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**Review of the doctoral dissertation of**

**Ms Michal Sigron under the title**

**"Learning to Become a Physics Inquirer: Environment, Process, and Challenges"**

In accordance with the currently applicable legal regulations, in the case of a doctoral dissertation the subject of the review is to assess whether it meets three basic criteria:

1. is "an original solution to a scientific problem",
2. demonstrates "the general theoretical knowledge of the candidate in a given scientific discipline",
3. demonstrates "the ability to independently conduct research work".

At the very beginning of my review, I can say that all these criteria have been met by the PhD student.

The originality of the dissertation consists in taking up a topic rarely explored in educational studies.

The doctoral student satisfactorily placed her analyses in the context of pedagogical knowledge. The term "satisfactory" should be understood in the way that, although the dissertation is characterized by substantive correctness, the doctoral student could, to a greater extent, have used pedagogical narratives to analyse the empirical data obtained, which would have significantly contributed to the enrichment of the value of the work. The volume of the work is impressive - 618 pages, 190 of which constitute an attachment. In this situation, theoretical foundations have been presented rather scarcely. The doctoral dissertation should be firmly rooted in the scientific theory(-ies). John Dewey's concept seems to be of key importance in this

work, but it is presented only on one page, which is a significant shortcoming in the doctoral dissertation.

Ms Michal Sigron moves freely around the discovered new territories of knowledge and is able to perform accurate analyses, which indicates her competence in the field of independent research activities. It is worth noting that, in her project, the doctoral student took the risk of exploring a space not described with unambiguous definitions and in which there are no designated paths of cognition.

J. Dewey's concept of learning. Inquiry is a process in which from what is not defined one comes to a certain uniform and clear whole in a targeted and controlled way. J. Dewey distinguished three stages of the Inquiry process: feeling the problem, defining the problem, trying to solve the problem.

Inquiry in the process of learning is an approach little known in traditional education, while reflection accompanies every human activity to a greater or lesser extent. We boil water without reflection, but when it comes to preparing a meal we already put much reflection into it. It is Inquiry that is essentially asking and answering oneself, i.e. verifying the undertaken activity in terms of its suitability for one's own self: sensitivity, impulses, needs, beliefs, knowledge, views. As a result of this, a modification of this activity may occur. So one should talk about Action Inquiry (cf. William R. Torbert, *Action Inquiry: The Secret of Timely and Transforming Leadership*). Inquiry makes sense when it contributes to modifying one's own actions. This project is assumed to cover only half of the process, i.e. Inquiry. Do questions with answers, but without implementing new activities, really develop personal potential? The ultimate goal of education, however, is to change the world for the better by the people who learn. Hence, the forming of an active and not merely philosophical attitude is the most important task of education. Man changes (develops) by changing reality, and this reality, in turn, conditions the changes of man. So why not introduce such a strategy into the learning process?! There are no rational negative answers. Unreflectiveness in education is probably the aftermath of modern thinking about education, which was to prepare a disciplined worker and soldier who carries out orders without reflection.



As the author writes, the uniqueness of the presented project consists in a comprehensive analysis of the perception of physics, by its learners, as an inquiry process in the long term perspective (over three years). Students' views on various inquiry components, the challenges they faced, and their relationship with their personal development at all stages of the programme were examined. In addition, students' perception of the learning environment of "Research Physics" and its contribution to their personal development, in particular their perception of student and teacher roles, the support and learning resources they received as part of the programme, as well as their satisfaction with it, were examined. Incidentally, an interesting topic could be the study of the evolution of the ability to reflect during the educational process. The Inquiry approach would then be a tool to stimulate reflectivity.

The research was carried out in a quantitative and qualitative strategy. The doctoral student is aware of the limitations and opportunities of the strategies used. She uses the potential of combining them. The research techniques used were adequate to the subject matter. However, the accuracy of the research may raise some doubts: did the doctoral student actually research what she wanted to research? This is a moot point. But about this later in the review.

One may also wonder to what extent the quantitative approach was the right choice with a small number of respondents.

A lot of space was devoted to the development of the research results, which indicates the doctoral student's reliable approach to this part of the research procedure. Sometimes, however, the too superficial treatment of the obtained data raises reservations. But about it below.

The "Discussion" part contains a number of interesting observations made by the doctoral student. She emphasizes that the students taking part in the project experienced the uncertainty of their knowledge of physics when, in their inquiries, they obtained results different than those in textbooks. An active approach to the acquisition of knowledge makes it possible for them to develop better cognitive competences (to a lesser extent knowledge). I believe that this is what the doctoral

student has in mind when she writes on p. 373 about the "active process of the creation of new knowledge".

The PhD student rightly notices that a failed experiment and obtaining unexpected results contribute better to the development of critical and creative thinking than gaining knowledge in a traditional way.

An important competence acquired by the students, which is emphasized by the doctoral student, is the awareness that teamwork gives better results than independent work. Being criticized by your peers makes it possible for you to develop a very important cognitive competence, i.e. the ability to approach your own perceptions and views critically.

The PhD student herself also demonstrates this competence in subsection 5.2 Research Limitations by approaching her own research in a critical way.

