European Proceedings of
Social and Behavioural Sciences
EpSBS

www.europeanproceedings.com
e-ISSN: 2357-1330

DOI: 10.15405/epsbs.2021.05.268

ISCKMC 2020

International Scientific Congress «KNOWLEDGE, MAN AND CIVILIZATION»

SCIENTIFIC AND TECHNOLOGICAL PRIORITIES IN LEARNERS' PROFESSIONAL IDENTITY IN THE TYUMEN REGION

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Abstract

The priorities of science and technology in high school are important to provide learners' professional identity among the jobs connected with fundamental and applied science and technological activity. Developed pedagogical model include content, pragmatic and evaluative components. Content modules have been approved as a variation to subject natural science knowledge, built into curricular and extra-curricular activities (science, technological, socio-cultural). A necessity of the focused work on high school learners' professional identity has been proved with their involvement into integrated, practice-oriented projects "Sciencelab", "Agrogeneration". A necessity of a special integrated educational setting "school-university – industrial site – society" has been proved to enhance the process of learners' professional identity on the integrated basis. The combination of the integrated surroundings (science, engineering, information, success, innovative, sociocultural), provides the profession choice with the account of employer's requirements, career prospects (scientific, professional), and personal development. The research proves the importance of science and technology in high school because they affect the choice of learners' professional activity.

Keywords: Scientific and technological priorities, professional identity, integration, region

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1. Introduction

The priorities of scientific and technological development, incorporated into all spheres of the economy, are the key strategies in the modern state (Agamirzyan et al., 2014). The development programs for enterprises, business structures, higher institutions, schools are subjected to these priorities. As strategically important trends of innovative development of the Russian state up to 2030 they are aimed at the development of: safety and rational use of natural resources; nanotechnologies and transport; space systems and geosciences; energy efficiency and energy saving (Egorova, 2015). The forecast of science-technological development of Russia and its priorities determine the key issues of the state innovative development (Sokolov, 2007). Science and technology today are leading trends in higher education which have a key role in the modern society in different positions: a) a source of the sociocultural development of the society; b) production of social, economic development; c) enhancing the living standards in the region; d) the condition for the sustainable development of the regional community (Shadrikov, 2010). Nowadays, education is perceived as competences' development. These competences are necessary in life, and science is an important element of human culture. It should be noted that education can be considered as an element of culture and science. Education both gives scientific knowledge and forms a thoughtful personality with own way of thinking, scientific and technological scope of view. Many scientific, technological facts have been accumulated during human history, and they become impossible to know. Thus, education, as a developing system, requires new scientific and technological methods and ways of teaching. Nowadays, many achievements have been done by schoolchildren, and students, for example: bioadditives' formulation technology (Ekaterinburg, 2017), medical appliances for medicine injections (Tomsk, 2016), an appliance for blood vehicles modeling (Novosibirsk, 2018) and others. Awareness of science and technology makes a person both receive a result and acquaints with labour and technology elements, which influences the choice of a future profession (Boiko, 2015).

2. Problem Statement

Specific methodological aspects of activity arrangement and structure have been disclosed to study theoretic-methodological framework for professional identity, authors' ideas, and concept genesis. According to Zeer (2008) it is a process of finding own place in the world of profession, perceiving yourself as a subject of a certain activity. Priazhnikov (2007) has a very interesting idea of professional identity. He understands it as "a process of preparedness formation in schoolchildren to conscious and independent perspective of own development, to find independently notional meaning in a certain professional activity" (p. 72). Professional identity is accepting by pupils relative criteria of professionalism determined in the society. A person decides for self whether to accept these criteria or determine them depending on the activity and level of professional ambitions to achieve a certain result in the professional activity. Professional self-actualization starts from professional identity. Accepting the importance of the accumulated educational experience in professional identity let's denote some contradictions: between the need in science-engineering staff in the region and low professional identity of high schoolers in these professions; between employers' and business requirements to the quality of science and engineering competences and insufficient level of application scientific, practical tasks for

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professional identity. Within the project "Key development trends in Russian education to achieve aims and tasks of the sustainable development in education" till 2030, new forms and methods of high school pupils' professional identity are required, which determines the aim of this work: what are the peculiarities of the high school pupils' professional identity in scientific, engineering specialities and majors in Tyumen region (Grebenuk et al., 2016). The empiric study base was MAEE Turtassk GES, MAEE Uvatsk GES in Uvatsk district in Tyumen region (275 learners in 10–11 grades).

