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THE TEACHERS` AND STUDENTS` AWARENESS OF STEM EDUCATION PRACTICED IN ENGLISH LANGUAGE IN KAZAKHSTANI SPECIALIZED SCHOOLS

Abstract. This article highlights the vital role of teaching STEM (Science, Technology, Engineering and Math) in English in Kazakhstani secondary schools specialized in science and explores teachers` and students' knowledge and awareness of STEM education practiced in English. The data reflected in this article is based on small-scale research held through the survey conducted among 149 Kazakhstani secondary school learners with in-depth study in math,physics and biology and interviews with 3 content teachers who practice teaching STEM subjects in English in schools specialized in science. The resultsof the survey demonstrate that students` general knowledge about a term of STEM is relatively low. Also, the results of the interview with teachers show that the STEM approach is applied through English in specialized schools and participants relate this approach to other methods such as PBL and CLIL. It provides encouraging expectations for further study and implementation of integrated STEM education with ELT in Kazakhstani secondary schools.

Keywords. STEM, STEM education, English in STEM, soft skills, integrated approach, professional English, ELT.

Introduction

Nowadays, humanity is experiencing a rapidly occurring transition period within the industrial revolution. It can be characterized by huge flows of information, digital transformation and new technological developments being invented every day. The main trends of this decade are

creative and innovative thinking, digital technologies, and multifunctionality in the ability to correspond to new challenges. Undoubtedly, these enormous changes impact the educational sector as well. The competency to meet the new requirements of society and the needs of employers led to the emergence of new and adapted educational programs and approaches such as STEM (Science, Technology, Engineering and Mathematics). Wahono (2020) defines that STEM education covers teaching, learning, and integrating the knowledge and skills of these areas, focusing on the real-world problem-solving capacity of the learners.

The STEM approach to teaching and learning originated in the 1990s in the United States and is now being implemented at the state level in countries focused on growing their own scientific and technical elite. STEM in integration with the acquisition of the English language is able to provide a number of positive socio-economic effects, improve employment patterns and bring a decrease in social tension in the labor market in the regions of Kazakhstan and prepare an internationally competent generation.

Scientists around the world faced the challenge of developing STEM as a new approach to teaching that would allow children to see interdisciplinary connections and apply them in practice. According to Kennedy and Odel (2014) STEM as an interdisciplinary discipline demands that educational tactics must be different from traditional methods so students could learn indeed. Thus, recent decades introduced STEM to education - that does not teach individual subjects but allows them to be learned in conjunction with each other in the framework of the implementation of complex educational projects.

Furthermore, key influencers to economic growth are specialists in science and technology who need to comply with international requirements, so accordingly, know English. The acquisition of Professional English for science specialists is essential considering the modern demands of the labor market as well as expanded access to science literature, novelty, and other resources in English for personal development. As emphasized by Francis and Stephens (2018), success in STEM for English learners opens new opportunities for better and stable income and economics. In this case, implementation of the STEM approach through English could help learners to acquire both content and language knowledge through soft skills, practice, and application in real-life situations. Language teachers could take advantage of this skills-

oriented approach and reach appropriate results considering children's interests by putting them into real-life situations.

Literature review

Almost all educational projects and programs require a needs assessment, a detailed planning process, and regular discussions with all stakeholders for an objective evaluation (Day-Miller & Easton, 2009). Currently, STEM is one of the main trends in education all over the world and one of the peculiarities of this approach is that it can be accompanied by English learning to cover learners` soft skills or "skills of the 21st century", including communication, negotiation, problem-solving, creative thinking, and cross-cultural skills. However, as stated in PISA (Program for International Student Assessment) 2018 results, Kazakhstan shows lower results than the OECD (The Organization for Economic Co-operation and Development) in reading, math and science. According to Ministry of Education and Science of the Republic of Kazakhstan (MoES) (2022) the National Report on the State and Development of the Education System of the Republic of Kazakhstan, the transition of secondary education to updated content will be emphasized considering the weakly expressed relationship with PISA tasks, i.e. elements of STEM education in the context.

Nevertheless, many leading secondary schools such as NIS, FizMat, BIL, and other organizations which practice STEM elements in Kazakhstan show significantly better results than other schools. As reported by the official website of Republican Scientific and Practical Center "Daryn" of the Ministry of Education and Science of the Republic of Kazakhstan (2022), participants from above mentioned intellectual schools are in the lead according to the republican subject Olympiads in natural as well as humanitarian sciences.

