions for practical problems (Delnooz, 2010).

The Creative Action methodology has since become the central point of focus in fifteen other studies (Delnooz et al., 2012). The model of the Creative Action methodology was operationalized in multiple ways by various researchers and has since been applied by primary school teachers. Although these fifteen studies differed in the way the theoretical model was translated into action and implemented, they all had promising results. Compared to the pupils in the control groups, the pupils in the experimental groups showed a significant increase of their motivation to learn and a significant increase of their grades for reading, writing, and arithmetic. They also showed a significant decrease in their oppositional behavior (Delnooz et al., 2012). It

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must be added that these studies did not measure these three variables all at the same time; some focused on motivation, others focused on reading and writing, and so on.

Based on these findings, we wondered if it would be possible to develop an instrument with internal and predictive validity to measure the effectiveness of teachers with the aid of the model of Creative Action methodology. This question will be answered after explaining the model of Creative Action Methodology and defining teacher effectiveness.

Creative Action Methodology

The Creative Action methodology is based on two principles. The first principle of the Creative Action methodology is based on the thought that our brains are not “made” to learn by heart. They are “made” to survive. They are focused on solving possible problems (for example Gergen, 1997; Phillips, 1997; Taatgen, 2009). Because our educational system is more focused on “sitting still” and “learning by heart” (for example Biesta, 2007; Bullough, 2012; Burnard and White, 2008), the Creative Action methodology predicts that our brains will revolt: pupils will be less motivated to learn and will start showing oppositional behavior.

The second principle of the Creative Action methodology is based on the thought that we live in a culture of *the* truth (for example Lunenberg, 2006; Robinson, 2007). Our students are taught how to make a marketing plan, what democracy means, how to calculate the profit of an organization, and so on. They pass their exams if they are able to repeat what they heard in class. Questions in these exams have one correct answer only.

According to the model of Creative Action methodology, this culture of *the* truth conflicts with our brains. It hinders the intellectual development of pupils because our brains are “made” to notice problems and to find ways to solve them. The focus in the educational system should be on these two aspects and therefore on discourse. Teachers should enhance this discourse by asking questions like: “What comments do you have on the way the profit is calculated?” (Is it problematic?); “What other ways are there to calculate the profit?” (Existing solutions); “What are the pros and cons of these solutions?” (Are they problematic?); “What is, according to you, the best way to calculate the profit?” (Problem solving); “Can you come up with a better way to calculate the profit?” (Problem solving); “What comments do you have on the way democracy is defined?” (Is it problematic?); “What other ways do exist to define democracy?” (Existing solutions); “What are the pros and cons of these definitions?” (Are they problematic?); “What is, according to you, the best way to define democracy?” (Problem solving); “What is the best way to define democracy, according to you?” (Problem solving).

This type of problem-based questions will trigger the students’ brains. They stimulate critical, analytical, and creative thinking. In other words, they stimulate the skills that are needed to understand a text or to solve an arithmetic problem. The traditional educational system is based on the thought that we should teach pupils how things are done. The model of Creative Action methodology is based on the thought

that pupils should be trained in “the different ways problems can be solved” and that they can come up with their own ideas, opinions, and solutions. It gives, in other words, the pupils more mental freedom and autonomy.

In the aforementioned study, primary school teachers translated the principles of the Creative Action methodology in various discourses. One teacher decided, for example, to give the pupils lessons in philosophy. Another teacher decided that the pupils didn't have to work according to the action plan in the textbook anymore. Instead, the teacher walked around asking problem-based questions to stimulate the pupils to make their own action plan. Another teacher did not use the book for arithmetic anymore. She talked to the pupils to figure out the problems they are dealing with in their daily lives and ‘translated’ the findings as much as possible into mathematical issues. Two other teachers decided to have the pupils work on something they would like to achieve (for example a fashion show or the fastest car in the world). In the meantime, the teachers walked around in the classroom asking problem-questions: “What kind of materials are suitable to make clothes?”; “Where can you buy these materials?”; “What about the idea of making a spreadsheet to get a better picture of the costs of a fashion show?”; “Do you have a marketing plan?” and so on. In this way, the teachers tried to integrate lessons like geography, history, mathematics, and English into the students' projects.

Characteristics of an Effective Teacher

What is an effective teacher? How do we define effectiveness? In this study, a teacher is considered to be effective if he or she (1) achieves the learning objectives set for the pupils; (2) is able to motivate the pupils to learn; (3) knows how to prevent oppositional behavior in the classroom.

