

Beyond duality; life-world and the science teacher training curriculum with phenomenological attitude

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Among the components of the curriculum, teacher is the most important human factor as the interface of the intended and implemented curriculum. Epistemological beliefs of teachers in general and science teachers in particular affect their teaching methods and consolidate the teaching process. As one of the most important philosophical approaches of the current century, the phenomenological approach has gradually gained legitimacy among researchers in various fields of science, including research methodologies in education. The main questions of the present paper are: From a phenomenological point of view, what is the conception of nature as the subject of science? What are the basic features of the science curriculum and science teacher training from a phenomenological point of view? The answers to these questions provide an epistemological framework for the consistency of science teachers' beliefs. This research has been done using the philosophical research (conceptualization, concept analysis, evaluation of conceptual structure). The results showed that the perception of nature obtained from the phenomenological point of view is beyond the subject and object of classical epistemology. Accordingly, a phenomenological model was proposed for the science teachers' training, consisting of the overlapping circles from the center, including nature, student, teacher, approaches to science education, and at the external level, the life-world.

Keywords: Science Teacher Training, Phenomenology, Science Curriculum, Epistemological Beliefs

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Introduction

Recent studies have confirmed the impact of overt and covert epistemological assumptions on all components of the science curriculum. Some failures in good science education have been attributed to these assumptions in the curriculum. Given the assumptions of the phenomenological approach, this article aimed to review and clarify the "science teacher training curriculum." After Edmund Husserl, the phenomenological approach has been historically considered in a specific sense. It is primarily aimed to address how objects are constituted in consciousness. According to Smith (2007), Husserl contrasts this approach primarily with positivism. In the second period, Husserl's thought achieves an interpretation, introducing the life-world category that continues in various forms in the works of later phenomenologists such as Gadamer, Heidegger, and Merleau-Ponty.

Due to the introduction of a phenomenological approach in teaching the science and the effect of epistemological principles on teaching and learning strategies, being aware of the theoretical foundations of such an approach - its capabilities and scope as well as its limitations - is a significant issue for the educational study and curriculum system. Considering the importance of science from the nineteenth century onwards, i.e., the search for the laws of nature using the tools that prepare the possibility to observe accurately, caused it gradually gain so much dignity and prestige among human beings. It even became an ideology - the originality of science. Any subject to be appropriately examined must be scientifically studied; otherwise, it is invalid to discuss. Hence, modern education systems consider teaching science and scientific research methods as one of their important tasks. The epistemological presuppositions of empiricism/positivism are the mainstay of scientific research in the modern period.

According to Usher, the essential components of these epistemological presuppositions include determinacy; i.e., there is a truth that can be known; rationality, i.e., there are no different explanations and they all end in the same thing; impersonality, i.e., the more objective, the better, and the less subjective, the better; prediction, i.e., science provides a generalization that enables us to predict and control; unreflexively, emphasizes on method and results and does not ask any questions about the process (Usher, 1996). The empiricist/positivist assumptions are derived from the model of the natural sciences and rely on quantitative methods and objective observation independent of the researcher. In Usher's view, despite criticisms of positivist epistemological presuppositions (including those of Coon,

Popper, and the phenomenological and interpretive movements), these presuppositions still play an important role in educational research. However, the development of qualitative methods that are the product of criticisms against the quantitative tradition is one of the signs of doubt in the absolute legitimacy of quantitative/positive attitudes (former). Some of the world's leading researchers, such as Bruner (1999), believe that educational research so far has indicated the method of doing things and not the theory itself (quoted by Bazargan, 2000). One of the reasons for this is the overemphasis of educational research on using methods based on positivism and neglect of other methodological possibilities (Bazargan, 2000). The present article asks whether adopting a phenomenological approach can fill the gaps in the current science curriculum affected by the dominance of positive and analytical approaches. If such a claim is accepted, what implications it might have for the science curriculum. The meaning of vacuum and gap is mainly the presence of a kind of dichotomy between the learner, both teacher and student, and a natural phenomenon that has created a kind of alienation in the triple relationship between teacher, student, and natural phenomenon.

The need to examine this issue stems from the fact that the domination of nature as one of the primary ideals of the enlightenment, which is reflected in the works of some researchers such as Francis Bacon, is also among the ideals of modern science. But if, according to Habermas, rationalism is considered an essential element in modernity that has the property of self-reform (Kahun, 2003). In the light of this quality, the intellect of modern man becomes more aware of what he once called science, and the effects of this rationalism are gradually manifested in the institutions he has established, including education. Scientism was once the ideal of modern education, is now challenged by a wide range of thinkers.

One of these critiques is the phenomenological approach, which claims to offer a different approach than previous attitudes, which is less likely to realize the disadvantages of previous attitudes and is also promising some advantages. Various researchers have shown that teachers 'and students' epistemological beliefs, which may often be implicitly acquired, influence their teaching and learning strategies in science (Kadioglu et al., 2009; Jaber et al., 2009; Rezende & Oliveira, 2009).

It seems that the student's alienation sense from the whole teaching process to what is being taught is one of the concerns of researchers in the field of science education, which, of course, has attributed an essential part to epistemological beliefs based on cognition (Dahlin et al., 2009). Educational cognition is an

educational position according to which conceptual cognition is necessary and sufficient for all types of cognition and learning (former). As a result of such an attitude, the richness, delicacy, and complexity of sensory experience are reduced to "refined subjects of science." In other words, abstract concepts in this view become an underlying perceptual "objective reality." Thus, changes in the epistemological beliefs of teachers and learners can make significant changes in both teacher teaching and student learning strategies.