Overall, the goal of STEM education is to analyze how this interdisciplinary and project-based approach can reinforce the scientific and technological capacity of learners, expand skills of critical, inventive and creative thinking, problem-solving, communication and collaboration and such advantages can be brought in the English language. This approach could be a beneficial tool that fosters learning science through English language acquisition and vice versa. For example, in Argentinian schools, integrated teaching of professional content and English has been incorporated into an official teaching curriculum as a "language-driven" mechanism (Banegas, 2015, p.104). Thus, the gradual adoption of this

approach allows us to develop and improve language competency among learners.

The development of STEM education is also reflected in Israel's preschool institutions. The following recommendations were presented at the International Research Conference "STEAM forward" which was held in Jerusalem in 2014 which are relevant and significant for inclusion in the educational space of all developing countries of the world:

- STEM education should start from the earliest preschool age.
- The study and development of the English language should be constantly ongoing. The language of science is English. The introduction of the English language is required in the teaching of subjects in the natural science cycle as the most significant scientific resources are published in English. For example, all 100 most influential scientific journals in the world according to the SCImago magazine ranking publish articles in English. Nobel laureates speak English.

As reported by applied research conducted in Kazakhstan, there is no unique method of teaching STEM in schools and universities. STEM is taught differently according to possibilities, the direction of the school and priorities of stakeholders, etc. (Imangaliyev et al., 2019). In the COVID-19 pandemic conditions, the country felt the urgent need of staff with critical thinking abilities, to create digital solutions and products. Therefore, the main approach to teaching STEM is the integration of STEM techniques and methods to existing subjects such as problem-solving, teaching through discovery, teaching in teams, the personality-oriented approach where English can be used as a target language.

Also, applied research on STEM in Kazakhstan states that there are many educational initiatives, such Science stars by the British Council, Maker Space by US Embassy, Oyla events, Science on stage by FizMat are held in English. Considering the direct and indirect beneficiaries of such projects, we can certainly say that popularization of the English language is increasing fast. Participants involved in such projects can be inspired so that more people are influenced to learn about STEM through English. As highlighted by Schleppegrell (2007), it is very important to understand that the material taught in STEM subjects is not separable from the language as the language is the key tool to have access to the content itself. No information that can be transferred or learned without language.

As the integrative interdisciplinary approach to learning, STEM offers

the academic scientific and technical concepts to be taught by a student-centered approach. In schools specialized in STEM subjects, English is used as a means of communication and medium of instruction, but not as a separate issue that they need to solve. This simplifies the perception of language learning from a psychological point of view. Also, a student learns language better by problem- solving which is the core target of STEM. Based on these assumptions, the given article is aimed to answer two research questions:

1. What are students` knowledge and awareness of STEM education in schools specializing in science?
2. What are content teachers` knowledge and awareness of STEM education andits application through the English language?

Research methods:

The data collection for this small-scale research was conducted in two stages through a mixed method approach: the quantitative survey from students and qualitative semi-structured and opinion-seeking interviews from instructors on awareness of the STEM approach and its applications.

The first stage - survey was done through the online google forms on an anonymous base among learners with B1 English language proficiency among participants from 3 Kazakhstani secondary schools specializing in math, physics and biology. Overall, 149 learners of secondary schools specialized in science participated in the questionnaire and all of them are currently studying specialized subjects in Kazakh or Russian. The majority of science students showed their enthusiasm to learn English through projects or other activities related to math, physics, and biology. However, as demonstrated in Figure 1. below, only 19.5 % of participants are familiar with STEM education.

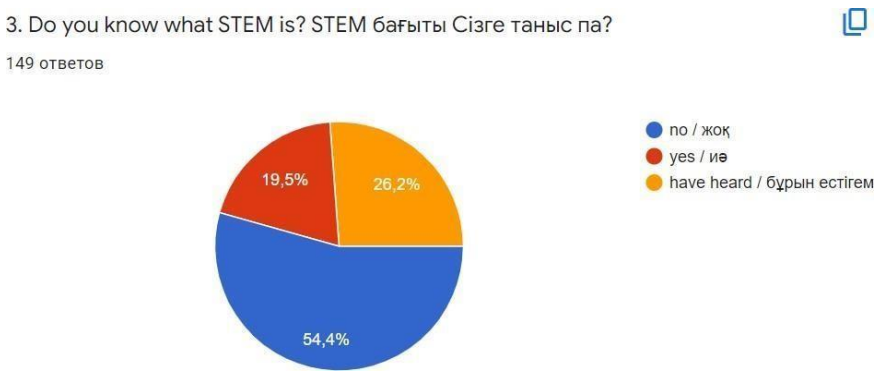

Figure 1. Results of the survey.

