

Applying Andragogy to Promote Active Learning in Adult Education in Russia

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I.V. Pavlova¹ and P.A. Sanger²

¹ Kazan National Research Technological University, Kazan, Russian Federation

² Purdue Polytechnic Institute, Purdue University, West Lafayette, IN, USA

Abstract—In this rapidly changing world of technology and economic conditions, it is essential that practicing engineers and engineering educators continue to grow in their skills and knowledge in order to stay competitive and relevant in the industrial and educational work space. This paper describes the results for a course that combined the best techniques of andragogy to promote active learning in a curriculum of chemistry education, in particular, chemistry laboratory education. This experience with two separate correspondence classes with similar demographics are reported on. Questionnaires and oral open-ended discussions were used to assess the outcome of this effort. Overall the approach received positive reception while pointing out that correspondence students have full time jobs and active learning in general requires more effort and time.

Index Terms—Active learning, Project based learning, andragogy, adult learning, chemistry laboratory education

I. THE NEED FOR ADULT EDUCATION

A person's initial period of education takes 15-20 years of life and prepares them to enter the work force. The working life of most adults continues for 30-40 years or more particularly as longevity is continually increasing. Investment in adult education is not only beneficial to the individual but is beneficial to society as well. It is important to create an awareness during the initial undergraduate curriculum that self-directed learning and continuous personal development is critical to success and depends largely on the ability to learn independently. In fact the UNESCO International Commission Report on Education for the XXI century [2] proclaims that teaching people how to independently acquire knowledge, skills and abilities should be the main objective of traditional education. Beside technical skills, improving interpersonal skills in an interdisciplinary environment is critical to professional growth in most careers. Therefore creation of this positive attitude toward self-directed learning along with the ability to flourish in an interdisciplinary team environment is one of the challenges of an undergraduate program, not only in the engineering disciplines but in all disciplines of a full university program.

Building on this foundation, technical professionals working in industry and in education are challenged to grow and remain current in their areas of expertise. Besides the challenging requirements of rapidly changing technology particularly in the information technology, their career growth is often into management involving inter-disciplinary teams and requiring a high degree of interpersonal skills to manage and direct such teams. As their years of experience increases, these professionals

acquire invaluable experience themselves and by observation of others in their environment. This experience gives the learner a rich context for applying new knowledge and new techniques. Therefore, as new programs are developed, the student's professional experience is a valuable resource and should be incorporated into the curricular strategy. Active learning using many of the tools from andragogy and project based learning could be an attractive approach to capitalize on their experience.

II. ACTIVE LEARNING APPROACHES USING ANDRAGOGY

Although the early concepts on adult education go back to the early 1800s, the concepts and name "andragogy" was popularized by Malcom Knowles in order to distinguish adult education from pedagogy or child education [1]. Since that time, andragogy has continued to grow particularly in Europe. Knowles theory and later embodiments in Europe are based on several observations that differentiate the mature and experienced learners from students just entering their careers.

- Mature learners must see the relevance of what their learning in their careers.
- Mature learners have a solid basic in their experience to make the content relevant.
- Mature learners take responsibility for their education.
- Mature learners are focused on the application of the content to problems, not on the content for the sake of the content.
- Mature learners are internally motivated and driven to learn.

Based in these fundamental assumption, the principles of andragogy include

- Problem centric
- Relevancy of the content to life and to prior experience
- Emotional Connection
- Self-directed learning
- Alignment
- Fun

In adult learning situations, teaching can focus more on training. Training activities can be less formal, and the role of the instructor shifts from a disseminator of information to a mentor and guide requiring a greater variety of methods and skills from the instructor. When traditional lectures and seminars are used, they must provide practi-

cal exercises, often experimental in nature, discussions, role plays, case studies, addressing specific industrial challenges. Effective use of group discussions and group work is common. The approach moves away from the theoretical knowledge and into practical application of the knowledge. In the tradition pedagogical paradigm widely used in Russia, the teacher acts as "the sage (the wise man) on the stage". In the andragogic approach, the teacher becomes instead a mentor and facilitator. Typical techniques used in the andragogic approach are: case studies, critical incidents, lecturettes (short concentrated lectures), peer to peer round table discussions. This new role for the instructor places a high value on the instructor having personal, first hand, experience from their own professional practice. In many universities today, most engineering professors have not practiced their profession in industry but have primarily focused on research making it challenging for them to relate to these experienced veterans of the profession.