Reviewing the literature reveals the importance of this issue and the need to pay more attention. In this regard, Niknam et al. (۲۰۱۱) explained the anthropological explanation of experimental science learning; they have concluded that the anthropological approach to science learning is not limited to students' mental abilities and cultural differences underlie students' perceptions of science. Findings published in another article by Niknam et al. (۲۰۱۲) on the subject of counting the worldview of Iranian students and its role in learning experimental sciences show that the characteristics of the worldview of Iranian students could be classified into an aesthetic, mystical-religious, naturalistic, environmentalist, and mysterious categories.

Bevilacqua & Giannetto (۱۹۹۵), in an article entitled "Hermeneutics and Science Education: The Role of Science History," examines the role of science history in science education and concludes that the history of science can establish a more profound link among the content of science books at different levels. Bagheri (۲۰۰۹), in an article entitled "Interests of science and problems of education," has addressed the issue of interests of science, especially from the perspective of Haber Moss, and in fact, shows the implicit importance of interests in the fields of human knowledge and science. Kozoll & Osborne (۲۰۰۴) also discuss the need to connect science textbooks and students' daily lives in an article entitled "Finding Meaning in Science: Lifeworld, Identity, and Self." In their paper, other basic components of phenomenology, such as embodiment and intentionality in dealing with science education, have not been considered.

Antilock (۲۰۰۲) addresses "Heidegger's deep ecology and phenomenology in his thesis." As it turns out, his attention was Heidegger's phenomenology, and he did not discuss the components agreed upon by the phenomenologists. Also, his discussion has been mainly focused on ecology, and in particular, its implication has not been considered in the debate on science education. This issue is indirectly related to science education and can be used. Dahlin et al. (۲۰۰۹), in their article

"An Argument for Reversing the Bases of Science Education - A Phenomenological Alternative to Cognitionism," have tried to provide an alternative to science education in the light of phenomenological critique from a phenomenological point of view. Still, most of their efforts are focused on the ecosystem and have not discussed other central concepts of phenomenology in their article.

Here it is necessary to explain that Van Manen, as a researcher and expert in curriculum research, states from a phenomenological point of view that there is a distinction between "teaching as practice" and "teaching as being." Focusing on "teaching as being" allows the teacher to understand how he or she experiences the subject matter and students, colleagues, and even himself or herself. All of these relationships are established and learned by students in the lived experience. Van Manen emphasizes that "education is neither a matter of process nor a matter of content; education is a continuous and powerful interaction of these two kinds of activity" (Van Manen, 1991, p.33). However, he acknowledges that his attitude toward using phenomenology in the humanities, including education, focuses on hermeneutic phenomenology. One of the questions he seeks to answer is where and how does "reflection" enter the reality of the bio-educational world? How is "reflection" experienced in practice? And how to distinguish in practice from the concepts of reflection in the existing literature in the field of education, such as ideas such as "deliberation" by Joseph Schwab (Van Manen, 1991). It is clear that familiarity with this attitude in the education system in Iran, which has always been concerned with absorbing and processing new ideas, can provide this readiness to curriculum planners to incorporate this attitude into science education, or at least provide a basis for rethinking the current science curriculum. Despite disagreements about the nature and function of the curriculum (Marsh, 2000). But commonalities in the curriculum are of interest to curriculum researchers that have often been agreed upon. These factors include "logic and policy, curriculum areas, general ideals and goals of the curriculum, curriculum design guidelines, content, teaching and learning principles, curriculum evaluation guidelines, and the validity of the curriculum" (Marsh, 2000, p. 21). The mentioned components can be focused on a specific subject (discipline), and different relationships can be imagined. According to Phenix's classification of the domains of meaning, six semantic categories can be considered, which are symbolic (language, mathematics); experimental (experimental sciences); aesthetics; synoptic (philosophy, literature, religion in

terms of their existential dimensions); ethics; synoptic (history, religion, philosophy) (Phenix Quoted from Marsh, ۲۰۰۵).

Accordingly, the science curriculum would be related to experimental semantics (Turner, ۲۰۰۰). In the present study, from among the components mentioned in the science curriculum - and to limit the scope of research - the concept of nature from a phenomenological perspective, the characteristics of the science curriculum and science teacher training (logic, policy, and content of the science curriculum, teaching principles, and learning) and the science curriculum based on a phenomenological approach would be examined.

Following the objectives mentioned, this study seeks to answer the following questions:

- From a phenomenological point of view, what is the idea of nature as a subject of science?
- What are the basic features of the science curriculum and science teacher training from a phenomenological point of view?

Research Methodology

The methodological attitude of the present study is based on the description and "philosophical research; conceptual analysis. » The flow of phenomenology with emphasis on late Husserl's views. After explaining the philosophical foundations, the achievements of the phenomenological approach would be examined as a methodological framework for curriculum research in science teacher training. Coombs and Daniels mentioned three types of research: concept interpretation, concept development, and concept structure assessment under Philosophical Analysis Research. According to them, "essentially, analytical-philosophical research aims to understand and improve the set of concepts or conceptual structures by which the experience would be interpreted." In the field of curriculum studies, there are important tasks that can only be adequately accomplished through the use of certain types of philosophical-analytical research" (Coombs & Daniels, ۱۹۹۱). Accordingly, a) in the section of a phenomenological attitude, the concept interpretation would be studied, that is, the existing conception of phenomenology as a contemporary philosophical movement would be explained by mentioning its basic components; B) in the second section, the implications of the phenomenological attitude to science teacher training - as one of the elements of the

curriculum - are conceptualized; and c) in the third section, such a structure would be evaluated using the comparison method (here is a comparison with cognitivism).