The conducted survey claims that learners` needs mostly require the integration of their interests. Undoubtedly, children of the digital era concur with the idea of integrating the English language learning process with science in practice.

The second stage interviews were conducted with two male and one female participants of the research (overall three) - content teachers from intellectual schools of Kazakhstan, Almaty (Participant 1 - math teacher, Participant 2 - biology teacher, Participant 3 - physics teacher). Interviewees were acknowledged with the aim of the research, on its confidentiality and that interview process is not compulsory. Participants` sensitive data are not published in open resources, but used to identify their experience in the STEM approach through English. Interviews were given a link to the Teams platform for a 15-minute online face-to-face meeting with recording upon participants` consent. The interview covered the following questions:

1. How do you understand STEM education?
2. Do you use STEM elements in your classes? What elements?
3. Can you please differentiate using STEM education through the Englishlanguage from other approaches like CLIL, PBL, EMI?
4. Your opinion about STEM classes in English? Advantages and disadvantages?
5. Are you knowledgeable and skillful in using STEM education through the English language? If not, what is needed?Participants could outline their awareness and views on the integration of STEM approach and language learning through science projects according to theopen-ended questions. Teachers shared their feedback on the STEM approach aswell as the challenges in widening its applications within educational programs.Interviewees highlight the positive influence of STEM similar to other reviewedstudies that this approach enhances the academic excellence of the students as they often participate in international Olympiads and competitions where English knowledge is mandatory. As emphasized by Participant 3, one of the famous questions of students during theory classes is “Where do we use this knowledge in our life?”. Therefore, teachers believe that STEM Education can help to demonstrate and explain to students

> the answer to the mentioned question. The techniques revealed by participants were exercises with calculus and other equations, digital games, and group work that stressed on content vocabulary and grammar improvement while applying English language practice during the classes. Participants 3 and 1 evaluate that teaching the STEM approach in English can be fulfilled using CLIL and PBL methods. Also, they reported that the benefit of teaching STEM in English is that both instructors and students have access to enormous sources of materials e.g. books and relevant scientific literature, videos, experiment guidelines and newly adopted technological science platforms, worldwide websites and science communities of international level etc.

Notwithstanding, Participant 2 highlights the examples of using the STEM approach offered in English that almost every topic in biology courses requires knowledge and skills from math and physics, chemistry or even informatics. For example, when students study the properties of water they learn the molecular structure of water, types of chemical bonds, polarity and charges. All these aspects allow teachers to explain the role of water and why it is essential for human life and the planet. Also, another sample was biomechanics when students use knowledge about motion and levers to understand how the human skeleton is adapted for bipedal locomotion. In genetics and ecology, participants use statistical formulas to assess the validity of predicted models of inheritance or compare variation in populations. But participants do not provide valuable examples with exact techniques and elements of how these processes are explained to students through the STEM approach, which shows a weakness of experience in using the STEM approach, its teaching methodologies, and concern about networking with other content and EL teachers.

Moreover, participants concur that challenges exist in broadening this approach which emphasized the limitations of the study that more expanded research is to be done covering ordinary secondary schools. Firstly, participants believe that they teach biology, physics or other science to reach and discover technology and engineering, but not all teachers cannot understand the connection between them in a simple way and feel uncertain in using the STEM approach in English as they refer it to CLIL or PBL. Secondly, as reported by participants, mentioned schools and lyceums implement curriculums specially designed according to high school biology, physics or math of the United States that might not be taken

into consideration by other organizations.

Participants believe that using English in STEM projects fosters language learning and studying only during English classes does not fulfill students`needs and they have to connect English with their chosen interest subjects, thereby should have additional learning opportunities. It is emphasized that collaboration between content teachers and English teachers is required to advance the performance of such initiatives.

All three participants expressed their understanding of STEM through English and related this approach to CLIL (content and language integrated learning) and PBL (project-based learning), using EMI (English Medium Instruction). However, the STEM approach reflects all these tactics to demonstrate to students the relevance of practice with theory by non-traditional methods.

Conclusion:

Based on the survey and interviews, the study needs deeper analyses on how teaching English through STEM can be appropriately implemented to gain better results in language proficiency. The survey with science students has revealed the current state of the ELT in specialized schools and the gaps for further studies. Also, the interviews with content teachers prove diverse tactics and perceptions of the teachers while teaching STEM in English. The findings of the current study are consistent with those of Wang, H. et.al. (2022) who states that instructors in each STEM discipline propose their individual perceptions about STEAM and how it can be offered to students which leads to various classroom proceedings. As a result, new questions emerge for future studies to explore the perspectives of STEM education:

- Whether current forms of ELT classes offer sufficient STEM elements anddo not limit students` perceptions.
- Whether teachers of the STEM subjects are competent in STEM pedagogy.

