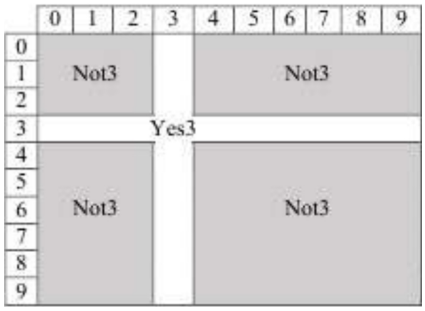

Figure 7: Definition areas of Not3 and Yes3 classes.

for automatic detection of hidden interpretable patterns in the training data set. The revealed patterns can be used then to construct a classification algorithm.

The learning algorithm for identifying combinations of features that have the property of class distinction is described. As a result of analyzing the training data set, the informativeness estimates of combinations of distinguishing features (from the point of view of classes) are automatically calculated and a classifier is built.

Based on model data, the results of applying the developed method to solve the classification problem are presented.

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ПРИНЦИП ОБЩНОСТИ СВОЙСТВ И KD-КЛАССИФИКАЦИЯ

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В работе исследуется актуальная проблема автоматического обнаружения скрытых интерпретируемых закономерностей в интеллектуальных системах. Концептуальную основу процесса обучения по прецедентам определяют способы описания и разделения классов. Известны три базовых принципа: перечисления членов класса, общности свойств и кластеризации. Предлагается оригинальный метод реализации принципа общности свойств, основанный на поиске сочетаний признаков, обеспечивающих различение классов. Эффективность подхода подтверждается результатами численного эксперимента.

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Interoperability as a Critical Component of the Educational Process in Secondary Schools

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***Abstract*—The paper presents some results of an analysis of the role of the development of interoperability, cognitive abilities and emotional intelligence in children in a modern school. The importance and ways of introducing technological tools with capabilities for interaction and data exchange to optimize the educational process are discussed. The significance of the development of cognitive abilities and emotional intelligence of students and the impact of this on their academic achievements and social adaptation are also considered.**

***Keywords*—Education, interoperability, cognitive abilities, emotional intelligence, intelligent educational systems**

I. Introduction

School education is an initial and very important stage, which forms the basis for all further development of an individual's education, exerting a significant influence not only on his future activities as a specialist in a particular sector of the economy, but also as an individual, a member of society. It is at school that "the intellect is formed, which is a combination of various functions (sensoryperceptual, mnemological and attentive)" [1], and the personality itself is formed. It is the complex development of the individual, the combination of professional, technical, and personal, universal knowledge and skills that determine the success of a modern person, his ability not only for his own development and improvement, but also for the development and improvement of society in all forms of its existence [2].

In the process of digitalization of education, a variety of tools, methods and technologies are used, largely based on the use of artificial intelligence algorithms. Such types of training as network and electronic are being developed, which include not only the direct educational part, but also means of automating the learning process itself. At the same time, often "behind the scenes" there remains such an important issue as the education of an individual capable of thinking creatively, being able to organize one's own learning process, and also working in a team, distributing tasks, negotiating, explaining his point of view, justifying his decisions. In fact, when considering the development of digital platforms and intelligent educational systems, we should talk about the human interoperability. It is becoming increasingly clear that interoperability is necessary both to create a single barrier-free information space based on the principles of openness, transparency, multi-purpose use of data, technological neutrality, and to ensure the priority of user interests, information security and protection of privacy [3]. The study of the development of the properties of interoperability, cognitive abilities and emotional intelligence starting from childhood is increasingly relevant with the development of society and the transition to the sixth technological order, in which the leading role is given, along with information and nanotechnologies, to cognitive sciences and socio-humanitarian technologies.

The main goal of the present paper is to give an analytical overview of the role and methods of development of secondary school students' cognitive abilities along with the emotional intelligence and interoperability. Another idea was to determine some basic concepts within the interoperability as a subject area and the property of a school student.

II. The cognitive abilities level and the interoperable behaviour. State of art

According to the American Psychological Association Dictionary of Phychology, cognitive ability is defined as the skills involved in performing the tasks associated with perception, learning, memory, understanding, awareness, reasoning, judgment, intuition, and language [4].

People are engaged at every step in the data value chain in collecting, analyzing, interpreting, and using data. In many cases, people themselves are data points. All these people bring perspectives, values, world views, and expectations, which are also embedded in political and organizational cultures. If we want data to work together, we need people to work together. We need human interoperability [5], [6].