The foundations of phenomenological attitude in Edmund Husserl's approach

From 1900 onwards, the philosophy of science developed into four traditions: a) analytical philosophy; B) the philosophy of hermeneutics based on the views of Martin Heidegger; C) philosophy of phenomenology, the product of the critiques of Husserl and Merleau-Ponty; D) philosophy of Hermeneutic phenomenology in the works of Patrick Heelan, Joseph Kockelmans, Ted Kisiel, Robert Crease, Joseph Rouse (Babich, 2009). According to another classification, three types of phenomenology could be listed: the phenomenology of nature by Johann Wolfgang Goethe (to whom Hegelian's phenomenology owes much), philosophical phenomenology, and ethnographic phenomenology (Østergaard, 2008). Babich's classification is more concerned with philosophical disciplines, while the Østergaard classification also refers to phenomenological influences in other areas.

To present the effective elements in the science curriculum from a phenomenological perspective - here emphasizes the philosophy of late Husserl's phenomenology - it is necessary to provide an overview of the important contexts and components of the phenomenological approach from the perspective of its original designer, Husserl. Edmund Husserl (1889-1959) was one of the most important figures of philosophy in the twentieth century and the creator of a movement in philosophy called phenomenology. In Moran's words, "it is Husserl's phenomenology that, as a genuine initiative, begins a movement that matures into a broad movement in the early twentieth century and expands with different tendencies" (Moran, 2000; p. 1).

As Smith points out: "Considering the whole of Husserl's intellectual life, a move from an initial emphasis on the objectivity of cognition (in mathematics, logic, and science) to an emphasis on the sensuality of our consciousness (in the pure or transcendental phenomenology) and an emphasis on the unconsciousness of our collective experiences of things is seen (in the philosophy of the biological world)" (Smith, 2007, p. 37). Husserl, beginning his philosophical studies, especially in his later works, actually intends to set out a path beyond the philosophically crisis-stricken Europe. He describes the disease and the crisis as follows: the superficiality of the new period can be called "originality belonging to perception" or

"objectivism," which has led to "naturalism" in various forms, and even the soul is considered a type of natural object.

The old and the new philosophies all superficially believe in the originality of perception. Only the originality of the German meaning challenged Kant, and in general very seriously, to this superficiality, which had reached a dangerous stage. "But the originality of meaning also failed to fully achieve the theoretical precision necessary for a modern philosophical reason and European man" (Husserl, 1960, p. 14). Husserl sees only two ways to deal with this crisis. One way is to destroy the West, which has departed from the principle of reason and wisdom and whose soul has fallen into the abyss of savage malice. The other way is for Europe to rise again from the spirit of philosophy, which, of course, requires rational courage to overcome nature (formerly). With his phenomenological project, he chooses the second way and seeks to expand it.

Husserl went beyond the usual meaning of phenomenology, i.e., the study of phenomena as empiricists emphasized its sensory aspects and rationalists such as Descartes or Kant emphasized its rationalist aspects. Thus, although phenomenology studies the consciousness experienced from a first-person perspective, it is distinct from its empiricist and rationalist types. According to Husserl, this is the approach that can study the essence. This is why Merleau-Ponty states at the beginning of his book *Phenomenology of Perception*, mainly according to Husserl: "Phenomenology is the study of essences; for example, the essence of consciousness or the essence of perception" (Merleau-ponty, 1962, p. 4). Hence, as Dartigues puts it, phenomenology is the study of the structure of consciousness and how the various objects are constituted in consciousness, and sometimes refers to what Husserl calls intentionality (Dartigues, 1974). Based on Husserl's discussion of areas of experience, his intellectual system's ontological and epistemological components can be identified. According to Smith (1997), Husserl's fundamental ontology appears in the three realms of facts, essence, and meaning. The realm of facts is studied by the experimental sciences (physics, biology, and psychology), the realm of essences by the idiomatic sciences (mathematics, logic), and the realm of meaning is among the phenomenological studies which, according to Husserl, is the new science of consciousness and examines the intentions of consciousness and its content. This ontology, together with epistemology (experimental sciences, idiomatic sciences, and phenomenology) and the three types of intuition (experimental, idiomatic, and phenomenological), provide the source of improvisation for our cognitions in these three types of knowledge.

Husserl, therefore, concerning this ontological and consequently epistemological division, according to their domains, has a pluralistic view to cognition concerning different fields of cognition. Husserl empties the intuition from our conventional notions (for example, mystical notions) and introduces it as the most important infrastructure of improvisation and, consequently, justification. Sakalovsky argues that three types of structures are always present in the phenomenological analysis. Awareness of these structures can help understand what is going on in a particular phrase or thematic development. These three structures included: A. Part and whole structure; B. The structure of this identity and plurality; C. "The structure of presence and absence." (Sakalovsky, 1999, p. 79). Sakalovsky's point is that in the appearance of every object in consciousness, using the metaphor of understanding a cube, one aspect always remains evident to us, and one aspect is hidden from us. The presence of one aspect indicates the other aspects of the perceptual subject, and the perception of an object indicates a whole.