How can a teacher achieve these goals in the classroom? What is typical for a teacher who is effective? An inventory has been made, based on the model of Creative Action methodology and experiences from the studies described in the previous section. This inventory resulted in two types of characteristics: the condition- and action-oriented characteristics.

The first type of characteristics (condition-oriented) refers to the skills the teacher must possess to be effective: (1) The teacher is capable of finding out, and knows, each individual pupil's cognitive strengths and weaknesses in order to take these into account during lessons; (2) The teacher is empathic and knows to connect the “world each child lives in” with the learning objectives; (3) The teacher has sufficient knowledge of subjects (such as mathematics, history, geography, writing) in order to give adequate information and start a discourse; (4) The teacher must know the learning objectives that must be achieved during the year.

The second type of characteristic (action-oriented) refers to the behavior a teacher is showing in the classroom. Some examples are: The teacher “invents” tasks during the lessons that are not in the textbooks and that are connected to the daily life and interests of the pupils; the teacher makes the pupils look at topics with different points of view; and the teacher interacts with the pupils to find out what is going on in their minds.

The inventory resulted in a list of independent variables that was used to make an observation form. The dependent variables (to achieve the learning objectives with the pupils; to be able to motivate the pupils to learn; to prevent oppositional behavior in the classroom) were also added to this list (see appendix A). In the next section, the validation of this observation form, called “Teacher Barometer,” will be described.

Method

In appendix A, it can be seen that the questions occur in the form of a proposition followed by the remark: “Compared to colleagues, this teacher shows this behavior... (more or less often)”. This remark has been added based on an initial experiment (N=10) with the observation form without the remark. It turned out that without the remark, no or almost no differentiation occurred in the scores. With the added remark, observers were better able to distinguish between the various characteristics of the teachers.

To test whether a correlation between the variables related to the Creative Action methodology and the achievement on learning objectives and motivation as well as preventing oppositional behavior does exist, a quantitative, explorative study was designed. 52 teachers were visited in class and evaluated by observers, using the observation form. In this study, observers had to be experienced in observing teachers from different primary schools and had to be familiar with the teachers’ way of teaching, to be able to answer questions like “Some teachers know very well which learning objectives have to be achieved at the end of the year;” “Some teachers know exactly the cognitive strengths and weaknesses of each individual pupil (for example in arithmetic or reading and writing);” “Some teachers are experts in the subjects they teach (e.g. arithmetic, reading and writing, history);” or “Some teachers have the capability to know exactly what is going on in the mind of the pupils” (the condition-oriented variables).

The selection procedure resulted in the selection of eight directors of primary schools and teachers’ coaches. These observers were asked (1) to select teachers with a known way of teaching to them, (2) to visit the teachers during classes, and (3) to fill in the observation form. Although potential bias could occur based on the fact that the observers were able to choose the teachers to observe, the observers and the teachers were left without a clue about the purpose of the research, in this way reducing the potential bias. They did not know what high or low scores on the observation form meant. Within 1 to 1.5 hours, the observers visited the teachers during their class and scored the Teacher Barometer. All participants in the research, observer and teachers, gave permission to become part of the research.

After the data collection, the scores for the variables “effectiveness,” “conditions,” and “actions” were calculated. The effectiveness of each teacher was calculated by adding the scores from the dependent variables in the observation form: (1) the teacher achieves the learning objectives with the pupils; (2) the teacher is able to motivate the pupils to learn; (3) the teacher knows how to prevent oppositional behavior in the classroom. The conditions variable was calculated for each teacher by adding the scores on the condition-oriented variables in the form. The action variable

was calculated for each teacher by adding the scores on the action-oriented variables in the observation form.

One observer returned some incomplete observation forms, which made it impossible to calculate the scores for *all* teachers. Also, it turned out that one of the variables appeared to be non-significant. It was decided to exclude this variable from further statistical analysis.

The data was analyzed with Excel (the graphs) and SPSS22 (regression analysis).

Results

The internal consistency of the variables was high ($\alpha = 0.92$). This was similar to the internal consistency measured in an earlier study by Boeijen, De Bruin and Goos (2013; $\alpha = 0.90$). Moreover, Boeijen et al. also tested the inter observer-agreement with observers who were *not* very experienced. This kind of inter observer-agreement turned out to be acceptable ($\kappa = 0.68$).

We first investigated if it would be possible to use the action-oriented variables as predictors. And is the same valid for the condition-oriented variables (see overview 1)?

Overview 1: The predictive value of the condition- and action-oriented characteristics with respect to (1) achieving the learning objectives of the pupils, (2) motivating pupils, (3) preventing oppositional behavior in the classroom, and (4) the combination of these variables (teachers' effectiveness).