Moreover, Karabay, A. (2017) demonstrates the findings that both STEM and social sciences students anticipated to achieve better results in English during the study, but only social sciences students were more adaptable to such integration and succeeded in it.

Considering that science subjects are primarily taught in Kazakh or Russian within Kazakhstani secondary schools, there is a need to initiate at least laboratories where content teachers in collaboration with English teachers could practice STEM projects through the English language with

learners and let them be acquainted with this approach. The main reason for proposing the STEM approach is that traditional English teaching methods may not always fulfill the needs of learners of the natural sciences. An interdisciplinary collaboration of ELT and science subjects can create a convenient environment to learn language by discovering laboratory, project-based, and real-life environment opportunities.

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ҚАЗАҚСТАННЫҢ МАМАНДАНДЫРЫЛҒАН МЕКТЕПТЕРІНДЕГІ АҒЫЛШЫН ТІЛІНДЕГІ STEM TECHING ПРАКТИКАЛАРЫНЫҢ МҰҒАЛІМДЕРІ МЕН

ОҚУШЫЛАРЫНЫҢ ХАБАРДАР БОЛУЫ

Аңдатпа. Бұл мақала мамандандырылған қазақстандық орта мектептерде STEM (Science, Technology, Engineering and Math) бағытын ағылшын тілінде оқытудың маңызды рөлін және мұғалімдер мен оқушылардың STEM білім беру бағытын ағылшын тілінде қолдануы туралы зерттеу қорытындыларын қарастырады. Мақалада ұсынылған деректер математика, физика және биология пәндерін тереңдетіп оқытатын қазақстандық орта мектептердің 149 оқушысы арасында жүргізілген сауалнамаға және аталған бағыттағы мектептерде STEM пәндерін ағылшын тілінде оқыту тәжірибесі бар 3 пән мұғалімімен жүргізілген сұхбат арқылы даярланған шағын көлемді зерттеулерге негізделген. Сауалнама нәтижелері оқушылардың STEM термині туралы жалпы білімінің салыстырмалы түрде төмен екенін көрсетті. Сондай-ақ мұғалімдермен жүргізілген сұхбат нәтижелері STEM әдісі мамандандырылған мектептерде ағылшын тілі арқылы қолданылатынын және қатысушылар бұл тәсілді PBL және CLIL сияқты басқа әдістермен байланыстыратынын көрсетті. Нәтижелер қазақстандық орта мектептерде интеграцияланған STEM білім беру бағытын ағылшын тілі арқылы оқытуды одан әрі зерттеу қажеттілігін ұсынады.

Түйін сөздер. STEM, STEM білім беру бағыты, STEM дегі ағылын тілі, икемділік дағдылары, интеграцияланған тәсіл, кәсіби ағылшын тілі, ағылшын тілін оқыту.

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ОСОЗНАНИЕ УЧИТЕЛЯМИ И СТУДЕНТАМИ ПРАКТИКИ ОБУЧЕНИЯ STEM В АНГЛИЙСКОМ ЯЗЫКЕ В КАЗАХСТАНСКИХ СПЕЦИАЛИЗИРОВАННЫХ ШКОЛАХ

Аннотация. В этой статье рассматривается особая роль преподавания STEM (наука, технология, инженерия и математика) на английском языке в казахстанских средних школах,

специализирующихся на естественных науках, а также исследуются знания и осведомленность учителей и учащихся о STEM-образовании, практикуемом на английском языке. Данные, приведенные в этой статье, основаны на небольшом исследовании, проведенном путем опроса 149 учащихся казахстанских средних школ с углубленным изучением математики, физики и биологии и интервью с 3 преподавателями предметов, которые практикуют преподавание предметов STEM на английском языке в школах специализирующихся на естественных науках. Результаты опроса показывают, что общие знания студентов о термине STEM относительно низкие. Также результаты интервью с учителями демонстрируют, что подход STEM на английском языке применяется, и участники связывают этот подход с другими методами как PBL и CLIL. Результаты показывают необходимость дальнейшего углубленного изучения и внедрения интегрированного обучения STEM с преподаванием английского языка в казахстанских средних школах.

Ключевые слова. STEM, STEM-образование, английский язык в STEM, гибкие навыки, комплексный подход, профессиональный английский, преподавание английского языка.

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