The concept of the life-world in the development of Husserl's phenomenology

Schleiermacher first used the term *Lebenswelt* to mean lived experience, and Dilthey later coined the term *das Leben* to mean inner life. The meanings of these two terms later became a part of the phenomenological concept. "life-world" refers to the category or general context of the totality of human experience, and it is the all-encompassing realm that encompasses our entire finite objective experience, and any experience is already within this realm. The "life-world" is a pre-reflective world given to us by direct experience and is the raw material of all our metaphysical and cognitive expressions. This world is common to all humans and is considered pre-predicative and pre-cultural. According to Husserl, when Plato and Aristotle puzzled their philosophy, the life-world was reduced to a "representation." Because it belongs to an unstable world thus, for the first time, they transcended the living world beyond mere belief. They entered philosophically into the realm of true and accurate world knowledge.

Before Husserl, Simmel, a contemporary thinker, and others used the term life-world. After World War II, it became a popular term for sociologists who used it in various senses. Many referred to Husserl without studying his philosophy. As mentioned earlier, Husserl used this term because of the crisis of European science and transcendental phenomenology. Husserl commentators have different views on the subject of the life-world. Zehavi believes that the meaning of the life-world is

incompatible with Husserl's early philosophy. But for Zahavi himself, the life-world is entirely consistent with Husserl's early philosophy and has even had a definite place for it in his phenomenology from the beginning. He has repeatedly developed the context of this concept in his earlier works. It is gradually becoming more profound and modified in his view, as he has done with other concepts (Zahavi, 2008).

The Philosophy of Phenomenological Science: The Relationship between the Subject of Science (Nature) and the life-world

To answer the first question: what is the image of nature in phenomenology? We can now briefly mention these features. The point of contention among Husserl's students is to explain the relationship between the life-world and the subject of science (nature). Some commentators tend to put science in front of the life-world. According to Smith, the subject of science (nature) and the life-world are closely related in three ways from Husserl's point of view. Here science is the subject of science and means nature:

1- Science is a part of the life-world. This issue is clearly stated in the book of experience and judgment. According to Husserl, everything that contemporary natural science presents as the designations of what is available also belongs to us, the world, as this world is given to the elderly of our time. And even if we have no interest in the natural sciences, and even if we do not know anything about the results, what is already available has already been given to us.

2- Scientific propositions gain their meaning by living in the life-world.

3- Science is justified by the life-world (Russel, 2006).

As can be seen, there is an interaction between this point and the first point, the justification of science by its belonging to the life-world (Smith, 2007). Husserl devotes the third chapter of the book *Crisis* to the introduction and praise of the life-world and considers this world as the broad horizon of all human experiences. From this perspective, science is only one part of the totality of the biological world. He states that transcendental phenomenology, by quoting the precepts of "scientism," helps us return to the life-world to discover fixed structures within that world. He argues that these structures can be the fundamental structures of ideal science, except that they are no longer isolated and unconnected to the real world. In his view, we encounter meaningful and purposeful bodies in the life-world, not merely mechanical and meaningless physical bodies.

Therefore, we can overcome the crisis by reducing phenomenology and returning to the life-world. Only in this case can we explain the human experience wholly and correctly and reduce reductionism, relativism, absolutism, objectivism, subjectivism, and rationalism. So, the life-world is the foundation of the all-encompassing world of all sciences, even the most special ones, and it is based on such an attitude that the ideal of intellect can be maintained. The ideological ideal is not to acquire the "definitive" system of philosophy and cognition but to provide a suitable foundation for rationalizing human experience (Husserl, 1989). According to Husserl, the life-world is given to us in the most immediate state, that is, the horizon of the world in which we live without constructing its content as the world (Husserl, 1989, p. 379). Such a thing is at least the fundamental meaning of the concept. Russell states that Carr-translator of *The Crisis* claims Husserl meant many meanings of the life-world that are not necessarily comparable. He may be right in this ruling. Nevertheless, we can choose two main meanings of this concept, the relationship between which is clear enough. These two meanings are the meaning of "thick" and the meaning of "thin" (Russel, 2006).

The meaning of "Thick" is when the term life-world, given to the whole world given to us, is used in direct experience and accumulated with cultural richness, practical meanings, and sensory richness. In this case, we are dealing with a historical-cultural world intertwined with complex social, political, and religious forms of subconscious religion. Here we are faced with various phenomena for which the humanities are responsible for research. So, "the thin meaning of the life-world is used to refer to more limited phenomena, which belong to the world of experience and differ from one culture to another, or at least nature as a subjective experience." It is at this level that we discover the plenum of sensory. As a result, the idealization of the natural sciences arises legitimately" (Husserl, 1989, p. 379).

Nevertheless, the thin meaning of the life-world is only an abstract part of the totality of the lived experience. We always find ourselves immersed in a cultural and practical world and enter it only after we abstract the world of a natural experience.

Common approaches to science education

To answer the second question, what are the basic features of a science teacher training curriculum in terms of a phenomenological approach? First, the important approaches used in science education are mentioned, its distinction from the phenomenological approach is mentioned, and finally, the characteristics of the phenomenological approach to science education are introduced and analyzed.