3. Research Questions

Literature review and study of pedagogical experience determined the conceptual framework and a functional-didactic meaning of professional identity. We understand professional identity as a starting platform of a future professional and personal life. Professional identity is the understanding by a person socially framed criteria of the professionalism. A person decides whether to accept these criteria or determine them depending on the activity and level of professional ambitions to achieve a certain level in the professional activity. Professional identity starts professional self-fulfillment. From the psychologo-pedagogical point of view, professional identity can be understood as self projecting in the professional activity. Analyzing the answers of the respondents to the questionnaire "My professional choice", the priority arguments when choosing future profession were the following: labour market demand (17 %), income (35 %), and possibility of self fulfillment (27 %), further education and entering the post-graduate course (2.0 %), possibility to pursue science (5 %). Comparing the answers of the respondents from the rural and city area we determined a low interest to the disciplines of natural science (15 %), to techniques (14 %), and technology studies (17 %). Most respondents are not motivated to study scientific, technical achievements due to some reasons: weak material grounds, "difficulty of science", "high load", "I don't need it". Let us note that it is impossible for one teacher to explain scientific-engineering priorities of professional identity to high school learners. A complex system of interaction between the high school and a GES is required; a professionally developing media with the enterprise is required. As planned setting it included teaching and engineering groups with the account of the professional, intellectual and creative potential of every teacher, engineer to achieve a required aim, which included work at different levels (school, Board, institute, enterprise). The modules of the model (content, pragmatic, evaluative) of professional identity of high school pupils are included into the curriculum of the science teachers' training courses based on "Tyumen Regional State Institute for education development in regions" (TRSIEDR). The group of teachers directed and corrected methodical work, analyzed and discussed the results, ways and methods of improving a pedagogical model. Within the issue of professional identity for science and engineering majors and specialities MAEE GES in Uvat, Turtas, Tobolsk, Tyumen participated via seminars, workshops, exhibitions, conferences. Let us give short information on blocks of the developed pedagogical system. A content module includes three modules: technical, science, sociocultural, built into curricula, science disciplines, elective courses, facultative curricula. The variative part of the subject built on the principles of integration, scientificity, innovation included a combination of tasks on professional identity. The content of the scientific module included the following teaching elements: ways and methods of scientific acquisition, innovations and inventions in natural sciences, nanomaterials, polymers, inorganic matters, organic matters. Fundamentals of patent activity. A scientific

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article and its structure (object, subject, hypothesis, study objectives). The content of the engineering module was oriented to study of techniques, technology, products, technical-ecological parameters of leading integrated enterprises, business structures in the region (oil and gas processing enterprises, monomers and polymers production, food industry enterprises, agricultural enterprises). The authors have developed a technological map on studying the features of a certain enterprise, with specific available information for study: general production characteristics, regional-geographic features, production resources, main products, and products distribution geography, technological, physico-chemical peculiarities of the raw materials, market product and semiproducts, main professions at the enterprise, socio-cultural role of production in the region. The historical module contains studying the enterprise history, development of science and technology in the region; the first engineering discoveries and science expeditions, first oil and gas, first railroads and their role in region's history and civilization; personalities and their role for the region. Sociocultural module included the issues of culture, economics, industry in the region, leading professions in the region and their role for improving economic and cultural welfares and resources in the region. The following integrated themes "Oil, gas, business in the region development", "My future profession in the region development" were included disclosing the significance of financial, socio-economical requirements for the future profession. The pragmatic module of the system oriented the learners for creative activities. During the work project learning, case-study, business games, workshops with representatives from different enterprises – potential employers, as well as representatives from schools, vocational schools and colleges were used where the requirements to the level of graduates' competences, innovations in science, technique and technology were discussed. Learning process was connected not only with the theoretical training but with excursions, as a necessary part of professional identity. For learners from the city schools the themes of the excursions were connected with the professions of fundamental science (microbiologist, physics, environmental engineer, biochemist) and applied (lab researcher, meteorologist, geologist). Studying real production, job functions, new staff, applied tasks for the professional experience, had a special positive motivational effect. The excursions' content to the enterprises was discussed with the representatives of industry. Meeting with university graduates-engineers (chemical-engineers, processing machine operator, programmer, economist) had a special positive motivating effect in professional identity. The learners of the rural areas had agrarian excursions: "Secondary tillage", "Agricultural plants in autumn", "Field-crop growing is a main enterprise of plant-production", vegetable farming excursions, cattle breeding excursions and others. When implementing this model of professional identity peculiarities and possibilities of the integrated educational medium, were taken into account. In this medium, secondary school and engineering university as internal medium contacted with external medium – regional society, industrial and business community. Internal and external media are interconnected and dialectically united "school – engineering university – an industrial site – society", which discloses their pragmatic possibilities for achieving the aim. It determines integrated educational medium as a complex system of the interconnected media (science, engineering, informative, success medium, innovative, sociocultural), which provide maximum level of understanding scientific and technological priorities in professional identity of high school learners. Integrated educational medium is a platform for active interaction "a learner – a student – a teacher (lecturer) – an engineer", as well as mutual "subject-subject" enrichment of