Emotional Intelligence (EI) is the ability to manage both your own emotions and understand the emotions of people around you. There are five key elements to EI: self-awareness, self-regulation, motivation, empathy, and social skills. People with high EI can identify how they are feeling, what those feelings mean, and how those emotions impact their behavior and in turn, other people. It's a little harder to "manage" the emotions of other people — you can't control how someone else feels or

behaves. But if you can identify the emotions behind their behavior, you'll have a better understanding of where they are coming from and how to best interact with them [7].

Let us consider some characteristics of preschoolers and schoolchildren, depending on their age, from the point of view of developing the ability for interoperable behavior.

Even in preschool age — about 4-5 years — the child begins to understand that other people may have opinions, thoughts, and desires that are different from his own. This ability to understand and accept differences in people's thinking develops as we grow older. Some researchers note that the better developed such mental empathy is, the higher a person's academic performance at school and university [1], [2], [4], [5], [6], [7], [8], [9], [10]. This ability helps build relationships of mutual understanding and involvement, participation between mentors and classmates, leading to the perception and understanding of tasks and requirements.

The younger schoolchild (6 – 10 years old) is characterized primarily by readiness for educational activities, i. e. he is ready to study systematically. It is also the ability to accept new responsibilities, which underlies the educational motivation of a primary school student. This period is the most important for the development of aesthetic perception, creativity and the formation of a moral and aesthetic attitude towards life, which is fixed in a more or less unchanged form for the rest of life. In elementary school, the younger student develops forms of thinking that ensure the further assimilation of various knowledge and the development of thinking. At this age, you can also develop the student's self-organization and self-discipline skills, for example, through group games, encouraging healthy curiosity, and interest in all kinds of creative activities.

In middle school age (from 10–11 to 14–15 years), communication with peers plays a decisive role. The leading types of activities are educational, social and organizational, sports, creative, and labor [1]. During this period, the child acquires significant social experience and begins to comprehend himself as an individual in the system of labor, moral, and aesthetic social relations. He has a deliberate desire to take part in socially significant work, become socially useful, and interact in a team.

In the period of early adolescence (from 14–15 to 17 years), value-orientation activity, which is determined by the desire for independence, acquires key importance. The main components of this period are friendship and trusting relationships. This is the stage that many authors call the final stage of personality maturation [1], [2], when professional interests are clearly formed, theoretical thinking, the ability for self-education, the ability to reflect are developed, the level of aspirations is formed. At this stage, a person is able to formulate his demands, interact with other members of the team, forming personal connections, for example, friendship, sympathy.

Each of the stages of learning and growing up should be accompanied by the acquisition of interaction skills in teams, not so much for the purpose of competitively achieving the result of joint activity, but for the purpose of teaching a person to look for the best, including joint, solutions to assigned tasks. That is, the main goal and task of an interoperable person is the search and implementation of the best solution in the given conditions and given the available opportunities, and not a competitive struggle for the implementation of one's own idea. At the same time, this approach should not teach children to abandon their own position, opinion, or belittle their ideas and achievements. An interoperable personality with a high level of emotional intelligence must be able to combine the ability to appreciate the personal and the collective.

Successful learning, cognitive abilities and emotional intelligence are deeply interconnected. There are many studies aimed at studying cognitive functions and their importance in the cognitive process [7], [8], [9], [10], [11]. Thus, work [7] shows that academic performance in various subjects (mathematics, reading, writing) has a strong dependence on the level of development of cognitive functions. The same work indicates that working memory affects academic performance more than intelligence level (IQ).

In [8], the authors provide research data on the development of cognitive abilities depending on age. The results were obtained based on an analysis of data from four large research projects, which tested about 11,000 people aged 8 to 35 years. It was noted that the most rapid development of the executive abilities of the brain occurs at 10-15 years of age; at 15-20 years of age, development slows down, and by the age of 20, cognitive functions begin to stabilize and reach their maximum level of development. Next, the person uses those skills—the executive functions of the brain—that he acquired at an earlier age. This is a clear confirmation of the need to develop cognitive abilities starting from preschool and especially at school age. It is during this period that a strong foundation can be laid for further successful cognitive and creative human activity.

Interoperability refers to the ability of different systems, programs and technologies to interact and exchange data without communication and semantic difficulties. From a technical point of view, in the context of school education, this could mean that different educational platforms, applications and resources need to be interoperable and able to exchange information with each other. This allows students and educators to use a variety of tools and resources to enhance learning and knowledge sharing. According to information technology standards, for example [12], "interoperability is the ability of two