Training technologies for Industry 4.0 experts: updated andragogical model

IOP Conf. Series: Materials Science and Engineering **537** (2019) 042050 doi:10.1088/1757-899X/537/4/042050

Training technologies for Industry 4.0 experts: updated andragogical model

N A Shumakova and M V Savelyeva

Reshetnev Siberian State University of Science and Technologies, 31, "Krasnoyarskiy Rabochiy" prospect, Krasnoyarsk, 660037, Russia

E-mail: shumna@inbox.ru

Abstract. The article concerns the experience in training useful academic competences to industry 4.0 experts. The developed English course being an example of the internet thing for adult experts is based both on the current technical resources and andragogical principles of selecting education technologies. The research materials emphasize the renewed forms of training content, and demonstrate interactive essence enlarging. We have created a formula to "calculate" the expertise achievability and highlighted the necessary conditions based on polyparadigm approach and the andragogical principles.

Interaction with the generation Y, millenials, or digital natives reveals the issues of the conventional educational technologies, their deficiencies and incompatibility with the society and individuals' demands, and this represents an intellectual challenge for the practicing academics. Realizing the essence of cyber physical system (CPS) not as a unity but as an intersection [1], we implemented these ideas into developing a training course that is an internet thing in itself.

In the middle of the XX-th century there appeared a new scientific area in pedagogy – andragogy that covers the methodology and approaches to educate adults. Andragogical principles focus on relations of motivation, goals and emotions of the trainees; the assignments to train adults should be age and profession-specific. [2]

Innovating the ideas of Lev Vygotsky and other outstanding scientists, who agreed that there is no one psychology [3], as university educators for adults, we could say, there is no one pedagogy; even andragogy can reveal its various sides, being a part of pedagogy. The current education conditions are the basis of long-life learning concept means continuous changes of environment, requiring personality's fast customising and functioning within renewed conditions. The students of higher education schools are bachelors, masters, post-doctorial students, and retrained staff or students getting extra skill training; all of them can be a part of their adult age group conventionally. Therefore, every adult group requires their own approach in training and selection of pedagogical technologies as well as creating unique conditions to obtain an appropriate result. We consider the research of training a group of adults extremely significant because we have obtained some experimental material to prove the results of adult training could be satisfactory if the trainers follow the pedagogical technology prescriptions selected according to andragogy principles.

Due to RF Federal Law №273 "To the education in Russian Federation" issued at 21.12.12, training the personnel of higher qualification (PhDs) is the third level in the system of higher education. We would like to focus on training post-graduates and educators, as they seem the most motivated students

connecting their further personal development with the chosen scientific field, where the students are intended to contribute their research. Foreign languages are an integral part of post-graduates' professional training: it is determined by the internationalization of scientific communication, cooperation development of scientists and researchers at the global level, and extension of scientific discourse within the current communication. Good practical skills of a foreign language facilitate an access to scientific information, internet resources; they contribute to international scientific cooperation and boost a professional level of a researcher.

Along with the globalization processes the integrative tendencies in science, culture and education are intensifying, this strengthens the part of a foreign language as a tool of all integration processes. It is the language that incorporates the unity of communication processes, learning process and personality development. Under these conditions the goal and tasks of learning a language have a common ground with post-graduate professional training and becoming a scientist, because we could follow a process of a new personality development, and a language is learnt simultaneously with science as a form, where scientific knowledge exists according to scientific communication. The current comprehension of science as discursive practice requires mastering the structures and strategies of scientific discourse as top-priority as well as forms and communicative means together with the skill to operate them, while a post-graduate learns a foreign language.

Therefore, the PhD students of non-linguistic fields should master practical skills in a foreign language, allowing to use it for academic purposes and do research in foreign language environment. A foreign language provides both a tool to obtain appropriate current knowledge in the professional and research spheres and a tool to share the obtained information based on independent research with the scientific community enriching it with new knowledge. [4] The foreign language course is both professionally-oriented and communicative. Its specific development is determined by the necessity to modernize domestic post-graduate education and specification of its contents at the stated level.

Within the course practical foreign language skills should cover the following spheres of both verbal and non-verbal communication:

Reading fluently books and articles written in a foreign language and published in a scientific field;

Writing annotations or translating parts of information from the foreign resources;

Reporting on the research topics of a post-graduate student, socializing on the topics of the research;

Writing research articles.