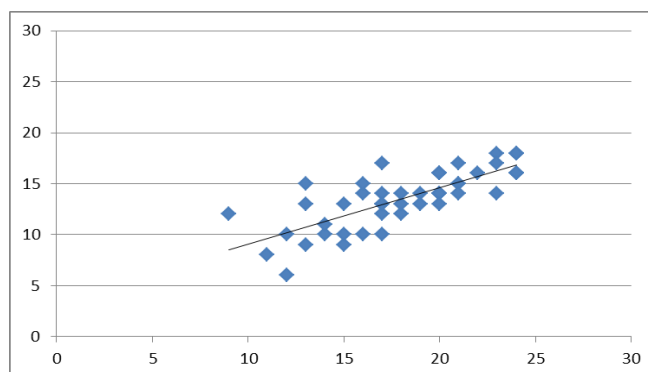
Variable:	To achieve the learning objectives	To motivate pupils	To prevent oppositional behavior of pupils	To be an effective teacher
A. Knows the cognitive strengths and weaknesses of each pupil	R ² adj= 0.37 P < 0.00; N= 51	R ² adj= 0.26 P < 0.00; N= 48	R ² adj= 0.28 P < 0.00; N= 48	R ² adj= 0.39 P < 0.00; N= 48
B. Sets goals for each individual pupil	R ² adj= 0.47 P < 0.00; N= 51	R ² adj= 0.26 P < 0.0; N= 48	R ² adj= 0.28 P < 0.00; N=48	R ² adj= 0.44 P < 0.00; N= 48
C. Knows what is going on in the mind of the pupils	R ² adj= 0.20 P < 0.00; N=50	R ² adj= 0.34 P < 0.00; N= 47	R ² adj= 0.22 P < 0.00; N= 47	R ² adj= 0.31 P < 0.00; N=47
D. Works outside the regular methods	R ² adj= 0.08 P < 0.02; N= 51	R ² adj= 0.16 P < 0.00; N=48	R ² adj= 0.08 P < 0.03; N=48	R ² adj= 0.16 P < 0.00; N=48
E. Is an expert in the subjects they teach	R ² adj= 0.63 P < 0.00; N= 51	R ² adj= 0.37 P < 0.00; N=48	R ² adj= 0.31 P < 0.00; N= 48	R ² adj= 0.58 P < 0.00; N= 48
F. Creates own ways to explain a topic to the pupils	R ² adj= 0.36 P < 0.00; N= 51	R ² adj= 0.26 P < 0.00; N= 48	R ² adj= 0.30 P < 0.00; N=48	R ² adj= 0.44 P < 0.00; N= 48
H. Utters criticism if a pupil makes a statement	R ² adj= 0.00 P < 0.32; N= 50	R ² adj= 0.02 P < 0.19; N= 47	R ² adj= 0.03 P < 0.13; N= 47	R ² adj= 0.01 P < 0.27; N= 47
I. Works very interactively	R ² adj= 0.12 P < 0.01; N= 50	R ² adj= 0.49 P < 0.00; N= 47	R ² adj= 0.43 P < 0.00; N= 47	R ² adj= 0.44 P < 0.00; N= 47

J.	Motivates pupils to find solutions themselves	R ² adj= 0.11 P < 0.01; N= 49	R ² adj= 0.45 P < 0.00; N=46	R ² adj= 0.25 P < 0.00; N=46	R ² adj= 0.34 P < 0.00; N=46
K.	Tries to enhance discussions during the lessons	R ² adj= 0.06 P < 0.05; N= 50	R ² adj= 0.27 P < 0.00; N= 47	R ² adj= 0.09 P < 0.02; N= 47	R ² adj= 0.16 P < 0.00; N=47
L.	Makes pupils use various perspectives	R ² adj= 0.08 P < 0.03; N= 50	R ² adj= 0.33 P < 0.00; N= 47	R ² adj= 0.28 P < 0.00; N= 47	R ² adj= 0.25 P < 0.00; N= 47
M.	Creates examples instantly on the spot	R ² adj= 0.06 P < 0.05; N= 50	R ² adj= 0.30 P < 0.00; N= 47	R ² adj= 0.17 P < 0.00; N= 47	R ² adj= 0.20 P < 0.00; N= 47
N.	Shows appreciation for critical remarks and creative thinking	R ² adj= 0.07 P < 0.04; N= 49	R ² adj= 0.36 P < 0.00; N=48	R ² adj= 0.24 P < 0.00; N= 48	R ² adj= 0.24 P < 0.00; N= 48
O.	Shows appreciation when pupils decide to take certain actions independently	R ² adj= 0.15 P < 0.00; N= 48	R ² adj= 0.22 P < 0.00; N= 48	R ² adj= 0.16 P < 0.00; N= 48	R ² adj= 0.22 P < 0.00; N=48
P.	Rearranges lessons when other things are going on in pupils' minds	R ² adj= 0.17 P < 0.00; N= 46	R ² adj= 0.33 P < 0.00; N= 46	R ² adj= 0.26 P < 0.00; N=46	R ² adj= 0.33 P < 0.01; N=46
Q.	Knows the learning objectives that have to be achieved	R ² adj= 0.58 P < 0.00; N= 48	R ² adj= 0.19 P < 0.00; N= 48	R ² adj= 0.26 P < 0.00; N= 48	R ² adj= 0.45 P < 0.00; N=48
R.	Makes up own assignments connected to the pupils' daily life	R ² adj= 0.32 P < 0.00; N= 47	R ² adj= 0.30 P < 0.00; N= 47	R ² adj= 0.26 P < 0.00; N=47	R ² adj= 0.42 P < 0.00; N= 47