Approaches to science education and curricula have similarities with the phenomenological approach, but the characteristics of the phenomenological approach to teaching and learning or the curriculum distinguish them. The most important of these approaches are:

-Science education based on the constructivist approach

The constructivist approach has been proposed in a wide range of philosophical and epistemological approaches. Constructivism in science means that the individual builds his knowledge, and the focus of the educational activities from the instructor or teacher changes on the learner or student. The phenomenological perspective in science education may be closely similar to the constructivist or social-constructivism perspective, but according to Østergaard et al. (2008), the constructivist perspective emphasizes the cognitive while the phenomenological approach emphasizes the pre-cognitive. The meaning of pre-cognitive can be interpreted using the words phenomenology, the same as the life-world. That is, we first find ourselves in a world, then explore it, and this is where the process of cognition begins.

-Science education approach based on context-based learning

The beginning of this approach dates back to 1980. This approach to science education or curriculum is the starting point for creating and understanding concepts in science (Bennett et al., 2000; Quoted from Østergaard, 2008).

In context-based learning, the use of theory to demonstrate and reinforce learning is emphasized. The contextual and phenomenological approach to learning is similar in that both emphasize the connection between the world of science and the life-world. But an important feature that distinguishes it is that the context is used only to represent scientific concepts in the context-based learning approach. In phenomenology, the science teachers tend to consider the life-world phenomenon as a base. Consequently, in phenomenology, the individual does not seek a suitable context for promoting understanding, but the life-world is the entry point into the world of science (Østergaard et al., 2008).

-Science education approach based on the history of science

This approach uses the feature of history to teach the nature of science (Clough, 2011). The approach of the history of science in the teaching of science provides an opportunity to learn deeply about the nature of science and broadens our judgment

of the nature of discoveries in the history of science, making us more familiar with what science is. Watson and Crick, for example, first discovered the structure of DNA in 1953, while Pray (2008) documents historical evidence that the foundations for DNA discovery were laid earlier by a Swiss chemist named Friedrich Meyer. It was identified in the late 1860s.

-Science education approach based on research as processes

Teaching and learning through research can take many forms. Immersion projects initiated and completed by students are typically short-term and research-based laboratory scientific content. Even short-term activities outside of the formal curriculum of teachers should evaluate students in a challenge with scientific content and issues related to the nature of science and ask questions that develop students' accurate understanding (McComas et al., 2000). In this approach, most researchers support the field of laboratory research. According to Lederman (2007), students' research experiences provide them with fundamental experiences for reflection on various aspects of the nature of science.

-Science education approach based on socioscientific issues

In this approach, social issues are considered as difficulties that are defined based on science, based on the type of educational goals that have an open end, have a flawed structure, are contentious issues that have multiple perspectives and solutions, and are often included or they become processes of science and create controversial social debates (Sadled & Zeidler, 2000).

-Science education approach based on reasoning

From an educational view, when we use a reasoning approach, we want students to be in a position to be able to put different statements into logical propositions and various forms and to evaluate them from a logical validity perspective. According to Sismondo (2004), scientists and engineers are always in a position to convince their colleagues and others of the value and validity of their beliefs.

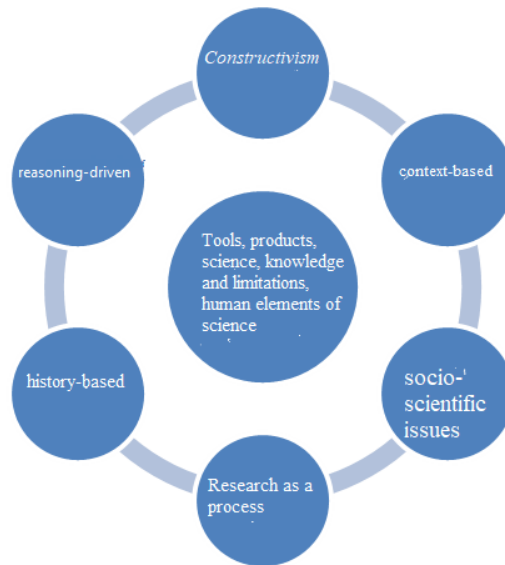


Figure 1: Combining the model of Mc comas et al. (2020) and Dahlin et al. (2009)

Phenomenological Science Curriculum Idea: Rethinking in Science Teacher Training

According to Østergaard et al. (2008), a classification of the application of phenomenology in science education and curriculum can be imagined:

A) Phenomenology of science education: In this category, understanding and analysis of the processes and activities of science teaching from a phenomenological perspective begins. The teacher and the student try to establish and develop their understanding and learning of science. This effort, which is descriptive and analytical, includes the activities of teacher and learner.

B) Phenomenology in science education: In this approach, the natural phenomenon itself, or the subject taught, is focused on (the third aspect of the triad), apart from analyzing and describing natural phenomena. This approach has a prescriptive feature and emphasizes Goethe's phenomenological approach.

C) phenomenology and science education integrated: Phenomenology and science education are combined in this approach. The Waldorf schools that Steiner founded are an example of this approach.

In the various phenomenological forms of the sciences as mentioned above, a) more emphasis is placed on teachers and their experiences b) perceptions of students are the focus of attention c) teaching and learning activities are based on the lived experiences and experiences of teacher and student (Østergaard et al., 2008).

In the light of this typology, the applications of phenomenology in science education and by relying on the philosophical foundations of the phenomenological view, its consequences in the field of teacher training can be identified. In the area of teacher training, and according to the distinction made between vocational learning and professional development by Fraser et al. (1997), it is possible to think of measures for change at two levels on this basis and in the approach to science teacher training. Like any alternative model, the phenomenological approach's distinctive features can be taught, and its learning rate can be measured and evaluated. At this level, beliefs, knowledge, skills, and attitudes change. Compared to vocational learning, career development involves broader changes that occur over a long period in the dimensions of the profession. Consequently, if we are to speak of science teacher training from a phenomenological point of view, we should expect that these changes would occur at two levels of vocational learning and professional development, which, of course, are closely related.