These key skills could be presented by the formula similar to the polyparadigm approach [6]

$C_{fl} = R_r + P_i^o + P_i^w + W_c$,

where the competence in a foreign language can be indexed:

C_{fl} – foreign language competence;

R_r - reading research literature;

P_i^o – processing information orally, discussing it with colleagues, doing presentations;

P_i^w – processing information in written form: writing annotations, summaries for further research, this type of assignment is based on other researchers' texts;

W_c – written communication: writing articles, monographs, speeches belonging to the researcher.

However, we could form a competence in a foreign language teaching post-graduate students the stated skills, but they will experience the difficulties in scientific communication if they do not have enough practice in real scientific communication. Therefore, we need to develop an expertise in a foreign language. We could achieve it if students will realize that a scientific community understands their ideas expressed with a foreign language they have been learning for a long time. Currently, the post-graduates' students scientific ideas are discussed by the colleagues at the conferences and via scientific publication.

$$E_{fl} = C_{fl} * N$$

E_{fl} – foreign language expertise;

C_{fl} – foreign language competence;

N – a number of scientific events, where a post-graduate student participates and applies his competences in a foreign language.

Expertise in a foreign language increases if number of participation increases. If N equals zero, we cannot speak about expertise at all and in particular within the androgogical approach, because this approach assumes practical application with a professional sphere.

A foreign language course for post-graduate students is the final stage of the comprehensive course and an independent part of it with all its specific characteristics. Independence is considered to be one more androgogical principle. [3, 6] There are following specific features of a foreign language course for post-graduate students:

- Practising language tools to obtain and share scientific information;
- A great number of pages for independent reading in the sphere of scientific research;
- Practising fluent scientific speech;
- Intensive workload per week for every post-graduate student;
- Individual and group training;
- Big volume of post-graduates' independent work.

Since post-graduates are adults, they have to combine their job, their research and university classes, some of them live far from university due to their job places and family locations. These are factors to make a part of the course distant, namely to organize the bulk of their independent tasks distantly.

In this connection we decide to select a few modules of the course to make them suitable for distant learning. The modules cover preparing for public speech and academic writing, as these modules should be based on personal research, experience, and plans of the students. Realising the training goal is possible due to the blended learning format. The format is considered to be an integrity of the two complementing each other approaches to impart knowledge and training practical skills: traditional and electronic education, in particular, due to Moodle, a popular system among educators in Russia to control the distant learning. Moreover, blended learning, due to some foreign researchers [5], corresponds to the current requirements of the androgogy approach. The trainees do not have to leave their job places to study, on the contrary, education is incorporated into their everyday life, it becomes more individual to meet their professional and research demands, they can choose time, speed to perform the tasks.

The bulk of their time at this stage of preparation to the candidate examination, the post-graduate students need to develop their writing skill that is based on searching for and translating a monograph written in a foreign language and published by a known publishing house to prove its quality. The monograph should be useful not only to train their reading skill, processing information, but it has to be valuable for the main research. To process the information, post-graduate students need to translate a part of the research, create a glossary to know the main terms and be able to use them for their own research articles, write an annotated bibliography also useful for their research papers and the dissertation, and finally, be ready to paraphrase the information and prepare a reference to prove the information in their own article. For that purpose, we could discuss the possible resources during in-class sessions.

All those manipulations with the monograph are really helpful as the majority of post graduates notice the improving their native language acquisition (87%) according to the research by L. Vygotsky [3]. Our second interesting scrutiny during training academic writing to post-graduate students is the category of trainees, who are interested in comparing specific features of writing scientific texts, their language selection, lay out: 57% of post-graduates recognise academic texts in comparison to 34% of master students and 10% of bachelor students. According to our survey to study the attitude of students to the scientific texts, approximately 30% of bachelor students realize the necessity to do written exercises to improve their academic writing; however, they consider them to be an ordinary exercise. The master students have almost the same percentage (27 - 35%) of those, who understand how important academic writing is for their future development as scientists. Post-graduates perceive academic writing as an integrated part of their research and the process of becoming a scientist (78%). Moreover, when a post-graduate student writes their first article, they have a unique chance to collaborate with other scientists, such as their scientific advisor.

