BRAINS² TÜRKIYE

ARTIFICIAL INTELLIGENCE PROGRAM APPLICATION PROJECT - I

ARTIFICIAL INTELLIGENCE IN EDUCATION
STRATEGIC TRANSFORMATION AND ECOSYSTEM

EĞİTİM, SANAYİ ve TEKNOLOJİ ENSTİTÜSÜ
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APPLICATION PROJECT - 1

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* **BRAINS² TÜRKİYE** is a brand/initiative with multi-programs based in Turkey which develops market, ecosystem and capacity in the 'Biotechnology', 'Robotics', **'Artificial Intelligence'**, 'Nanotechnology', 'Space' and 'Strategic Services' fields. The programs planned through identical visions and strategies for each main fields which transforms the new business models and multidimensional power distribution in the global economy, are implemented under the common title of **BRAINS² TÜRKİYE**.

BRAINS² TÜRKİYE Artificial Intelligence Program will analyze which AI fields would provide highest potential for future growth and which benefits can be gained from this growth by the Turkish AI sector, through considering Turkey's available strength and potential both in academic and industrial sectors.

Upon determining the industrial fields together with their sizes and scales as a result of the studies performed towards discovering the idle potential of AI industry in order to find the most reasonable and promising interests for the National Artificial Intelligence Sector and to increase the efficiency of the private and public sector; such determined industrial fields shall be considered as the sectors which might have the strongest contribution to the competitiveness of the country, the efficiency of the economy and the welfare of the nation.

First of the priority application projects planned under the **BRAINS² TÜRKİYE Artificial Intelligence Program** was carried out with the title of "**Artificial Intelligence in Education | Strategic Transformation and Ecosystem**".

Education is one of the most discussed topic in our country in recent years. Millions of students - parents - teacher mass aside, this interest for the Turkish people in general it has become; education issues constitute the main agenda of our country. In this case, the meaning we give to education; for us, it goes beyond teaching only as a corporate, has begun to be perceived as **the future of the whole country in terms of economy and administration**.

This has led to the rapid transfer of industrial products and concepts to the education sector. The concept of "**Industry 4.0**" term, self as "**Education 4.0**" also placed it on the agenda of schools. What does the school take out of this digital transformation and how the debate on the need to follow a path. Many different ideas on the subject have been shown off without strained. Perhaps the most remarkable point here is the introduction of education programs in the field of informatics. The current developments in the information sector emerged with the idea of adding to the field of education, but many training programs that do not prove useful are the result of this issue.

This is the case with teachers and educational scientists, high technology it is sufficient to mobilize their products not only to be their users, but also to reshape them for their own needs. Theory and practice of education areas have their own processes and needs. The main purpose of the Project is; **which artificial intelligence applications can be developed to meet educational needs the evaluation was determined as**. Particular attention should be paid to three points.

Data Acquisition

The **most basic requirement** to create artificial intelligence algorithms is to provide sufficient data. In this process when we talk about education; students, teachers, parents, collect data from many educational stakeholders such as school employees, managers, employers will be the subject. At the beginning of this process, setting the criteria for each stakeholder is a priority. For example; recording a child starting school today, he or she starts his or her education life without any information except for his demographic information. Assessments are made over time and are based on teacher observation. There is no mechanism to show how different observations are for each student. For this reason, the data collection from early ages and the teaching of these data in terms of factors that will affect the learning. It is essential to use it as long as you give feedback. Periodically collected data; It is envisaged that students will be used to determine their readiness, to predict academic achievement and to take measures, and to make a decision in course - field - department choices.The most important step to be taken to realize this phenomenon is; establishing "data collection policy" for education stakeholders. This policy; students, teachers, parents, school collecting and processing data from many educational stakeholders such as employees, managers, employers, storage and transfer procedures.

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Various opinions and expectations of all stakeholders which are considered to have a direct impact on education, ensure that the data is used only for the content, process and evaluation of the training. Students' physical (health, genetic, etc.), emotional (psychology, motivation, perception, attitude, etc.), social (socio-economic environment, family characteristics, etc.) measurements; protection of personal data, protection of privacy, the freedom of belief, the right to use effective remedies, should be taken.