Six perspectives are necessary for good teacher training to change teachers: 1. Change in education; 2. Change in the compatibility; 3. Changes in personal development; 4. Change in area correction; 5. Change as a systematic restructuring; 6. Change means growth or learning. In other words, if we want to talk about teacher training in the general sense and science teacher training as creating a professional identity from a phenomenological point of view, it is necessary to make a turn at both disciplinary and pedagogical levels. Yee (1996) has attempted to propose a framework called the case method for science teacher training based on Husserl's transcendental phenomenological approach. He has introduced this method to understand the professional development activities of science teachers.

Østergaard & et al. (1998) outline four steps to fill the gap between the scientific world that is abstract, imagined, understood, conceptualized, and transmitted to students through the teacher:

A) Create a rich and vivid picture of the observed phenomenon; A phenomenon that has different manifestations.

B) Selecting some of the student's everyday concepts using rich descriptions to transfer them to scientific concepts

C) Introducing scientific concepts or models. These concepts or patterns, which the student often experiences as abstract phenomena, are introduced as continuing the experience and not in opposition to daily experiences.

D) Using scientific concepts in everyday experiences to deepen understanding of the phenomenon.

This proposal of Østergaard et al. (2008) can play an influential role in guiding and enriching the phenomenological attitude in educational and research activities as a strategy.

Using the phenomenological approach in science education implies a kind of pragmatism in the phenomenological approach that creates a rotation at the ontological, methodological, and curriculum level of science as an interdisciplinary field. It seems that in the current approaches of science education and science teacher training, there is a kind of dichotomy between science and the world, both teacher and student. A kind of duality is created in the student as the researcher and nature as the research subject. From the phenomenological point of view, according to what has been said, science and the subject of science - nature - result from the correlation between man and nature, which can be mentioned as the origin of science. To avoid these classical dichotomies, Husserl uses the terms *noesis* and *noema* instead of conscious subject and object of recognition. In this type of terminology, not the separation and duality but the correlation between the researcher and nature is mentioned. Accordingly, man has never been alien to nature as the subject of science, and science has no origin other than the human biological world.

An assessment that can be made from the combination of McComas et al. (2000) and Dahlin et al. (2009) models in the field of science education approaches and its tools from a phenomenological point of view, relying on the concept of the life-world, is that in each of the introduced approaches, there is a dichotomy between the natural world as the realm of scientific research and the student as the researcher. The teacher is the mediator of this circle, the teacher is added to the dual circles, and a kind of trinity is created. In other words, in proportion to the combination of the McComas and Dahlin model, the model of science teacher training is obtained, which relies on a fundamental duality. Whereas from the point of view of the concept of the life-world, which is the legacy of Husserl's late thought, if we can look at the teacher-student relationship and nature, we can introduce a comprehensive model that has the characteristics of each approach on a correlated and non-dualistic basis. Or it is based on the trinity. Because awareness and what it's about, in the teacher and student as human elements of the science curriculum, there is a kind of multiplication and correlation with the same awareness, including teacher-student, student-teacher, teacher-nature, and student-nature. Such a relationship can express

an approach appropriate to the phenomenological attitude. This relationship is shown in Figure ۲.

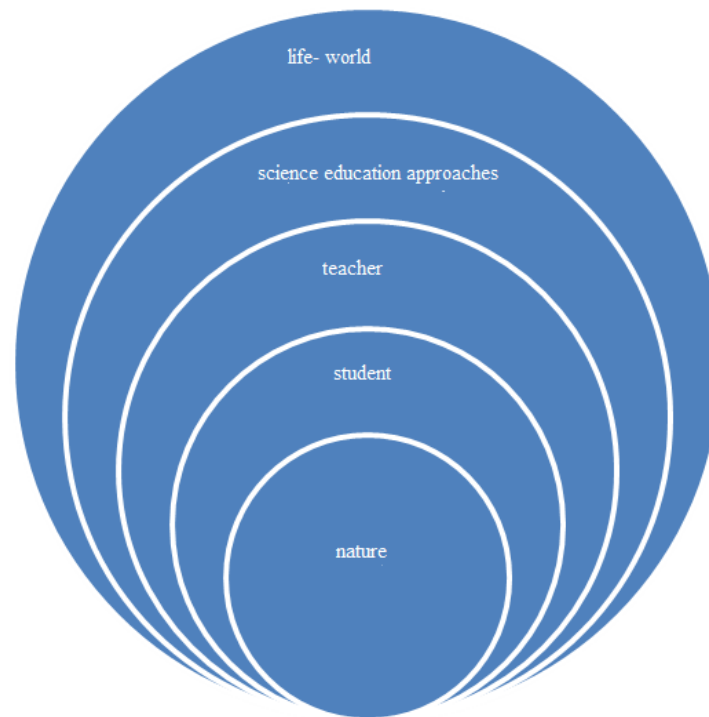


Figure ۲: The approach of science teacher training in phenomenological attitude

In this model, the teacher himself is in a life-world, and his understanding of science depends on the world-life surrounded by its cultural elements. Such a context has made his understanding of science possible. In the phenomenological approach of teacher training, the teacher must first be aware of how science is consolidated in consciousness and trace the role of different elements in it. Next, he should try to become aware of the student's perception by relying on the student's life-world. Such a two-way effort is more likely to bring the science teacher closer to the practice of teaching because the basis of teaching in the phenomenological view, as Van Manen (۱۹۹۱) puts it, depends on communication with the student through the approximation and overlap of the world of teacher and student. Such a view is in line with the results of Østergaard et al. (۲۰۰۸) and Van Manen (۱۹۹۱), but the difference is that focusing on the living world is an area that can enable communication and tact in teaching.

