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PECULIARITIES AND DIFFERENCES OF TEACHING MATHEMATICS IN GERMAN AND UKRAINIAN EDUCATION SYSTEMS

Abstract. *This article considers the problem of adaptation of Ukrainian pupils to the educational system of Germany. It shows that the problem of adaptation is related not only to language problems, but also to the differences between the Ukrainian and German educational systems, which causes considerable problems among migrants.*
Key words: *education, migrants, mathematics, learning process.*

Introduction. Due to the current situation in Ukraine, namely with the war with the Russian Federation in 2022, quite a large number of people have left in search of a safe life. The women with children of school and pre-school age were a main contingent, and a large part of this population settled in Germany.

Thus, according to sociological surveys, 66% of the people who have left are women with children, and about 37% of them are under 18 years of age, and they must attend different educational institutions [1].

And this problem has been particularly acute since August-September 2022. Thus, the majority of children from Ukraine went to Ukrainian schools online between February and August 2022, and lot of them didn't attend schools in Germany, and the main influx of Ukrainian pupils to the German schools came in August-September 2022.

In addition, about 26% of Ukrainian families plan to continue living in Germany after the end of the military conflict, which means that Ukrainians will continue to study in German schools [2]. Of course, the issue of language is one of the key problems in solving of the adaptation problem but it is not the aim of this article to explore and discover this problem, because it is a natural problem that arises everybody when somebody is moving to a new country.

It is much more important to understand how much the curricula and teaching methods of German and Ukrainian educational institutions are different. It is necessary to do a comparative analysis of the teaching of a subject in Ukraine and Germany for realizing this.

The aim of the study is to make a comparative characterization and to find out the differences and overlaps in the curricula and methods of teaching mathematics in Ukrainian and German schools. And as a result to answer the question: "Is it easy for any child to integrate into a new educational environment? When and under which conditions is it better to do it".

The materials and methods for the study are an analysis of the mathematical literature on the research question and also our own experience in the respective educational structures of the two countries.

Research results. The analysis of the

literature and our own experience in the respective educational structures in Ukraine and Germany has shown that there are significant differences in the very methods of teaching the subject, in its content, in the requirements for work and examinations. And these requirements are more significant in the upper grades than in the lower grades. And the meaning for successful adaptation in an educational environment only an existence of sufficient level of language proficiency is enough is a wrong perception.

Discussion. Mathematics as a discipline for this study was not chosen by chance. Firstly, mathematic is one of the basic discipline and its "language" is universal throughout the world. Secondly, mathematics is a science of more numbers than words, which is why it is probably the easiest to adapt to in a new environment.

Let's divide the learning period of pupils in Germany into three parts: Grades 5-6; Grades 7-10; Grades 11-13. It we are talking about the 5th and 6th grades, then we can say an average child with a good knowledge of German can fit into the German educational system without any big problem.

The teaching methods in the German school are similar to those of Ukrainian schools at this stage. There are some differences, but they are insignificant. Therefore, we will not do well on them.

After the 6th grade the pupils are divided into two main categories: Sekundarschule und Gymnasium. The structure of the Sekundarschule will not be discussed in detail. It is only necessary to point out the fact that the level of education itself is extremely low, with the expectation that pupils who study at this level should acquire elementary skills, and in the future should obtain a simple working profession. We shall focus on those pupils who follow the direction: Gymnasium and Abitur.

Thus, in the 7th Grade are a more significant difference in the topics and features of the subject presentation. Such sections as "Vektoren", (studied in the 8th Grade of Ukrainian school), and areas of flat figures: "die Flache des Parallelogramms, des Dreiecks, des Trapezes, des Vierecks" are already included in the curriculum. Again it should be noted that with a sufficient level of mathematical preparation it is not difficult to "catch up" with the missing material (it is presented quite simply in these classes). The only problem that can realistically arise in 99% of the cases, which simply needs to be addressed beforehand, is the problem of translation and comprehension of German mathematical terminology [3].

Firstly, there is sometimes a total discrepancy between German mathematical definitions and English definitions (even though the languages belong to the same linguistic group), and secondly the impossibility of "direct" translation of some concepts.

For example, one of the sixth-grade problems had to be solved with Dreisatz, and only the attached solution to the problem made it possible to understand that this is how an ordinary proportion of the form: $\dfrac{a}{b} = \dfrac{c}{d}$. In the second stage (grades 8-10) the situation becomes a little more complicated.

First of all, this again refers to the inconsistency of mathematical terminology. In Ukrainian education there is such a mathematical concept as "zeros of a function" (points where $f(x) = 0$) in German it is defined as Nullstelle [4, 5].

