European Journal of Educational Research
Volume 7, Issue 2, 181 - 187.
ISSN: 2165-8714
http://www.eu-jer.com/

Determination of Teacher Candidates' Views Concerning V Diagrams Used in General Biology Laboratories

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Received: January 12, 2018 ▪ Revised: February 9, 2018 ▪ Accepted: February 10, 2018

Abstract: This study was conducted within the scope of the General Biology Laboratory II course, which was taught in the Science Teaching Department in the Spring semester of the 2016-2017 academic year. The study group consisted of 40 teacher candidates in their second year in the Science Teaching Department at a state university in Konya. The purpose of the study, in which case study design was used, was to determine the views of teacher candidates concerning the V diagrams used in the General Biology Laboratory II course. To this end, experiments were conducted for a period of 10 weeks and reports for the experiments were formed by the teacher candidates in the form of V diagrams. The views of the teacher candidates regarding V diagrams were collected through open-ended questions and analyzed via content analysis.

Keywords: *Teacher candidate, V diagram, general biology laboratory II.*

To cite this article: Kayacan, K. (2018). Determination of teacher candidates' views concerning v diagrams used in general biology laboratories. *European Journal of Educational Research*, *7*(2), 181-187. doi: 10.12973/eu-jer.7.2.181

Introduction

In courses such as science, biology, physics and chemistry which contain a lot of abstract concepts, it is extremely important for students to learn by discovery in order to achieve meaningful learning. Teachers need to use diverse methods, techniques, materials and tools during classes to ensure that students learn by discovery. Teachers' work and efforts in this regard can yield successful results only if students desire to learn. Students wanting to learn, on the other hand, must first develop a sense of curiosity and embark on the process of learning by discovery by asking questions about the subject. This is so much so that even in the most ideal learning environments, successful results will not obtained if students do not learn how they learn (Calais 2009). It is extremely important in learning by discovery that students should enjoy doing science, making meaningful explanations, forming/collecting evidence and participating actively in the process of doing science (LeBlanck, Cavlazoglu, Scogin & Stuessy 2017). One of the best learning environments where learning by discovery takes place is the laboratory. Basically, what is expected of laboratory activities is to ensure that students turn laboratories into genuine learning environments by making meaningful connections between the theoretical information learned in classes and what they observe during laboratory work (Meric & Nakiboglu 2000).

The V diagram, which was developed to enable students and teachers to understand the purpose and nature of laboratory work in science courses, is one of the most appropriate and important documents that could be used in the process of learning through experience. Developed by Gowin as a result of twenty years of hard work to enable students to understand the nature of knowledge and the steps in its formation, the V diagram is based on 5 fundamental questions originated by Gowin to demonstrate information in a situation or document. These five fundamental questions are: 1- "What is the focus (effective) question? 2- What are the key concepts? 3-Which research methods were used? 4- What are the knowledge claims? 5- What are the value claims? (Novak & Gowin 1984).

Gowin argued that this diagram would enable students to establish relationships between theoretical knowledge and laboratory work, thereby rendering laboratory reports more understandable and useful. In this way, when work is carried out appropriately, laboratories can be turned into genuine learning environments in addition to being places where only hand skills are improved and thus learning takes place as knowledge is constructed in students' minds. Correct learning of the most basic concepts by students serves as a foundation for better understanding of subsequent

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subjects. Basic concepts are understood correctly during laboratory work conducted using V-diagrams by establishing relationships with theoretical knowledge; besides, V-diagrams enable better measurement and evaluation of student achievement. Moreover, they allow students to make preparations before laboratory work (Meric & Nakiboglu 2000).

V diagrams are effective as a technique that contributes to meaningful learning in addition to their use as test reports. While students are getting ready for the test topic and in the concept section of the diagrams, it will be beneficial for students to use these tools and techniques in the concept section of the diagram as conceptual maps, conceptual networks, meaning analysis charts and mental maps. In this way, students will be able to link concepts related to the topic before the experiment/test and learn by doing/ through experience during the test. Use of tools such as conceptual maps, mental maps and meaning analysis charts in the conceptual section of V-diagrams ensures that V-diagrams cover all these materials, and hence contain multiple materials in this regard (Tekes & Gonen 2012).