Finally, the legislation for the protection of personal data and the relevant technology assume all administrative and technical protection measures required by the nature of the data the institution needs to be determined. The comprehensive data collected is based on data understanding in a general understanding of educational policies. Artificial intelligence and learning process, as well as the opportunity to make policy the basis of the software will be developed. Besides training in Turkey there is an OECD **Online Training Database** to improve research quality. This database has been used contains data on the raw data used in the preparation of **Education at a Glance** reports and indicators on the education system. The aim is that the individual researchers will be able to collect data from a large and detailed data collection. Researchers using this database; country-specific or international students using variables such as age, gender, type of school, age at school, student-to-teacher ratio make inferences.

Transformation of Teaching Profession

Teachers do not have their own professions due to artificial intelligence or other high-tech products the need to be relieved. The use of technology in education the main purpose of the dissemination is to **support the teacher in the teaching process**. Teacher preparation of content in the teaching process, pedagogical maneuvers and evaluation various software and hardware. The aim here is teacher, moving further from the size of the practitioner; to make him a **teaching designer**.

Personalization of the Learning Process

In education, discussions on "**personalized education**" is one of the potential uses of artificial intelligence. Data collection and collection of data on student development for "personalization of education" The methods used in the process of "Instructional design", which are shaped by the content, process and determination of the product, are discussed.

Use of Genetic Data

Data can be collected from several different sources. For instance, it can be oriented into characteristics of an instructor, conditions of the educational environment, effectiveness of the education method or characteristics of the learner. Each field provides significant clues with regard to learning in itself; and, the current state in each of them must be known to be able to explain one of the cases.

The most important reason underlying usually getting the mistaken results of decisions about education and frequent changes in education is the fact that the decision made does not focus on learner, instructor, learning environment or instruction method; but focuses on only one of them. Consequently, an intervention which does not comprise alternative situations cannot be as influential as expected.

In order to start the study, if the **measurement of the learner characteristics** is taken into consideration in the first place; measurements can be made on different variables such as intelligence, interest, motivation and success. However, these measurements have a risk of changing from one measurement to another because of the individual's own development, the characteristics of the test and the environmental factors.

In today's technology, **determining the genetic characteristics of the learner** brings great ethical debates with it on the one hand; on the other, it is perhaps the easiest matter to determine since the genetic material never changes from birth to death.

The cost of the tests to identify gene sequences in a human being was at a level of million dollars in the early days of genetics studies. Yet, at the present time, the cost has decreased to the level of 100 dollars in some companies (23 and Me, Genos, Veritas Genetics, Ancestry DNA, Living DNA Review, Home DNA review, My Heritage DNA, etc.). In fact, people can attain a lot of information about their genetic constitution even without leaving their house; it is possible with a drop of saliva to be placed in the sampling tool in the box which was shipped by cargo.

Today, many parents, especially parents from families with a high risk of genetic disease, apply tests **to diagnose genetic diseases** before birth. The increase of awareness about these issues day by day brings to mind the questions of "How likely is it that increasing number of estimation methods which are cheaper, which give faster and more reliable results affect education?", "How can the data be collected, preserved and used?".

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Researches that were conducted on 240,000 people show that there are 22,000 genes in a human body. Genetic studies have focused especially on "intelligence", which is seen as a learning capacity. Researches have been identified **the existence of 500 genes affecting the learning potential** out of 22,000 genes. These genes are related to some features like "intelligence", "some personality characteristics", "five sensory acuity"; and, these genes have the potential to be activated or to be kept recessive depending on the environmental impact. The presence of one or more of the 500 genes identified in a person does not mean that they will have a superior-high intelligence or a special talent.