III. ACTIVE LEARNING IMPLEMENTATION

A. Correspondence Course for Chemical Laboratory Education

In Kazan National Research Technological University (KNRTU) have developed an approach to active learning that was applied to a course on the organization and teaching of chemistry laboratory. The active learning methods in this course resulted from the assimilation of exceptional educational material accompanied by strong assessment and evaluation. The initiative had the following goals:

1. investigate and research active adult learning methods existing in the literature with proven efficacy,
2. validate and demonstrate their efficacy; and
3. identify, through trials, testing and feedback, the most motivating active learning methods of andragogy and PBL

To investigate the efficacy of the active adult learning methods the following assessment methods were used: surveys, oral discussion (in the form of an interview), personal observation, and direct inquiry during the period of the course.

The study involved 50, 3rd year students of the correspondence department at chemical technology of organic substances (____), divided into two groups being instructed in parallel in a single thread:

- Group 1 - age group 21-36 years (23 people), and
- Group 2 age group 23-45 years (27 people);

Student participation was 100% with all 50 students active in the effort.

Many andragogy tools were introduced into the course including seminar, lecture with errors, hands-on practice and experimentation sessions, brainstorming, business simulation, lecture-visualization, and lecture-dialogue. The *seminar-lesson* is a format in which students report to the group on a predetermined topic which they have researched. *Lecture with errors* is a format in which the students are given prior warning that the lecture shall contain a certain amount of error: technical, methodology, and behavioral. The average number of errors on the 1.5 hour lecture is 5-7. Students at the end of the lecture should identify the error and, either along with a teacher or alone, give the correct version. *Practice or workshop* is

a peculiar form of connecting theory and practice. The structure of the workshop is as follows: an introduction by the teacher, questioning by the students, a practical part, and a final word of the teacher. There are several variations in the practical part- abstracts, presentations, discussions, training exercises, problem solving, observation, and experimentation.

Brainstorming is a method for creative idea generation. The main objective of storming is to help participants uncover the conscious and subconscious mind, stimulate the imagination, think out of the box and get an unusual or original idea. *Business Simulation* is a form of a business game which involves a simulation model of the process under study, work; presence roles. *Lecture-Dialogue* is a format when content of the lecture is given through a series of questions to which the student must answer during the lecture. Finally *lecture-visualization* is a lecture enhanced by a display of slides, various images, structural and logical schemes, synopses, diagrams and videos. These methods form the basis for the students to evaluate the effectiveness of active learning.

B. Attitude Survey Instrument Used

The survey consisted of 16 questions divided into three thematic groups. The first group of survey questions (1-7 questions) was designed to identify common functional characteristics of active learning methods: relevance, effectiveness, interest on the part of students, simplicity and ease of understanding, recall and reproduction of the course material.

1. Is the project based approach beneficial to learning?
2. Is the material easier to understand if it is accompanied by a slide presentation, information booth, pictures, posters, group discussions and/or brainstorming?
3. Is the material easier to remember, if it is accompanied by a slide presentation, information booth, pictures, posters, group discussions, brainstorming?
4. Is it beneficial to include and discuss the projects and problems as part of group discussions, business games, seminars, practical and experimental exercises?
5. Do you feel more engaged in class in an interactive mode compared to classical lectures, practical exercises, laboratory work?
6. Do you feel you are improving individual understanding through participation in the project?
7. Do you see performance improvement through participation in the project?

The second group of questions (questions 8-13) focuses on the effect that active learning and project based methods had on the development of interpersonal relationships, personal qualities of students and attitude toward each other compared to the classical approaches of straight lecture.