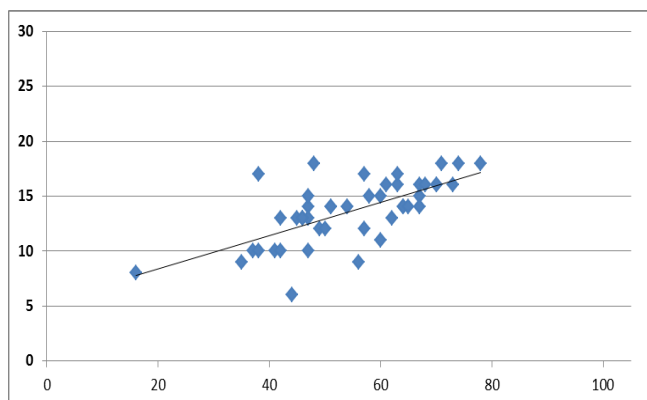
All variables as described in the Teacher Barometer (see appendix A), except for one, contribute significantly to the extent in which a teacher achieves the learning objectives with the pupils; knows to stimulate the pupils to learn; and is able to prevent oppositional behavior in the classroom. The non-significant variable was “utters criticism to pupils.” This is remarkable because it begs the question, “how can pupils explore if they are not feeling safe in a classroom?”

The previous findings paved the way for the final analysis: to add the scores from the teachers on the condition-oriented variables; to add their scores on the action-oriented variables; and to find out to what extent both types of scores contribute to the effectiveness of a teacher (see overview 2 and 3).

Overview 2: Relation between ‘conditions to teach’ (x) and ‘teachers’ effectiveness’ (y).



Overview 3: Relation between 'actions' (x) and the 'effectiveness of teachers' (y).



Note: The removal of the outlier (actions=16; effectiveness= 8) reduces the R^2_{adj} with 0.04

This analysis shows that both scores are useful instruments to predict the effectiveness of a teacher. The variable “conditions” explains 59% of the variation in effectiveness ($R^2_{adj}= 0.59$; $df1= 1$; $df2= 46$; $F=69.89$; $P< 0.00$). The variable “actions” explains 44% of the variation ($R^2_{adj}= 0.44$; $df1= 1$; $df2= 46$; $F=37.47$; $P< 0.00$).

Discussion

From a theoretical point of view, the conclusions from this research are: (1) it is possible to develop a valid measurement instrument for educational effectiveness, and (2) it seems possible to explain educational effectiveness from an evolutionary point of view: when engaging students' minds by offering them practical problems to solve, they become more motivated to learn, resulting in higher performance achievements and less oppositional behavior.

Limitations

Limitations of the research are based in the fact that teachers from all years of primary school have not been included. New research that already is taking place is focused on the youngest pupils of primary school. Other limitations concern the fact that the observers have to know their observed teachers very well. It is desirable to develop an instrument without this limitation, so it can be used by more observers in different situations.

Conclusions and future study

When education does benefit from teachers using the Creative Action methodology, the Teacher Barometer offers an opportunity to be used in different ways. New teachers can be coached by more experienced teachers in Creative Action methodology, who score high on the Teacher Barometer. It can also be used as an instrument for progress interviews: scores on the Teacher Barometer show areas where teachers can develop their professional behavior.

In the future, it could be beneficial to train teachers in using the Creative Action methodology. More research can show whether the teachers are able to learn how to use the Creative Action methodology in their classes. Some trainings have already taken place and it seems that most of the teachers are able to change their behavior in a short time. However, a small number of teachers fail in this respect. They cannot teach without using a textbook that explains what to do during each lesson. They cannot change their behavior towards the pupils. They cannot discover what is going on in their pupils' minds. They are not able to enhance discussions. More research is needed to verify whether this is really the case and what explanations can be given. Results of this research will soon become available (de Vries, 2018).