Nature/Structure and Parts of V Diagrams

The shape and parts of the learning device, which was named V diagram as its design was likened to the letter V and which consists of three parts, namely conceptual part, focus question and method section are as follows;

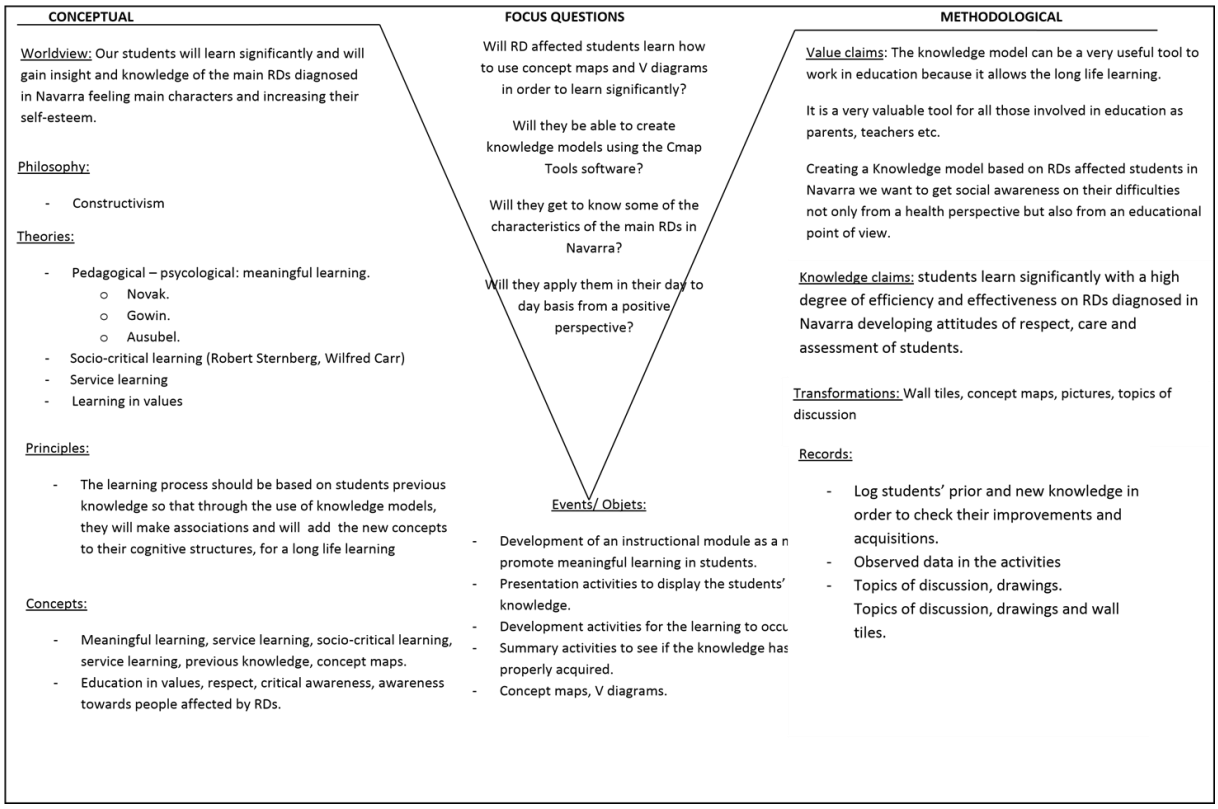

Figure 1. Parts of a V Diagram (Villarreal and others 2015)

•*Focus Question:* It is thought as transition from theory to practice. It is concerned with the problem that will be investigated in the study. Focus question may be one or two. It may be a question that has to be proved experimentally, a conclusion arrived at in the experiment, a key concept or a question revealing the purpose of the experiment/test. It indicates that phenomena in the study.

•*Tools-Materials:* This section involves effective tools and materials that are unique to the experiment and are used during the experimental procedures.

•*Theories and Principles:* Theories and principles concerned with the subject matter of the experiment are written in this section. Theories and conceptual information are guiding lights assisting in the understanding of subject of the experiment and they also help us in determining what tools and materials we should use in the experiment.

•*Concepts:* Fundamental concepts and information that need to be known with regard to the subject of the experiment to be conducted, terms, expressions and symbols connected with them are written in this section before the beginning of the experiment and thus students learn the concepts related to the subject of the experiment.

•*Informational Claims and Experimental Claims:* Informational claims involve the section which contains answers to focus questions. Claims made by students should be consistent with the conceptual and methodological information that guides the focus question.

•*Data and Data Transformations:* It is the section where activities/procedures and phenomena are re-presented and re-organized in a more successful and meaningful way.