In order to learn or develop a skill, the newborn human infant has two determinant factors. One of these factors is genetic and the other is the environmental (epigenetic) factor. Recent researches have deduced that **the genetic factor on intelligence is effective at 60% level, whereas the environmental factor is effective at 40% level.**

While scientific studies have been trying to explain the effects of genes on intelligence, which is regarded as learning and learning capacity, it has been seen that the effect of environmental factors is at least as important as the genetic basis. In addition to this information, the effects of genetic factors on intelligence can be seen more clearly in conjunction with age- going from childhood to adulthood. By taking into consideration these reasons, it can be assumed that only the individuals being supported by appropriate environmental conditions that will lead to the existence of genetic predispositions can actualize their capacities at the highest level.

The Human Genome Project (HGP), which began to do its researches in 1988, has set an example for many scientific studies. Over the past 30 years, gene studies have come a long way from generating more intelligent, healthier, faster etc. babies to the preparation of personal treatments and personal medicines. The utilization of genetic data for health is one of the most important issues that occupy a place in the agenda of the health sector. Collection of data that have an influence on learning processes such as data collected for personal treatment methods can be served as an example for **personal education**.

Then, is it possible to carry out the procedures, which are conducted for the collection of bioinformatics, for education? If we consider the potential of cheaper and easier access day by day, what can keep us away from taking a DNA test, of which price decreased to 10 dollars in a decade and which involves a "report of learning potential"? The topic has been analyzed under three subtitles to be able to explain the questions just as "What should we do if we face with the people, who are like today's parents' having their children taken intelligence tests and coming to schools by declaring their children have a superior-high intelligence, that come to the schools with these test reports?", "Is this a scenario which can be prevented or should be prevented; or, is this a situation that is extremely possible and extremely soon?"

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1. Technical Information

Developments in the field of genetics have progressed in the identification of genes today. "It is not just the detection of genes that can cause disease in the advancing ages, but changing them", "the selection of the embryos with healthier genes and being born of those genes" are examples for the ordinary news. The fact that human DNA has turned into rewritable information from a readable information has enabled to the production of "specially designed" people.

The knowledge for being able to do "**gene design**" like creating a new genetic information, designing an artificial gene, and altering a part of an already existing genetic information has been produced thanks to the fields of molecular biology, engineering and bioinformatics. This information has initiated a major transformation in the health sector; and, it has the potential to influence other areas such as education in the near future.

2. Ethics

The news about generating babies who are more resistant to some diseases as a result of intervention to embryos with the CRISPR-Cas9 method has been widespread throughout the world. These researches, which are thought to have been made in a kindly and humanist way, have caused great social problems in some periods of history. The serious problems that the scientific community known as "Eugenics", which was established with inspiration from the ideas of Francis Galton, who worked on intelligence and the hereditary effects of intelligence (1883) caused in society cannot be ignored.

It had become a government policy in the USA to intervene the African-American people - without giving information- in addition to the mentally-impaired, visually-impaired and hearing-impaired people under the name of "**genetic sterilization**" at the beginning of the 20th century. Similar ideas also lie behind the genocides in Europe during the World War II.

Although the utilization of genetic data in education is technically possible in today's conditions, the ethical debates and the inability to make an estimation about the way using the information properly constitute the greatest risk. There is a very high risk of making decisions that will deeply affect the social structure like having people with certain genes special trainings and making a separation of those who have less of the desired gene sequence. The fact that there is not a consensus on confidentiality in the collection of genetic data and personal information and prevention of misconduct is the biggest threat to the scientific studies.

3. Systemic Operation

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It is possible to create educational environments in which individuals can maximize their potential by revealing genetic predispositions. Theoretically, even if it is possible to collect genetic data and support them with an organized educational environment for the reveal of genetic predispositions, this will necessitate a completely new order within the general system of education.

Another important issue is the processing of the collected data. Since it is not possible to process the collected data with simple operations, the use of artificial intelligence systems in these regulations in the educational environment is extremely important in decision-making and in determining alternatives. It will not be possible to use the collected data effectively if it cannot be modeled.

As a summary, the information we receive about a child, who starts school today, in order to determine qualifications of the learner is such limited to credentials and basic family information that this information does not give the slightest clue about either the learning potential of the child or the educational life of the child in the future.

If we suppose that the main purpose in education is to "ensure the potential of the learner to develop at the highest level", the genetic characteristics of an individual can be determined in order to increase performance of learning, identify strategies that will enable faster, easier and deeper learning.