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science and technical knowledge. A system of work on the content and conducting research projects had a particular value in choosing scientific and technological priorities. The ideas about nature matters and their genetic interconnectedness were developed during the project activity. The issues of synthesis inexhaustibility, orientation of natural science technologies on deep processing of raw materials and waste reduction in the production were of special importance. Working on the projects learners inferred the cause-and-effect relationships between the composition and the properties of nature substances and ways of their processing. The knowledge where the substances are applied and personal interest promoted understanding how to produce the substances. Widening science-technological aspects of the subject content enhanced remembering the material and developed meta-subject competences necessary to solve important complex problems. Understanding and comprehension of the material motivated the learner to scientific and engineering achievements. Thus, the content module fulfilled the integrated approach to studying and understanding scientific, engineering achievements. Let us denote some science-engineering projects demanded for professional identity since 2007 to 2019: “Studying air pureness by the lichen indication”, “Analyzing types of ophthalmological diseases”, “Studying the quality of the Tura river, the Irtysh river, the Tobol river”, “Studying the quality of the snow cover near the industrious zone”, which combined chemistry, biology, geography, ecology, mathematics. The results were reported at the scientific conferences. Visiting by the learners an integrated elective course “Science, technology, and techniques in natural science” developed innovative way of thinking, independent decisions, interest to future profession (Manuilov & Fedorov, 1987). An integrated elective course “Regional chemistry was conducted together with engineers and was aimed at the analysis of the achievements in oil chemistry, ecology, chemical industry in the region. The content of all disciplines and integrated courses included extracurricular trends. A special attention should be paid to the project “Sciencelab” of the regional level, implemented in the Tyumen region for learners of 6–11 grades (October, 2018). The main purpose of the project is forming online science-technological community for training in skills of self-presentation, developing their science-technological scope, research competences in important for the regional areas of science, technique and technology. The participants of the developed project implement new forms of studies in natural science, fulfill science-research projects on laboratory facilities, show self-presentations, and do them via Instagram. Special forms of lessons in the project “Sciencelab” should be noted: study, scientific micro research, laboratory course on studying new material. The equipment is scheduled according to the school timetable and the timetable of the online lessons in sciences in other schools (according to the schedule of every school). The efficiency of the curriculum was created with the implementation of real enterprises in the Tyumen region (1–2 times in a month). Two times a term there was a telebridge of schools on conducting an experimental lesson. Teachers interacted online with students, gave “visiting” lessons (with the participation of science workers and representatives of business structures). 23 schools of the Tyumen region participated in the project from Tyumen, Ishima, Tobolsk. The students studied scientific and technological achievements in agriculture within the online educational project “Agrogeneration” launched 2012 by the Department of Science and Education in the Tyumen Region. The main aim of the project is creating the conditions for professional identity of the learners and their further motivation to the employment in the countryside. The content of the project is oriented onto scientific, educational, technological and engineering trends required in the countryside.

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Since 2012 till nowadays the number of participants has increased to 121 schools, which proves high interest of the schoolchildren to the progressive development of the countryside, determining their place in the agrarian sphere and desire to live in the native village. The target groups for this project are: pre-school establishments, schools, vocational schools, social partners: employers, non-governmental associations and organizations. In teaching activity, the project "Agrogeneration" starts its implementation from primary general education. The curricula of "The world around us" and "Technology" have modules with agro-technological and agro-business content, which forms the ideas about the peculiarities of technology, technique of agriculture; peculiarities of the economic thinking and primary science skills. Compulsory education (5–9 forms) suggests introduction into the biology, technology, chemistry mathematics curricula 8–16 hours' agro-technological modules. These modules suggest studying practice-oriented tasks with the close connection of the content with agriculture areas. Laboratory assistants have been developed to fulfill fore-specialized and specialized curricular, syllabi for training vegetable growers, flower growers, stock farmer, and machine-man.

4. Purpose of the Study

The purpose of the study is developing and implementing the model of professional identity orienting senior learners to scientific, technical specialities and areas in the Tyumen region.