Discussion and Conclusion

The important point here is that the phenomenological approach is in conflict with reductionism and emphasizes the importance of pre-reflection in creation and exploration in science education. Given the very concise and limited expression of some of the most important components of Husserl's phenomenological attitude, the phenomenological approach in science can be considered a critical approach compared to the positive approaches; that according to the Babich (2009) classification mentioned earlier, falls under the meta-analytic classifications. From a phenomenological point of view, science is the product of scientists' work, which comes from their biological world, not scientists who see themselves as isolated from the world and play more of an observer role.

Hence, it should be emphasized that the experimental science and phenomenological attitude in science and science education do not contradict each other, but it is a continuum that is somehow continuous. An important implication of the critical nature of the phenomenological approach is that it passes the duality of Cartesian heritage and considers the important constitutional role of consciousness in the construction of the world. The understanding of objects in the world, both material and immaterial, is the product of the same cube metaphor that Sakalovsky referred to; the component as a whole, the presence, and absence, the oneness in the multiplicity, which together constitute the elements of the concept of phenomenological intuition.

For example, when a science teacher talks about water in the classroom as a substance from the materials of the universe, it is said that the states of water are solid, liquid, and gas; although it implies all of Sakalovsky's elements, as mentioned earlier when placed in my living world as a student-scientist, I can think and research phenomenological about the origin of the water phenomenon as a phenomenon of the universe. What is the relation of water to me, and what is my relation to water; my intentionality determines my relationship. That is, when I take a phenomenological view, my attention to the water becomes meaningful as one of the phenomena of the world, which is consolidated in my consciousness, and this is where phenomenological science and, consequently, the teaching of phenomenological sciences begin. In a scientific and laboratory analysis, water results from a combination of atoms called two hydrogens and one oxygen.

Paying attention to the pre-reflection in the phenomenological approach can open a meaningful discussion in pedagogy in the general sense and teacher training and scientific education, which contrasts the views that prioritize cognition over

anything in education. The importance of action in a philosophical explanation creates a turn in epistemological ontologies.

References

- Antilock, M. (۲۰۰۲). *Deep Ecology And Heideggerian Phenomenology*. A thesis submitted in partial fulfillment of the requirements for the degree of Master of Arts. Department of Philosophy College of Arts and Sciences.
- Babich, B. E. (۲۰۰۹). *Against Analysis, Beyond Postmodernism*. Fordham University. Retrieved on ۱۰ Sept. (<http://www.fordham.edu/philosophy/ie/babich/cpbabich.htm>).
- Bagheri, Kh. (۲۰۰۹). *New perspectives on the philosophy of education*, Naghshe Hasti publication.
- Bazargan, A. (۲۰۰۵). *The need to pay attention to the underlying views of epistemology in the humanities, in the educational sciences with respect to Dr. Alim Mohammad Kardan*, (pp. ۳۸-۵۰), SAMT.
- Bevilacqua, F. & Giannetto, E. (۱۹۹۵). Hermeneutics and Science Education: The role of history of science. *Science & Education*, ۴, ۱۱۵-۱۲۶. <https://doi.org/10.1007/BF00487079>.
- Clough, M. P. (۲۰۱۱). The story behind the science: Bringing science and scientists to life in post-secondary science education. *Science and Education*, ۲۰(۷), ۷۰۱-۷۱۷. <https://doi.org/10.1007/s11191-010-9310-7>.
- Coombs, J. R; & Daniels, L. (۱۹۹۱) *Philosophical Inquiry: Conceptual Analysis: Forms of Curriculum Inquiry* (ed) Edmund C. Short, State University of New York Press, ۱-۲۷.
- Dahlin, B. & Østergaard, E. & Hugo, A. (۲۰۰۹) An Argument for Reversing the Bases of Science Education - A Phenomenological Alternative to Cognitivism, *Nordic Studies in Science Education*, ۹(۲), ۲۰۱-۲۱۵.
- Dartigue, A. (۱۹۹۴). *What is phenomenology?* (translator: M. Navali). SAMT Publication (Original Edition: ۱۹۷۴).
- Fraser, C., Kennedy, A., Reid, L., & McKinney, S. (۲۰۰۷). Teachers' continuing professional development: Contested concepts, understandings and models. *Journal of In-Service Education*, ۲۲(۲), ۱۵۳-۱۶۹.
- Husserl, A. (۱۹۹۹). *Philosophy and the Crisis of the West*, (translators: R. Davari; P. Zia Shahabi; and M. Joozi), Hermes Book Publication. (Original edition ۱۹۶۵).
- Husserl, E. (۱۹۸۹). *The Crisis of European Sciences and Transcendental Phenomenology: An Introduction to Phenomenological Philosophy*. Evanston: Northwestern University Press.
- Jaber, I; Halwany, S. Rizk, N. & BouJaoude S. (۲۰۰۹). *Epistemological beliefs in science: an exploratory study of Lebanese university students' epistemologies*, in Tasra, M. F. & Çakmakci, G. (eds) *Contemporary Science Education Research: international perspectives*, pp ۲۰۷-۲۱۶, Turkey (ESERA).
- Jafari harandi, R., mir shah jafari, S., Liaghatdar, M. (۲۰۱۳). A comparative survey on the goal element of science education curriculum in Iran and selected countries. *Journal of Educational Sciences*, ۱۹(۲), ۸۷-۱۰۶.