Since an article and other assignments in English intercultural communication is a significant aspect to learn while working with them. During in-class sessions a trainer can specify emotionality of scientists-beginners, who do not feel the situation and could be emotional in both writing and speaking. We need to discuss with our students when their emotions will not spoil the text, for example, science popular articles, but, on the other hand, absolutely emotionless publications in Russian scientific journals are not suitable for foreign publications. The post-graduates should study the features and author instructions of the leading journals in their research area indexed by SCOPUS and Web of Science.

The 1/3 of the course is connected with training public speech. In fact, every course unit ends with a presentation and public speech to the audience. The final admission to the candidate exam is after the public speech to the audience. As a rule, it can be a conference audience, which is more preferable for the post-graduate students, because they have the real condition to present their research, the second chance is to speak to the audience of post-graduate students sharing the same course with the speaker. The results of the experiment are: the conference speakers feel more exited and satisfied; their scores for the candidate examination are higher, because they realize the andragogy principle – practicability. Their peer could demonstrate only a speaking skill.

We would like to state that using the distant education resource [6] allows to optimize the academic performance rating of post-graduate students; in addition, according to the course structure, a trainer can assess post-graduates distantly, dynamically and individually leaving and routing the notes to the post-graduate student. A student can disagree, it is possible to share opinions; the procedure is not associated with the traditional assessment of a dominating trainer and a subordinating trainee.

Training adults requires organizing collaboration conditions between a trainer and a trainee, since under these conditions a trainer facilitates an educational process and a trainee obtains their autonomous position. Knowles, M.S. is one of developers of the theory and their practical application. [7]

We believe that developing interactive principles of training post-graduate students is worth discussing. [8] A. Gitterman warns that if a trainer does not take into account an adult student personal experience, the training results will not be satisfactory. The idea has been checked and proved by the time. Nevertheless, if a trainer applies a discipline-oriented approach, the adult audience does not demonstrate their motivation, and, as a consequence, they do not have their expertise. The problem-oriented approach reveals their interest and helps develop necessary skills. [8]

Therefore, planning and participating in training post-graduate students as digital natives it is necessary to follow the main principles of both industry 4.0 requirements and andragogy:

- A course should be professionally-oriented and based on trainee's personal experience and needs;
- Independent learning is a leading activity. Within the context of the principle, distant educational projects occupy the leading positions;
- To organize a course properly a trainer needs to involves collaboration of peer-students and among a trainer and trainees. The methodology allows to highlight the priorities among the teaching directions before the process starts and during the education process;
- Training is based on the available students' life experience, their practical skills. This principle facilitates to use the available knowledge to develop additional one based on the previous; the principle is essential to develop students' creative ability.
- Outlived personal experience and conservative approach can be adjusted to new conditions. This technique can help people with old-fashioned stereotypes get motivation and need for further education.
- The course developer should take into account the principle of the trainees' freedom to choose their target, contents, methods, terms, and location for their education. If trainers and course developers realize the principle in their work, it will result in their trainees' developed expertise in the discipline. [11]

References

[1] Lee E A 2015 The Past, Present and Future of Cyber-Physical Systems: A Focus on Models *Sensors* **15** 4837-69
[2] Fersman N G 2011 To some issues for training adults Proc. of internatinal scientific confernce Communication in polycode space: language, cultural and didactic aspects 11-13 May 2011, St Petesburg state polutechnic university
[3] Vygotsky L1986 *Thought and Language* (London: The MIT Press)
[4] Shumakova N A and Voroshilova A A 2012 *English for postgraduate students: text-book for post-graduate students* (Krasnoyarsk: Siberian State Aerospace University)
[5] Kytmanov A A, Noskov M V, Safonov K V, Savelyeva M V and Shershneva V A 2016 Competency-based Learning in Higher Mathematics Education as a Cluster of Efficient Approaches *Bolema* **30(56)** 1113-26
[6] Maev I V, Dautova O B, Dicheva D T, Andreev D N and Aleksandrova K O 2013 Andragogic Aspects of Gastroenterology Training in Terms of Doctors' Postgraduate Education *European Journal of Contemporary Education* **6(4)** 215-9
[7] Knowles M S 1972 Innovations in teaching styles and approaches based upon adult learning *Journal of Education for Social Work* **8(2)** 32-9
[8] Gitterman A 2004 Interactive Andragogy: Principles, Methods, and Skills *Journal of Teaching in Social Work* **24(3/4)** 95-112