•*Records (Measurements, Results, and Observations):* All experimental results, measurements and observations obtained throughout the experiment are given in this section.

Methodology

Research Goal

The purpose of this study is to determine teacher candidates' views regarding V diagrams. Use of V diagrams especially in laboratory classes is becoming increasingly important to enable students to organize their learning successfully. Conclusions that have been reached in studies conducted in recent years in particular indicate that V diagrams increase academic achievement levels, encourage students to explore and that knowledge learned through them becomes more permanent. On the basis of all these results, it is important to know what kind of benefits students will obtain from preparing for classes using V diagrams in a Biology laboratory where verbal expressions outnumber mathematical expressions. In addition, due to their having to work mostly in the theoretical section, determination of what kind of views students hold with regard to the teaching of the classes and what kinds ideas they present concerning preparation V diagrams is important in that this will guide teachers, students and researchers regarding whether V diagrams should be used in subsequent classes. In this study, the case study technique, which is one of the qualitative research techniques, was used to determine teacher candidates' views concerning V diagrams. Case studies are regarded as a distinctive approach used in seeking answers to scientific questions. McMillan (2000)defines case studies as a system in which one or more phenomena, media, programs, social groups or other interconnected systems are investigated in detail (Buyukozturk et al. 2010).

Sample and Data Collection

The research group of this study is consisted of 40 student form teachers in their second years in the Science Teaching Department in the Faculty of Education at a state university in Konya. The data obtained in the study were analyzed by two researchers using content analysis technique and the results were presented in Tables. The data were analyzed by two experts in the field of Science separately in order to ensure reliability of the study.

Analyzing of Data

In order to collect the data of the study, a structured questionnaire prepared by the research and consisting of four open-ended questions was used after it was assessed by two scientists specialized in their fields and it was given its final form.

Application of Research

Before the start of the application stage of the study, the teacher candidates were taught about V diagrams for one class hour and they were provided with preliminary information about parts of V diagrams and how they should be prepared. After that, the teacher candidates were asked to create V diagrams for each experiment in all the experiments to be conducted during the term in the General Biology Laboratory (II) course instead of preparing test reports. Consequently, the teacher candidates prepared the focus questions and conceptual sections of the V diagram before they came to the classes, leaving the remaining parts to be filled during the process of experimentation, attended the classes in this manner with V diagrams with them. The teacher candidates were presented with a term schedule indicating what experiment would be conducted at what week before the beginning of the term. Therefore, the teacher candidates knew beforehand what experiment they had to be prepared for. Having filled those parts of the V diagrams except data transformation section during the class, the teacher candidates wrote the data transformations section and their discussions relating to it and then brought their V diagrams to be submitted in the next class. Classes were held for a total of 13 weeks during the term and 14 experiments were conducted, namely the effect of molecule size on diffusion, the effect of the density of diffusion medium on velocity of diffusion, determination of blood groups, the effect of heat on enzyme activity, the effect of enzyme amount on reaction rate, the effect of substrate amount on reaction rate, investigation of the structure of the flower, investigation of DNA, searching for organic nutrients, determination of starch, sugar, protein and fat, factors affecting rate of photosynthesis, plant tissues: parenchyma tissue, epidermal

tissue cells, hair and stomas, supporting tissues (collenchyma) and stone cells. The sample V diagram for investigation of plant tissues under microscope is given in appendix.

Findings / Results

The teacher candidates responded with the following positive views to the first question asked in accordance with the purpose of the study, namely "Explain your positive/negative views concerning preparation of V diagrams with your reasons": they give concise, clear, obvious and simple information; they do not contain unnecessary details and information; all that is related to the class or the experiment can be seen on a single piece of paper in an orderly fashion, they are easy to use when one revises past units or prepares for an examination; they encourage studying before a class; they save time; they look fine to the eye; they are easy to prepare; they allow efficient use of paper /they save paper; they are fun, different, interesting, efficient and memorable; they improve one's interpretation and drawing skills; they ensure active participation in classes; they allow meaningful learning, permanent learning, ease of understanding and effective learning. The teacher candidates also gave such negative views as follows: they are inefficient/inadequate; they are time-consuming/they waste time; they are colorless and do not attract attention; they are not adequately explanatory and provide limited and little information.