8. Does participation in problem (active) exercises increase individual responsibility more than in the classical lecture approach?
9. Do active exercises increase the sense of confidence in yourself and your abilities than the classical approach?
10. Do active exercises create stronger relationships toward your classmates?

11. Do active exercises create stronger relationships toward your teacher?
12. Do active exercises increase a sense of respect and tolerance for the opinions of others?
13. Does project-based learning develop professional qualities, skills, abilities to a greater extent than the classical methods of teaching?

Finally the last three questions (14-16) explored the satisfaction of the students with the active learning project based teaching methods and satisfaction with the knowledge acquired.

14. In your opinion overall, are project-based learning methods effective in learning?
15. How do you think the use of project-based learning contributes to the effectiveness of the educational process?
16. In your opinion overall, is there a need for project-based learning in the educational process along with classical lessons?

C. Feedback from the Attitude Survey

68% of respondents found the active learning approach beneficial. However, only 52% of respondents agreed that the sessions taking place in an active and interactive modes are more interesting and generated more enthusiasm among the students. It was found that when the lecture course was accompanied by a slide presentation, the material was easier understood (72% of respondents) and was easier to remember (56%).

According to the survey 38% of students reported increases intellectual stimulation and 44% felt improvement in organizing and planning of chemical laboratories" as a result of the active learning approach. The response to active learning methods was encouraging: adult students found it easier to learn the training material, to find solutions to the issues raised and to encourage students to increase academic achievement.

For the thematic portion regarding personal interaction, 36% of respondents indicated that participation in problem (active) employment promotes a sense of responsibility, 22% improves self-confidence, 84% increases respect and tolerance for the opinion of others, and 28% felt a better professional competence as a result of the active learning approach. It should also be noted that the respondents (68%) showed improvement of friendly relations within the group and an improved attitude toward the instructor (34%).

The final theme (14-16) revealed that 64% of the respondents are confident in the effectiveness of active learning teaching methods were satisfied with the knowledge acquired. 26% believe that the use of active learning methods enhances the effectiveness of the educational process and 66% of respondents consider it important to use active learning methods in the educational process. Overall the response from the students was positive, encouraging and justified further research and curriculum development.

D. Survey on Particular Active Learning Methods

In the second survey the students were asked to rate the many forms of active learning that were introduced in the course. In figure 1, the methods are rated. Three methods (lecture with visual enhancements, laboratory experimen-

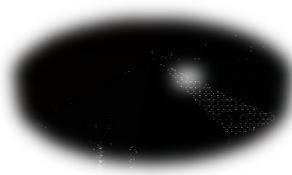


Figure 1. Active Learning Methods

tation and seminar) are rated the highest clearly above all the other methods. 20% of the respondents selected the lecture-presentation with visual enhancements method, which allows to focus only on the main material of the lectures presented in a concise and informative context supported by tables, charts, explanatory drawings and pictures. 18% of respondents opted for the experiment, the distinguishing characteristic of which is the ability to more fully integrate into the workflow. 16% of respondents interested in participating in the workshop where the students make a presentation in front of classmates and share their own experience.

When asked about the best lecture format, the lecture-presentation was the overwhelming favorite: 54% versus 32% for the classic lecture and 14% for the problem lecture, in which each new section begins with the formulation of a problem, followed by the disclosure of the methods and ways to solve it.

With regard to assessment or testing methods, the multiple choice test was the clear preference with 68% of respondents. Active learning options such as lecture with errors 22% of the respondents and control work with less than 10% were clearly not appreciated. The interpretation is that the adult students with full time jobs favor ready-made answers to select from which are more easily related to their experience as opposed to forming the answer in their own words as in the case of written tests.

For the adult learner, there is a clear preference for learning methods that allow for discussion and exchange of ideas. Accordingly 76% to the respondents favor group discussions where the student can fully disclose their attitude to the question posed, prove their own point of view to the problem, and justify the solution.