Can genetic information enable us to reach those who have completed their educational life without being aware of their own abilities within the education system? For instance, can this information be used to give a chance to those who have the genes that constitute the musical talent but have lived until now without even touching a piano?

While the personal characteristics in the genetic basis, the five sensory acuity and the characteristics determined by the learning potential can be a starting point for the personalization of education, it will also lead many ethical debates to emerge.

Due to the fact that not every country, every university, every research center has the same technological facilities for gene studies, those who has this information has also the power to control it. This power can be used in various ways; from producing a genetically modified human being to creating an appropriate educational environment that will reveal the genetic basis that an individual has.

The studies on the construction of future learning environments have shown that; the **transition from mass instruction to personalized learning** is not possible to regulate and manage with mere human labour. Therefore, new algorithms for education will be required in order to plan the learning process of the learner characteristics..

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Natural Language Processing

The speed of development in intelligent systems in the digital era has increased the studies on language. Starting from Linguistics, these studies begin with an examination of the structure (grammar, phonetics, syntax, content integrity, etc.) of the language (Turkish, English, etc.). Subsequently, Computational Linguistics (Statistical Natural Language Processing), turning the language into mathematical statements by subjecting the information obtained from linguistics to statistical analyzes.

In Natural Language Processing, the information obtained from Linguistics and Computational Linguistics is used to enable computers to perform linguistic operations in a more humanoid (imitating a human) way through machine learning. **Natural Language Processing** (NLP) has started to be used in many different fields such as Sentiment Analysis, Answering a Question, Information Retrieval, Machine Translation, Text Summarization, Text Classification.

When examining, "intelligent" language approaches used in educational environments, it should be to consider two different perspectives: "**learning**" and "**teaching**". In the perspective of "Learning", it is necessary to examine the practices aimed at people who are with the aim of learning something and at the point of "Teaching", for the purpose of teach something, it is necessary to examine the practices aimed at increasing the level of effective and comprehensibleness and often assisting the educator.

Nowadays, **online education platforms, synchronous and asynchronous e-learning systems and distance education programs** are extensively encountered. Each of these environments is a system that requires communication with the student, mostly through texts, by way of an intermediary virtual environment. At this point, there is also a need arises which is evaluate the texts that we encounter as a means of communication.

Automatic detection of inappropriate and/or profanity sharing in the texts shared by individuals for the purpose of communicating in educational environments called "**virtual classrooms**" on these related platforms and preventing the sabotage of the educational environment is one of the examples of Natural Language Processing applications.

When evaluated with a wider perspective, substantial inferences such as, analysis of the student profile and the level of interest of the participants to the course by monitoring for a certain period of time the textual sharing of these participants whose physical behavior is not examined, determination of the potential to exhibit anomalous behavior to disrupt the environment can be made by Natural Language Processing methods. In addition, situations that make learning level difficult and slowing down such as dyslexia and attention deficit can also be detected automatically by long-term monitoring of the misspellings that people frequently make.

Especially in foreign language education, reading comprehension and exercises to express thoughts in writing with different sentences are often applied to people. These exercises enable the assessment of many metrics such as individuals' vocabulary breadth, the level of grammar, the ability to make correct sentences, and the determining whether the text is correctly comprehended. Educators' determination of this information from the texts written by the students, a challenging process bring along with.

Yet, with the Natural Language Processing methods, processes such as semantic similarity between the two texts, synonym identification, related word analysis, grammatical errors detection can be performed easily and with high performance. This situation makes it possible to automatically evaluate and grade the written texts adhere to certain criteria. **Automatic Spell Check** applications such as "Grammarly" and "The Writing Mentor by ETS", can perform processes such as find grammatical errors in the written texts and suggest synonyms.