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Technische Universiteit, Eindhoven

Appendix A. The Teacher Barometer

Remarks:

- This instrument is translated from Dutch into English. The validity of this English version is therefore unknown.
- G, S, and T measure the dependent variables (to achieve the learning objectives with the pupils; to be able to motivate the pupils to learn; to be able to prevent oppositional behavior in the classroom)
- A, C, E, and Q are the condition-oriented variables. To give teachers a score on these variables the observer must know her or him very well.
- B, D, F, H, I, J, K, L, M, N, O, and P are the action-oriented variables. A trained observer is able to give a teacher a score on these variables.
- All variables are measured on a scale from 1 to 6. The variables A, B, C, E, and F have to be recoded (1=6; 2= 5; 3= 4; 4= 3; 5=2; 6=1).

Items:

A. Some teachers know exactly the cognitive strengths and weaknesses of each individual pupil (for example arithmetic, reading and writing). Compared to colleagues, this teacher knows this:

More exactly	1	2	3	4	5	6	Less exactly
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B. Some teachers set goals for each individual pupil that are frequently evaluated. Compared to colleagues, this teacher sets goals and evaluates:

Often	1	2	3	4	5	6	Rarely
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C. Some teachers have the capability to know exactly what is going on in the mind of the pupils. Compared to colleagues, this teacher has:

More capabilities	1	2	3	4	5	6	Less capabilities
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D. Some teachers work outside the regular methods and use other tools to explain topics. Compared to colleagues, this teacher works according to:

Regular methods	1	2	3	4	5	6	Enhanced methods
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E. Some teachers are experts in the subjects they teach (e.g. arithmetic, reading, writing, history). Compared to colleagues, this teacher has:

More knowledge 1 2 3 4 5 6 Less knowledge

F. Some teachers create their own ways to explain a topic to the pupils. Compared to colleagues, this teacher creates his/ her own way of explaining:

Often 1 2 3 4 5 6 Rarely

G. Some teachers are very effective in achieve the learning objectives with their pupils. Compared to colleagues, this teacher is:

Less effective 1 2 3 4 5 6 More effective

H. Some teachers utter criticism if a pupil makes a statement. Compared to colleagues, this teacher does utter criticism:

Often 1 2 3 4 5 6 Rarely

I. Some teachers work highly interactively. They ask the pupils many questions. Compared to colleagues, this teacher asks questions:

Rarely 1 2 3 4 5 6 Often

J. Some teachers motivate their pupils to find as many solutions as possible by themselves. Compared to colleagues, this teacher facilitates this way of thinking:

Less often 1 2 3 4 5 6 More often

K. Some teachers try to enhance discussions during their lessons. Compared to colleagues, this teacher enhances discussions:

Less often 1 2 3 4 5 6 More often

L. Some teachers try to let the pupils look at a problem from various viewpoints. Compared to colleagues, this teacher tries this:

Less often 1 2 3 4 5 6 More often

M. _
Some teachers create their own examples instantly on the spot to explain a topic to the pupils. Compared to colleagues, this teacher creates his/ her examples:

Less often 1 2 3 4 5 6 More often

N. _
Some teachers show appreciation of critical remarks and creative thinking of their pupils. Compared to colleagues, this teacher shows this appreciation:

Rarely 1 2 3 4 5 6 Often

O. Some teachers show less appreciation if pupils decide to take certain actions independently. Compared to colleagues, this teacher shows this kind of appreciation:

Rarely 1 2 3 4 5 6 Often

P. Some teachers cancel the lessons if it turns out that other things are going on in the minds of the pupils. Compared to colleagues, this teacher cancels the lessons:

Rarely 1 2 3 4 5 6 Often

Q. Some teachers know very well which learning objectives have to be achieved at the end of the year. Compared to colleagues, this teacher knows these learning objectives:

Less 1 2 3 4 5 6 More

R. Some teachers make up their own assignments related to the pupils daily life and by doing so, raise their interest. Compared to other colleagues, this teacher makes up his/ her own assignments:

Rarely 1 2 3 4 5 6 Often

S. Some teachers succeed in involving the pupils during the lessons. Compared to other colleagues, this teacher succeeds:

Less often 1 2 3 4 5 6 More often

T. Some teachers have to deal with oppositional behavior in the classroom. Compared to colleagues, this teacher has to deal with this behavior:

Less often 1 2 3 4 5 6 More often