A large majority of the teacher candidates' views regarding preparation of V diagrams appear to encourage their use and preparation owing to reasons such as that V diagrams ensure meaningful learning, enable ease of understanding, do not go into unnecessary detail, and provide concise, plain and clear information. However, though small in number, there are views stating that use or preparation of V diagrams is unnecessary because the space is inadequate, or they give limited information or they are time-consuming. Sample statements relating to these views are as follows;

"The fact that the V diagram was on a single page and that it was prepared in a simple and clear manner so as to reach the whole of the information enabled it to be understood easily."

"The page involving the V diagram is too small, so we have to write by shortening what we have to write."

Some of the teacher candidates, who were asked the second question, namely, "Explain your positive/negative views concerning the application of V diagrams in the laboratory class.", stated that the use of V diagrams in the laboratory class might be beneficial citing reasons as the following; they help reinforce what we have learned; with them it is possible to evaluate and check ourselves; preparation for examinations is easier because everything is on a single page; their visual design improves motivation towards the classes; they save time; it is advantageous to come to classes with prior knowledge and well-prepared; they are easier to prepare than test reports; they are more orderly, simpler and clearer than test reports; test/experimental results are memorable, clearer and more obvious; it is easier to conduct experiments/tests with them; and they are more successful and efficient. However, there were teacher candidates who, in contrast with these, stated that V diagrams were not useful because they are time-consuming; test results cannot be understood properly as they have not been written in adequate detail, and theoretical information is limited.

According to the findings, a large majority of the teacher candidates expressed favorable views concerning the use of V diagrams in laboratory classes due to such reasons as that test results were memorable, clearer and more obvious and that they worked more successfully and efficiently in classes, whereas a very small portion of the teacher candidates stated unfavorable such as that theoretical information was limited and that they were time-consuming. For example, the teacher candidates said the following with regard to the use of V diagrams in laboratory classes:

" Preparing V diagrams in laboratory classes instead of writing reports was both easier and more memorable"

"They are favorable in that they are short and clear as test reports. However, I found them unfavorable in that there was not enough space in the test report especially while writing the theoretical section."

"I think they should be used but they should not be too detailed because they took a lot of my time."

Some of the teacher candidates who were asked the third question, namely "Explain whether or not V diagrams had an effect on achievement ", stated that V diagrams were effective in that they helped revise past topics; topics that were hard to learn could be learned easily while completing the diagram; they motivated the students towards the classes; we had to come to classes well-prepared beforehand; they enabled permanent learning; preparations for examinations were easy and fast rather than boring because the information was clear, brief and easy-to-understand. However, there were views stating that achievement was concerned with the subject, not with V diagrams. Nevertheless; a large majority of the teacher candidates stated that V diagrams had a positive effect on being successful, citing reasons such as that preparations for examinations were easy and fast not boring because the information was clear, brief and easily understandable; and that they enabled meaningful and permanent learning of concepts. On the other hand, a small

portion of the teacher candidates stated that V diagrams did not have an effect on achievement, arguing that being successful is related to the subject; it has nothing to do with V diagrams. The teacher candidates expressed views such as the following concerning the question:

"Since I wrote brief and understandable information in the V diagram, I think it is useful to students in terms of providing permanent learning."

"It has an effect on success because students reinforce their prior knowledge with the information they have learned in classes. They come to classes knowing certain things beforehand, not with an empty head. Students will naturally be successful."

"I do not think they will have an effect on success whether they are V diagrams or ordinary writing unless students themselves study and make an effort."

A group of the teacher candidates, when they were asked the final question, namely "Explain with reasons whether or not you may prefer to use V diagrams when you become a teacher.", stated that they thought of using V diagrams, citing reasons such as that they do not occupy much space; they are easy to prepare; they encourage students to be orderly and organized; they raise feelings of interest, enthusiasm and curiosity towards classes; they are understandable and memorable materials; they save students' time; they help students in preparing for examinations; and they are successful in evaluating students. However, some other teacher candidates stated that they were undecided in this respect and that they could use them if the topic was short and there were simple experiments. Another group of teacher candidates on the other hand stated that they would not use V diagrams because they were not suitable for that age group, or they might take the easy way out or they would not write appropriately.

When we examine the findings relating to this question, we see that a large majority of the teacher candidates stated that they would prefer to use V diagrams when they become teachers because they are materials that allow permanent retention and that they find them successful in terms of evaluation of students, whereas a small number of students argued that they would not use V diagrams as they are not suitable for the age group. Another small group of teacher candidates stated that they were ambivalent as to using V diagrams and could use them only if the topic was short and the experiments were simple. Below are a few of the responses given to the question by the teacher candidates.