In subsection 5.3, in turn, she shows openness to new approaches and experiences, writing about the possibilities of reformulating the research procedure in order to get to know the explored subject more thoroughly.

### Main discussion threads

#### ***Coping with uncertainty***

Coping with an uncertain situation can be reactive or impulsive. These are immature behaviours, typical for a child. You can also use a mature approach, i.e. a specific strategy(-ies). One of them was proposed by the Polish psychologist Józef Koziellecki when writing about transgressive activities. The author of this review proposed the principles of transgressive education, starting from J. Koziellecki's thought (see P. Błajet, (Nie)przypadkowa edukacja (*Non*)accidental education).

To sum up, in uncertainty one can act in an immature or mature way, i.e. reactively-impulsively or in a strategic way (according to certain rules). It is not very clear what the students' declarations mean when they respond that they cope better with the uncertainty of the discoverer's situation, and what development in this aspect is all about. It should be assumed that these are their personal statements that convey their feelings and thoughts.



### *The ability to decentrate. The ability to reflect.*

Assuming that the self-assessment of one's own educational behaviour may be a source of objectified knowledge about the effectiveness of the educational process requires certain pre-assumptions. Two of them are of key importance:

1. The ability to decentrate, which is a necessary condition to free oneself from egocentrism (reactivity and impulsiveness). Without decentration, the individual remains unaware of the characteristics of his or her behaviour, and the rules of conduct are determined by a fit of passion. He or she is also susceptible to pressure from the surrounding. In this situation, we cannot be sure whether his or her narrative (answers to the questionnaire questions) corresponds to the objectively occurring properties of the activity and whether it is an original narrative and not one mediated by the occurrence of social pressure; such social pressure may take the form of the questions in the questionnaire, to which "it is appropriate to: answer as expected by the "person asking questions, who is significant for me".
  2. The ability to reflect (reciprocally linked with the ability to decentrate). According to E. Langner, reflectiveness can be understood as "... active data processing, characterized by cognitive differentiation, i.e. creating new categories and distinctions. Creating distinctions makes it possible to create new categories and vice versa. What has been made distinct may be considered important or trivial, but always as a result of conscious thought work. Reflectiveness can be defined as creating **multiple perspectives** or being aware of the **context**. An individual in this state, by diversifying the outside world, diversifies his or her own abilities more and more. He or she gets all involved in creating. In a state of unreflectiveness, it is quite the other way round; the individual draws on existing categories and on existing distinctions".
- It is not known to what extent the surveyed students - from 15 to 18 years of age - have acquired these competences. Taking into account the age (stage of development) of the students, it can be assumed that they are rather on a low to average level. The abilities to decentrate and self-reflect in the "smartphone" generation, if you believe Jean Twenge, the author of "iGen", are very limited,

because the period of egocentrism is extended. Thus, the following question arises: to what extent the students' answers and statements can be treated as scientific "data". All the more so because the students were asked or made statements on issues very complex from a psychological point of view: "resilience and flexibility in the coping with situations of uncertainty and with frustrations and the development of creative thinking in the solving of problems that appear during the inquiry and to overcome the situation of uncertainty or powerlessness." p. 374). I believe that the doctoral student is aware of these limitations, and therefore uses triangulation to verify the objectivity of the information obtained. Still, however, these data remain a text rather than parameters. The text should undergo further qualitative "processing"; without it we are only dealing with the incompleteness of cognition.

### *The category of development*

One of the key categories used in the dissertation is development. Development is also a key category for pedagogical thinking. At the same time, it is rarely defined in the pedagogical narrative. Development was not defined in the dissertation under review, either. The doctoral student used an intuitive approach, which is also the most common approach in educational practice. However, while the teacher or educator can understand development *implicitly* (as a derivative of acquired knowledge in the course of getting a profession and many years of practice), teenagers, when asked about developmental changes, do not necessarily have to accurately answer the question about development. They may simply not be able to distinguish development from change, and not all change is development. Expanding knowledge and skills do not have to be tantamount to development. In other words, students' answers to the questions about development in various aspects of their activities should be "put through" the filter of the researcher's knowledge to determine which of the declared changes can be defined as developmental (even if the doctoral student did not define the criteria according to which a change could be described as developmental).

### **Conclusion.**

The dissertation is an original and valuable approach to the issues highlighted in the subject. The doctoral student showed pedagogical knowledge and methodological reliability, the ability to organize the content, the ability to conduct scientific analysis, and the ability to communicate clearly. Despite some shortcomings identified in the review, the work is a valuable and original contribution to pedagogical knowledge.

Taking into account all the above statements, I consider that the doctoral dissertation under the title "Learning to Become a Physics Inquirer: Environment, Process, and Challenges", submitted by Ms Michal Sigron and written under the supervision of Prof. dr hab. Stanisław Dylak, meets the requirements of Art. 13.1. of the Act of 14 March 2003 on academic degrees, the academic title, and degrees and titles in the field of arts (Journal of Laws of 2016, item 882, as amended). Therefore, in view of the above, I request that Ms Michal Sigron be admitted to the further stages of the doctoral dissertation.