It is possible to say that in our world where 2.5 exabytes of data - for easier understanding; it is up to about 250 thousand US Library of Congress - are produced every day, it is very difficult to do research on any subject. While determining which of the millions of sources in digital environments is reliable is an issue of itself, bringing together the information obtained from all sources is a process that is almost impossible. Especially in the digital era, where technology is developing at an incomprehensible speed, being able to follow the developments can be a source of stress for educators who striving to transfer the most up-to-date information to the students. Produced to minimize these problems, **Text Summarization** enables you to access summary information about a topic within seconds by using software, only keywords, various optional date filters, and which resources to use. One of the significant points here is that the semantically close ones of the data in the sources are brought together in a certain order and presented to the end-user.

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In order to reinforce what is learned in educational environments and develop power of creative thinking, assignments are often given to students by educators. While these tasks sometimes require researching a topic and bringing together a lot of information from different sources, as well as they can sometimes be a role in developing one's creativity too. It is a very easy and preferred method for students to gather information from digital sources that sometimes secure and often insecure, especially for assignments that require different sources to be scanned. At this point, control mechanisms such as **identifying the source from which the information is obtained** (detection of plagiarism) and Natural Language Processing applications that help educators have been developed. Following the topics teaches to the students during the semester, many students' nightmare; exams step in to determine how much is learned by the students. Exam periods are seen as stressful for students as well as a very exhausting process for educators.

Question-making and Question-answering Software that accepts the course notes in texts as input, comes to the aid of the educators. There are, for sure, solutions to help the students who get lost in hundreds of pages of textbooks and lecture notes during the exam period. At this point, Natural Language Processing applications, which successfully perform the Text Summarization task, are become available to service.

While the control mechanisms that help the educators develop, systems that ease the work of the students continue to develop rapidly on the other hand. While Natural Language Processing eases human life in many subjects, it can gateway to the come about of practices that provide ease to students in the field of education, but which in reality have negative effects in developing learning skills.

For example, automated **Article/Notice Writing Applications** that require only keywords to be submitted are already in use, and even notices created with these systems are accepted at international congresses!

On the other hand, Machine Translation is yet another application that provides great ease especially in the translation of international education resources into the native language and it has shown great technical progress in recent years. However, on the long term, there is also the possibility that people may weaken their ability to form sentences and express themselves in a foreign language.

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With Natural Language Processing, in addition to applications such as Answering a Question, Information Retrieval, Machine Translation, Text Summarization, Text Classification, different sectors can develop new applications according to their needs. For example, Banks carry out many banking transactions of their depositors through "Digital Assistants". In the education sector, **Digital Assistants** are used to meet the learning needs of a subject; it simulates interaction with the teacher and personalizes learning by providing learner - teacher communication.

For example, while "My Science Tutor" developed by Boulder Language Technology helps students in science lessons, applications like "Alphary by Alphary GmbH" are used in foreign language learning.

One of the uses of Natural Language Processing in education is the evaluation of open-ended exams. Open-ended exams can be prepared in the form of essay or question-answer that students form according to their own answering style. This method is considered more challenging by students as it requires higher-order thinking skills than multiple-choice questions or gap-filling questions.

The extent of multiple-choice exams is broad, objective scoring can be done, it has high reliability and easy to evaluate. But it does not reflect the learner's perspective and the world of ideas. These questions cause increase the number of students who focus only on a certain point and cannot see the other extent of the fact (Berberoğlu ve İş-Güzel, 2013). The extent of open-ended exams is limited but useful for evaluating productive skills. The scoring of these questions depends on the evaluator (subjective) and therefore its reliability is low. For educators, it is difficult to evaluate the open-ended exams, and for students, it often seems difficult to answer and unfair to evaluate (Berberoğlu ve İş-Güzel, 2013).

There are multiple answers to open-ended questions, and what is important here is to see how the person receives the information and expresses himself/herself to the other one, whether his/her experience is enough and how successful he/she is in transferring it to the other one. Although it provides more information on learning for educators; long time spent for evaluation has become a less preferred method over time due to crowded classes and heavy work load density. However, in more recent times, the number of studies that draw attention to the strengths of open-ended exams and mentioning its re-dissemination has increased.

Open-ended exams reveal not only the level of knowledge about a topic, but also the high-level thinking skills such as cognitive strategy skills and self-control skills.