5. Research Methods

The following methods were applied: theoretical (literature review, theses on the topic of the research, science materials, periodicals); empirical (pedagogical observation, tests, questionnaires, and comparative analysis), methods of mathematical statistics. Products of learners' activity (portfolios) were analyzed to specify the level of professional identity formation. Portfolios analysis, case and problems study, fulfilled projects, internship reports give an objective idea about the author. Methods of studying motivation of the profession choice were "The questionnaire for the professional identity", requirements hierarchy by Maslow (2001), a vocational aptitude questionnaire, L. Iovaishi methods modified by G. Resapkina (as cited in Pozniak & Shashnov, 2011). To prove our hypothesis we used the method of mathematical statistics. The comparative analysis of the level parameters at the end of the forming experiment was implemented with Pearson criterion χ^2. In computer calculation Pearson criterion χ^2_{emp} = 32.55 was higher than the significance level $\chi^2_{0.05}$ = 5.99. The discrepancy between distributions is statistically valid at the level 95 %, that proves the efficiency of the model for professional identity.

6. Findings

The evaluative component of the pedagogical model allowed determining the efficiency of its implementation by the activities (science, technological, organizational) (fig. 1).

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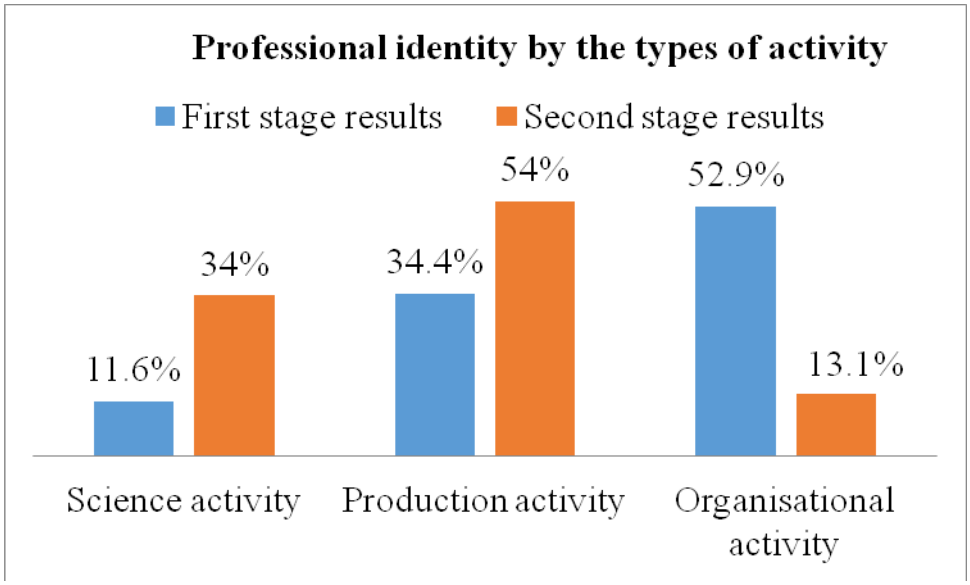

Figure 1. Diagnostics efficiency of learners' professional identity

At the first stage of the experiment, before implementing the model organizational activity prevailed (52.9 %), and scientific activity was less (11.6 %) than pragmatic activity (34.4 %), than after implementing the pedagogical model the results of the poll were different and the scientific activity (34 %) and production activity (54 %) increased. As well as there was an increase in motivation to the choice of professions in fundamental and applied science of engineering trends.

7. Conclusion

The research proves the importance of science and technology in high school because they affect the choice of learners' professional activity. The account of scientific and technological priorities provided developing and testing of professional identity model implemented in the integrated educational medium ("school – university, production"). The content modules of the model (science, technological, sociocultural) provided developing skills, interest to the future profession by the activities (science, production, organizational). The following tasks were solved: the learners were trained to science, technological activity, to developing knowledge in different aspects. The implementation of new integrated courses, innovational projects for developing science and technological skills, necessary in the future profession, has been tested experimentally. The theoretical importance of the study is in justifying the system of psychologo-pedagogical support for learners' professional identity; in developing modules of the pedagogical model (content, pragmatic, evaluative). The practical importance of the research in the demand of this pedagogical model, integrated courses of the regional importance in general education establishments. The developed activities: the competition "The world of professions in science, techniques, technology", the elective courses syllabi "Science, techniques, technology in natural science", "Regional chemistry", "Oil and gas in the region from history up to modern times"; projects "Study of the water quality in rivers Tura, Irtysh, Tobol", "Studying air purity by method of lichenoid indication", "Sciencelab", "Agrogeneration" have great importance for professional identity, education, upbringing of learners in the region and are implemented in the teaching practice of the whole region.

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