E. Open Ended Oral Group Discussion

To further investigate the reasons behind the survey results, an oral interview survey method was also used. The conversation was conducted with two groups of students. The conversation was held on one of the final classes in the lecture hall in the atmosphere of ease and trust. Students' answers were recorded on tape and later analyzed, summarized and structured. Seven questions were posed to the groups.

1) *Do you think the participatory approach used in this course was relevant and why?*

In general the students confirmed that active forms of learning were important, as this form is better for understand and less time spent on memorization. These classes encourage students to work in groups with reflection and presentations. Moreover, in discussion groups, it does not matter whose answer is more accurate. It is important to take into account the views of each on

the question and an opportunity to prove their point of view.

The groups also voiced opposing views. Active forms of learning require more attention, greater participation and takes more preparation time. Many students come to the evening session and sometimes come to class already tired. It is easier to prepare for tests in the classic approach, and takes more spare time to complement their training with seminar papers and reports.

2) *By what factor does active learning increase in your intellectual activity and degree of interest?*

When lecture is supported with examples from life and visualization in the form of posters, pictures and illustrations, the material is understood better. The active educational process for practical and laboratory classes is actually demonstrated. For example, as the reagents are stored, what forms of clothing and remedies exist? why glassware and equipment (laboratory equipment) have such a shape and arrangement? Some of their classmates shared actual direct experience reinforcing the lesson.

3) *Why, in your opinion, do not the active forms of learning lead to the strengthening of the sense of responsibility?*

- We believe that active forms of learning do reinforce responsibility as students must perform a greater amount of self-training at home. Much depends on the commitment of the students themselves. Active forms of education are likely to lead to greater responsibility and a sense of proper behavior but much depends on the moral and ethical qualities of the student.

4) *What do you like about the lecture-presentation format compared to classical? Slides that accompany the lectures show most important information while pictures and illustrations allow for a better understanding of the essence of the content.*

5) *Describe why you like/do not like these methods of active problem solving - group discussion, brainstorming, role play.*

Group discussion allows the group to find or suggest ways to solve problems and to justify its choice to the other team members to communicate. Working in a collaborative group is easier than working on their own. Brainstorming involves gathering a certain number of ideas within a given time but can be time consuming and requires a high degree of efficiency and mental effort. Business games are not really a suitable form of training for adult students 35-40 years old. This form of training may be better suited to younger full-time students.

6) *Why does the active or participatory form of training motivate or not motivate you to study?*

Active forms of learning are 1) generally more interesting, 2) provide more direct involvement than classical, 3) course material is understood easier and faster. On the negative point of view, the active learning 1) requires more out of class time for self-training and 2) students are accustomed to the classic forms of training.

IV. FUTURE WORK

The positive feedback from this initiative has led the way to extending this approach and integrate the active learning aspects of andragogy with the appropriate methods of Project-Based Learning (PBL). It is expected that team based projects on subjects directly related to the content should be welcomed since group problem solving and discussion as well as practical application of the content is at the core of PBL.

V. SUMMARY

Thus, active learning methods stimulate the thinking of students and are characterized by a high degree of interactivity, motivation and emotional perception of the learning process. The use of active learning methods can also develop cognitive and creative activity of students, improve the effectiveness of the educational process, generate and assess professional competence. It was found that the vast majority of the respondents supported the active learning teaching methods used. The survey results of the survey support that preferred lecture includes visual enhancement through slides and videos, the preferred testing method is the multiple choice test and the preferred problem solving method was the group discussion.

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AUTHORS

I. V. Pavlova is associate professor, Department of Engineering Pedagogy and Psychology of Kazan National Research Technological University, Karl Marx Street, 68, 420015, Kazan, Russian Federation (e-mail: ipavlova@list.ru). Member of IGIP. Her academic focus is the application of principles PBL in Andragogy.

P. A. Sanger is a professor in the School of Engineering Technology in the Purdue Polytechnic Institute of Purdue University, West Lafayette, IN 47907 USA (psanger@purdue.edu). His academic focus is real world, industry based senior capstone experiences including global international experiences.

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