Cognitive strategy skills include sub-skills such as; (1) using multiple ways to solve the problem, (2) re-expression and repetition with other words to better understand the question, (3) selecting and organizing related and given information (from the stem of the question) to solve the problem, (4) thinking about the meaning of the problem before starting to solve, (5) spending more time to better understand the difficult questions and (6) converting the problem into different forms.

Self-control skills include: (1) controlling the processes during the solution, (2) going through upon solutions, (3) judging the accuracy of processing, (4) asking how well do while continuing to solve problems, (5) error correction and (6) keeping track of how works going during the solution.

The fundamental steps to be taken in the discussions about how to design an assessment using Natural Language Processing in the evaluation of open-ended exams for educators are listed as follows.

1) Designing artificial intelligence systems to generate questions for the stable progression of in-class, in-school, national and international examinations.

2) The use of the central education program (national curriculum) can be used as an advantage, and the evaluation of the results of common open-ended exams for each course in schools can be done by using Natural Language Processing in a system to be established by the Turkish Ministry of National Education.

3) It may be possible to training artificial intelligence models by analyzing and accumulating the answers received by adding trial questions to the national exams.

As a result; the development of **Turkish Natural Language Processing** in terms of semantic structures, scanning how complex or simple sentences are, synonyms, word phrase, sentence structure and Turkish grammar is the first condition for making more accurate evaluations in every field.

In order to use Natural Language Processing in education, educators need to learn the basic working principles of this system and they must have at least a basic awareness of their use in their disciplinary areas.

Artificial Intelligence in Distance Education

Face to face education is done in schools. In distance education, it is done on platforms named "Learning Management System". This platform, meets all the needs of educational institutions like a school. Although distance education has a field of use in all levels of education, the discussions in the Workshop focused on higher education in particular.

According to Turkish Council of Higher Education, distance education defines as; in higher education institutions, teaching activities are planned and carried out based on information and communication technologies and the education in which the courses are given simultaneously by the instructor without being obliged to be in the same place, based on the interaction between the student and the instructor and the students.

With the help of lesson plans in distance education, it is determined when live classes will be held. Thereby, students take part in the virtual classroom within the specified time. In the face-to-face (traditional) education, the environments that enable the academic activities performed in the classrooms to be interacted visually and audibly over the internet are called "**virtual classrooms**". In the virtual classrooms;

- The instructor gives his/her lectures visually and audibly in front of the camera.

- The instructor gives his/her lecture by using the presentation tool and adhering to the course notes that pre-prepared.

- In this system, if the instructor wishes, he/she uses the "whiteboard", which is similar to the "blackboard" used in schools. At the same time, the students watch the writing and figures on the blackboard.

- Students can ask questions during the lecture. The instructor can answer this question in written or verbal form at the time, as other students will hear and see.

- The course of the instructor is recorded to the archive in video format. The student can watch this video at any time to understand the subject better.

Artificial intelligence classification models are frequently used in data mining and are used to reveal hidden patterns in databases.

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A certain process is followed to classify the data. Firstly, an artificial intelligence model is obtained by using part of the existing data set for educational purposes. The performance of the models is determined using the data allocated for testing. Then, with the help of these models, it is determined that how to decide when a new situation arises. In addition, the factors that are effective in the model are taken into consideration and focusing on these factors is provides.

Collecting data is easier in the virtual environment than in the traditional classroom environment due to the fact that topics such as data production, data recording and data processing can be done more easily and quickly.

In the classrooms where the traditional education done, it is quite difficult to determine interest and attention span, tracking of busyness about the lecture and teacher's pedagogical maneuvers. In the virtual classroom environment; recording every movement of the student, time spent on a page, response speed and even eye tracking makes it possible to use all of them as data.

It is possible to use the data obtained from all behaviors by modeling the variables such as performance evaluation, detection of undesirable behaviors, and developing individual propositions.

Artificial intelligence in distance education can be used to evaluate the results of activities. By this means, it helps educators about which factors are effective on success and which factors should be focused on. This can produce results about what to do and what not to do. Apart from these, it also guides educators in developing predictions and on "Personalized Learning".