Accordingly, there are other points which are called 'argument zero' (points where $x = 0$). But such definition expressed in one word isn't exist in German educational language, and an example in this case would roughly look like this: Bestimme den Y-Achsenabschnitt der Funktion $f(x)$. But the notion of

Nullstellen can also be found in another sense. Thus, for a function $f(x) = \dfrac{(x+3)(x+1)}{(x-2)(x-3)}$, if the points $x = 2, x = 3$ are Nullstellen des Nenners, and the points $x = -3, x = -1$ are the zeros of the numerator: Nullstellen des Zählers. But if, for example, we change the condition of the problem a little bit and it looks like this: "Finden Definitiosnbereich der Function": $f(x) = \dfrac{(x+3)(x+1)}{(x-2)(x-3)}$ In this case, Nullstellen des Nenners are the points of discontinuity of the function (Polstelle) or the points where the function is undefined.

Another example. For example, if a Ukrainian pupil tells about Exponente, it's mean only a function of the form $y = e^x$, while in the German school it looks like this: Exponente is the number 2, for the function x^2. And in this case, the German definitions aren't equal not only the Ukrainian (Russian) definitions, but even the English ones. Without knowing this, it is possible to get the task completely wrong. In general, it's necessary to pay attention about the love of German mathematics to investigate of lot of kinds of functions. For example, in a German mathematics course (8-10 grades) on Gleichung einer Hyperbelfunktion, pupils not only construct a function of the form $y = \dfrac{k}{x}$ itself, but also study more complex functions of the form: $y = \dfrac{k}{x+a} + c$ and find senkrechte Asymptote, and waagrechte Asymptote.

And German pupils study the theory of limits in the 10th grade for this already: Linksseitiger (rechtsseitiger) Grenzwert an einer Polstelle, Verhalten der Function im Unendlichen. It should be noted that this kind of asymptotes is studied in the Ukrainian curriculum in the first years of universities [6]. Additionally, topics such as Binomische Formel, Logarithmen, Polynomdivision (grade 11 of Ukrainian school) are studied between grades 8 and 10.

We would like to pay special attention to the Kurse für Wahrscheinlichkeit Theorie, which is studied as part of the 10th-13th grades of a German grammar school, but many of topics from this course correspond to the first year of a Ukrainian university and they are greatly different in their presentation methodology [7]. One the positive side, there are a lot of topics in grades 8-10 that correspond entirely to this same interval of study in the Ukrainian school and they are very simple in their terminology, not at all different in the way they are presented, so it is easy to understand them. These are topics such as: Lineare Gleichungen (Ungleichungen), Lineare Function, Bruchterme und Bruchgleichungen, Quadratische Gleichungen and others. But, for example, Trigonometry (Kurse fur Sinus, Kosinus, Tangens), on the contrary, is more fully represented in the Ukrainian school. The course: Kurse fur Geometrische Orte will not be discussed in detail, we will only note that it is quite simple, and practically corresponds to a similar course in the Ukrainian school. Thus, three main differences appear clearly in the upper grades already: a discrepancy in topics, difficulties in lexical translation, and sometimes a different way of presenting the material. As the grade increases, the difference between the German school and the Ukrainian school becomes more and more pronounced, and when you consider that there are significant differences not only between topics but also between definitions, and even a good knowledge of English and mathematical literature in English is often not saved, and it can be argued that already when determining a

child's grade above eighth without prior preparation there may be considerable difficulties

In this case, if a pupil is "above" the 8th grade, he/she either has to be clearly prepared for the German curriculum at school, or he/she has to be at least one grade lower. In addition, pupils have to pass a transitional examination (for admission to upper secondary school and for further studies at a university). Especially those children who get into the upper grades (Abitur classes) will find it very difficult. This is because the structure of Abitur is radically different from the mathematics exam EIT (External Independent Testing) in Ukraine, and it can have happened that an excellent Ukrainian mathematics student will fail the exam than pass it [8].

In Ukraine, for example, the EIT in mathematics is divided into three main parts. The two first parts of the three covers the whole course of school mathematics and may include fairly easy tasks at the level of 6th-7th grade. For example, reduce a fraction, or simplify an expression. In addition, the first two parts have answers (test form) and there is simply an opportunity to guess the right answer.

The Abitur exam is only aimed at assessing and determining the level of knowledge of applicants who want to pursue university studies, so the German Ministry of Education does not consider to include tasks at Grade 6-7 level, where the pupil has to demonstrate his or her ability to reduce fractions. The tasks of the Abitur exam are based only on the knowledge of upper-secondary school grades 10-13, it has no test part and it is not possible to pass the Abitur in mathematics if you do not know it well enough, a good knowledge of secondary school mathematics will not help[9].

Conclusion: The analysis of mathematics courses in schools in Germany and Ukraine and their subsequent detailed comparison allowed us to draw the following conclusions: the structure of German and Ukrainian education is quite different. It differs not only in the complexity of translation of individual terms and definitions, but also in the content of topics and methodological peculiarities of material presentation.

Whereas in the lower and middle grades it is possible to move from "grade to grade" without losing a year of schooling, in the upper grades such a move is not only inappropriate, but can also lead to quite negative consequences for the student himself/herself.

Prospects for further research: Thus, it is clear that the integration of migrant children into German education is a very complex and multifaceted process which requires not only further research, but also the adaptation of the German education system and the introduction of additional subject support for migrant children.

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