- Justi, R. (۲۰۰۹). Students' pre- and post-teaching analogical reasoning, in Tasra, M. F. & Çakmakci, G. (eds) Contemporary Science Education Research: international perspectives, pp ۳-۱۲, Turkey (ESERA).
- Kadioglu, C.; Uzuntiryaki, E. & Capa Aydin, A. (۲۰۰۹) *The role of epistemological beliefs in high school students' learning strategy*, in Tasra, M. & Others (eds) Contemporary Science Education Research: international perspectives, pp ۲۰۰-۲۶۰, Turkey (ESERA).
- Kahun, L. (۲۰۰۲). *From Modernism to Postmodernism*, (A. Rashidian, translator). Nashre Ney Publication. (Original Edition ۲۰۰۳).
- Kozoll, R. H., & Osborne, M. D. (۲۰۰۴). Finding Meaning in Science: Lifeworld, Identity, and Self. *Science Education*, ۸۸(۲), ۱۵۷-۱۸۱. <https://doi.org/۱۰.۱۰۰۲/sce.۱۰۱۰۸>.
- Lederman (Eds.), *Handbook of research on science education* (p. ۸۳۱-۸۷۹). Mahwah: Lawrence Erlbaum.
- Lederman, N. G. (۲۰۰۷). Nature of science: Past, present and future. In S. K. Abell & N. G. Marsh, Colin J. (۲۰۰۰). *Key Concepts for Understanding Curriculum*, London, Taylor & Francis e-Library.
- Matthews, A. (۲۰۱۰). *An Introduction to Merleau-Ponty Thoughts*, (Translator: R. Barkhordari), Gam No Publication. (Original Edition, ۲۰۰۶).
- McComas W.F., Clough M.P., & Nouri N. (۲۰۲۰) Nature of Science and Classroom Practice: A Review of the Literature with Implications for Effective NOS Instruction. In: McComas W. (eds) *Nature of Science in Science Instruction*. Science: Philosophy, History and Education. Springer, Cham. https://doi.org/۱۰.۱۰۰۷/۹۷۸-۳-۰۳۰-۰۵۷۲۳۹-۶_۴
- Merleau-Ponty, M. (۲۰۰۲). *Phenomenology of perception*, (Translated by Colin Smith). London: Routledge.
- Moran, D. (۲۰۰۰). Introduction to phenomenology, London: Routledge.
- Niknam, Z.; Mehrmohammadi, M.; & Fazeli, N. (۲۰۱۱). Experimental Science and Culture Education: Anthropological Explanation of Experimental Science Learning. *Iranian Curriculum Studies Quarterly*, ۰(۲۰), ۳۶-۸.
- Niknam, Z.; Mehrmohammadi, M.; & Fazeli, N. (۲۰۱۲). Learning in Role Its and Students Iranian of View World Scientific Science, *Iranian Curriculum Studies Quarterly*, ۷(۲۶), ۸۲-۰۰.
- Østergaard, E; Dahlin, B. & Hugo, A. (۲۰۰۸). 'Doing phenomenology in science education: a research review', *Studies in Science Education*, ۴۴(۲), ۹۳ - ۱۲۱.
- Pray, L. (۲۰۰۸) Discovery of DNA structure and function: Watson and Crick. *Nature Education*, ۱(۱), ۱۰۰.
- Rezende, F. & Oliveira, I. (۲۰۰۹). *University students' epistemological beliefs on natural and social sciences*, in Tasra, M & Others (eds) Contemporary Science Education Research: international perspectives, pp ۱۷۳-۱۷۷, Turkey (ESERA).
- Russell, M. (۲۰۰۶). *Husserl (A guide for the perplexed)*. London & New York, continuum
- Sadler, T. D., & Zeidler, D. L. (۲۰۰۰). Patterns of informal reasoning in the context of socioscientific decision making. *Journal of Research in Science Teaching*, ۳۷(۱), ۱۱۲-۱۳۸.
- Sakalovsky, R. (۲۰۰۰). *An Introduction to Phenomenology*, (Translator: M.R. Ghorbani). (Original Edition, ۱۹۹۹).

- Sismondo, S. (2002). *An introduction to science and technology studies*. Malden: Blackwell.
- Smith, D.W. (2007). *Husserl*. Abingdon: First published by Routledge.
- Turner, T. (2000). The science curriculum: what is it for, in John Sears and Pete Sorensen (eds) *Issues in Science Teaching* (2-10) London and New York: Routledge & Falmer.
- Usher, R. (1996). A critique of neglected epistemological assumption of educational research. In David Scott & Robin Usher (Eds.), *Understanding educational research* (p 9-32) London: Routledge.
- Van Manen, M. (1991). *The tact of teaching: The meaning of pedagogical thoughtfulness*. State University of New York Press.
- Yee, S. F. (2019). *A Phenomenological Inquiry into Science Teachers' Case Method Learning*. Springer Briefs in Education, <https://doi.org/10.1007/978-981-13-2679-0>.
- Zahavi, D. (2008). Phenomenology, (ed.) Moran, D. in *Routledge Companion to Twentieth-Century Philosophy*. (p. 661-693). Routledge.