Since distance education uses advanced information technology (IT) infrastructures, it has significant advantages over face-to-face education in data collection and processing. Particularly, machine learning models can be used in the analyzes to interpreting the behaviors that has not yet emerged from the data obtained from the student (C50, Boosted C5, Regression Trees, Support Vector Machine, Logistic Regression, "Random Forest" Deep Learning, etc.).

For instance, the demographic characteristics of the student at the time he/she started school and the use of his/her current success to predict future success are among the most frequently carried out studies.

As a different example, as a result of the analyzes conducted on the courses chosen in distance education, it can be predicted how many students will enroll for which course in the next semester. For these analyzes, there are methods of machine learning which analyzes the relationships between the records in the database and tries to reveal which events can occur together simultaneously. "**Association Rules**" are obtained by identifying these relations.

In order to develop artificial intelligence applications in distance education, it must be fed with continuous data. For that purpose, it is required to record the perspectives and process evaluations of students and faculty members on the **Learning Management System** (LMS) periodically. The system can be directed the users to make evaluations during the education process. These evaluations will be processing by the system during the semester and it will be published real time alerts about the system.

Consequently, the data collected during the distance education process and some of the suggestions for artificial intelligence application are listed below.

1. Combining all the questionnaires conducted to the students and using them in the student's performance analysis, so determining the relationship between student perception and success in a subject.

2. Developing a system that produces results on a related topic (for example, "people who be in the opinion of A and B, what are they thinking of other topics") by using questionnaires.

3. Course contents, participation in live classes, interaction with faculty members, monitoring of their behavior in live classes and forums and revealing the activity-performance relationship based on such data and thus developing recommendations for personalized learning.

4. Determining the behavioral model of the students tracking the course contents and live course recordings, thereby developing suggestions by revealing the issues that are hard to understand.

5. Developing a system that can offer suggestions by taking into account the activities that caused students' failure.

6. Developing a suggestion system that can guide students in course selection.

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ARTIFICIAL INTELLIGENCE IN EDUCATION
STRATEGIC TRANSFORMATION AND ECOSYSTEM

Computer Vision Methods

Image processing methods provide the basic information about the objects that are illustrated, such as distinguishing the objects, identifying and defining details of objects in a drawing. The recent past, image processing techniques were able to solve relatively more primitive problems such as "is there an object or not" or "how similar are the two objects". Today, image processing methods are used in numerous fields such as healthcare, defense industry, security, autonomous vehicles (land, sea and air) and marketing. For instance, in the healthcare field, thanks to **image processing technologies**, it is possible to detect cancer cells from MR (Magnetic Resonance) images of breast cancer patients with both faster and more accurate target detection. An algorithm developed for skin cancer is able to visually diagnose potential cancer with a high accuracy over a database of approximately 130,000 skin disease images.

The YOLO (You Only Look Once) algorithm, which can detect objects in image processing, is one of the most frequently used algorithms. The foremost reason why YOLO is frequently preferred is that it is faster than other. For example, region-based object detection algorithms such as R-CNN first identify areas where the object is likely to be located, and then carry out separate CNN (Convolutional Neural Network) classifiers there. Although this method gives better results, since an image is subjected to two separate processes, the increase in the number of operations on the image causes a low average of "frame per second" (FPS). The reason why the YOLO algorithm is so fast is that it can estimate the class and coordinates of all objects in the picture by passing each picture (image) through the neural network at one time. Thus, determination can be made quickly from video or instant viewing. The speed in this determination is especially important for autonomous vehicles. In a motion, driverless vehicle must recognize the objects in the field of view swiftly and decide whether to go or stop just like a human driver.

Image processing technologies were first used in the Intelligent Classroom Behavior Management system developed by HSedu in 2017 within the extent of a commercial product. In the **Intelligent Classroom Behavior Management**, emotional states during the course are determined by the images taken from the cameras placed in the classroom every 30 seconds are analyzed with facial expressions of the students. The images taken from the cameras are processed with deep learning software called embedded system and it reports to the teacher what emotions the student is in during the course through seven emotions (anger, grief, joy, etc.) represented by facial expressions. Eventually, it is thought that this method gives feedback to teachers and will help them to select the methods by identifying the moments of drawing interest or not. Another image processing application developed by HSedu is the integration of the cameras placed in the school entrances with the face recognition system and automatic identification/attendance control.