"I am thinking of using them because I believe that if students have classes using V diagrams instead of writing ordinary reports, they will retain the information".

"I would not use them. They are a little simple and students usually take the easy way out. They would not take me seriously if I asked them to prepare a V diagram. They would not write properly; the classical method (the notebook) is good."

"I might use them or I might not, I d o not know. It depends on the subject or the content."

"I am not thinking of using them because I think they will be above the level of age group I will be teaching.

Discussion and Conclusion

It can be said on the basis of the findings of the study that a la majority of the teacher candidates stated favorable views concerning preparation of V diagrams. Nakiboglu, Ozatli, Bahar, Karakoc (2001) found that although the teacher candidates used the V diagram for the first time, they grasped the rationale behind V diagrams easily and did not have much difficulty in filling them. In addition, it was concluded that V diagrams contributed to students' meaningful learning and that they did better in the post-test compared with the control group. Likewise, in another study conducted by Gursoy and Meric (2000), it was determined that students' preparation of V diagrams encouraged them to think, thereby rendering the knowledge they acquired more permanent. Luftand et al. (2001) used V diagrams as an example of an alternative report in Hydrology laboratories. V diagram and traditional format were compared as a guide for laboratories. It was found that students using V diagrams were more successful in organizing an experiment, analyzing data and making generalizations, pointing out the results clearly and in thinking and learning processes.

When the findings obtained from the responses to the second questions are examined, a large majority of the participants expressed favorable views regarding the application of V diagrams in laboratories and the feature they mentioned most frequently was that they were easier to prepare than reports. When the studies conducted in this regard are examined, is seen that there are various views. In a study they conducted, Gursoy and Meric (2000) found that students were able to answer the questions to the technical questions they prepared as a result of their experimental observations and they used the theoretical information from the experiment in this regard, so they could

establish relationships between their laboratory observations and theoretical information. Similarly, Roehrig, Luftand and Edwards (2001) stated that students were able to bring out the information construction processes in their minds through V diagrams and that traditional laboratory reports failed to provide that much information. It was found in a study conducted by Dogru et al. (2015) that teacher candidates arrived at the judgment that V diagrams were superior due to their being brief, systematic, easily perceivable; they added that V diagrams were better because visually they enable seeing the whole, are practical, attractive to the eye and have an order. There are many studies in the relevant literature whose findings are in parallel with the findings of this study (Novak&Gowin, 1984; Lebowitz, 1998; Nakiboglu & Meric, 2000; Nakipoglu, Benlikaya& Karakoc, 2001; Ozer, 2002; Atilboz& Yakisan, 2003; Evren, 2008; Ince, Guven & Aydogdu 2010).

It is seen that a large majority of the teacher candidates thought, in response to another open-ended question, that V diagrams were effective with respect to achievement. Their most effective aspects were that it was easy and fast rather than boring to prepare for examinations with them because the information in them was clear, brief, obvious and understandable, and also they enabled us to learn concepts meaningfully and. Tortop et al. (2007) used V diagrams to determine misconceptions and students' attitudes towards classes. As a result of their study, they found that V diagrams contributed to determination and elimination of misconceptions. They also stated that V diagrams enabled classes to be more efficient and pleasant, thereby leading to a positive attitude towards classes. In an application conducted in a Biology laboratory by Sulun et al. (2009) to determine the effect of use of V diagrams on student achievement, the researchers concluded that the academic achievement levels of the students in experimental group where classes were conducted using V diagrams were higher than the academic achievements of the students in the control group where laboratory method was used. Likewise, Dogru et al. (2015) stated in a study they conducted that the favorable aspects of V diagrams for teacher candidates involved their being practical, enabling doing research, being visual, and concise, forming focus questions, establishing relationships with daily life examples, facilitating understanding and being orderly. Similarly, in a study conducted by Kirilmazkaya and Zengin (2016) entitled "Identification of teacher candidates' misconceptions about the concept of photosynthesis through V diagrams and determination of their views concerning this tool", it was concluded that for teacher candidates, advantages of V diagrams outweighed their disadvantages.

Finally, a large majority of the teacher candidates expressed favorable views with regard to preferring to use V diagrams when they become teachers. When the relevant literature is examined, it is seen that there are studies that have found results similar to the results of this study (Nakhleh, 1994; Atilboz & Yakisan, 2003; Alvarez & Risko, 2007; Evren, 2008; Dogru, Selvi, Koklukaya & Yildirim, E, 2015).

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