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In the educational environment, it is also possible to evaluate images other than face recognition by image processing. For example, an evaluation can be made through drawings drawn by children. People have different means of expressing themselves. The most basics of these are **language**, **writing** and **drawings**. The language development level at which children can express themselves is when they around 2 years old. Learning the written language develops latest because it requires the development of certain skills (vision perception, auditory perception, fine motor skills etc.) and it is seen as part of the formal school system. Until a child learns to write, from the age of 2 to 7, one of the most basic means of expression is the drawing. At an early age, children express emotions and the things they see through drawings. Studies on children's drawings have provided improvements about to follow the cognitive development (intelligence) of the child, creativity level, how he/she perceives the world, his/her relationships with his/her environment, his/her personality and his/her inner world from their drawings.

Drawing analysis is one of the methods used by psychologists and pedagogues for quite a long time to understand the emotional and cognitive characteristics of the child. With their drawings, children give important clues about both the world they perceived and their inner world. As children grow up, their drawing become more detailed, proportionate and more realistic. From the point of the development of drawings, there are some striking and very distinctive features that characterize children's paintings in each stage.

Analyzing children's drawings in terms of emotional and cognitive characteristics is both costly and time-consuming because it requires a psychologist and pedagogue to focus on each child's drawing individually. Therefore, this method is preferred only when the monitoring of the child becomes compulsory (anger, abuse, enuresis, encopresis, low school success, etc.). When the child drawings are examined, the influence of imagination is prominently in the figures drawn. For example, a child who is asked to draw a human can draw a human being flying and winged, with some limbs missing or unreal. This and hundreds of similar cases complicate the problem of classifying the contents in this drawing.

A child development specialist basically wants to get the following inferences in a drawing: describing what different objects are (Home, Adult, Child, School, etc.); to understand where the objects in the drawing are, what they do; to understand the information in the drawing such as, objects being near or far to each other according to certain point, dimensions, drawing details, position on drawing paper and their size.

In the light of this information, the experts who analyze the pictures can make inferences about the characteristics of the child such as intelligence, emotional state. It may be possible to digitalize these analyzes by using image processing method.

PROJECT ACTIVITIES

'Artificial Intelligence in Education' Workshop - 1
"Applications of Artificial Intelligence in Education"
(04 September 2018, Microsoft Turkey Office - Istanbul)

'Artificial Intelligence in Education' Workshop - 2
"Using Genetic Data in Learning Environment"
(16 January 2019, KWORKS - Koç University Entrepreneurship Research Center - Istanbul)

'Artificial Intelligence in Education' Workshop - 3
"Natural Language Processing and Education"
(08 February 2019, KWORKS - Koç University Entrepreneurship Research Center - Istanbul)

'Artificial Intelligence in Education' Workshop - 4
"Educational Data Mining"
(22 March 2019, KWORKS - Koç University Entrepreneurship Research Center - Istanbul)

'Artificial Intelligence in Education' Workshop - 5
"Artificial Intelligence in Distance Education"
(25 April 2019, KWORKS - Koç University Entrepreneurship Research Center - Istanbul)

'Artificial Intelligence in Education' Workshop - 6
"Usage of Computer Vision Methods in Education"
(13 June 2019, Sarıyer Akademi - Sarıyer Municipality Education INstitution - Istanbul)

Under **BRAINS² TÜRKİYE Artificial Intelligence Program**; within the frame of the first application project titled "**Artificial Intelligence in Education | Strategic Transformation and Ecosystem**"; **'Artificial Intelligence in Education' Workshops** organized under 6 different themes were completed by research, analysis, evaluation, presentation and brainstormings, and the final reports of the meetings are prepared in Turkish and English, and published in the related official websites, mainly as of **BRAINS² TÜRKİYE**, **TASAM** (Turkish Asian Center for Strategic Studies) and **ESTEN** (Education, Industry and Technology Institute).