Applying Andragogy and PBL Approaches to Enhance Continuing Professional Education in Russia

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INTRODUCTION

In this rapidly changing world of technology and economic conditions, it is essential that practicing engineers continue to grow in their skills and knowledge in order to stay competitive and relevant in the industrial workplace. This paper describes an approach to adult engineering education that combines the best techniques of andragogy with project based learning taking advantage of the experience, maturity and wisdom of the adult learner. The experience with three separate classes with very different demographics are reported on and compared as part of a Fulbright specialist grant to Northern Artic Federal University (NArFU) in Arkhangelsk, Russia. Well known project based learning (PBL) exercises such as the Skyscraper Project [1] and the “Deep Dive” video [2] plus embedded

projects were used to introduce project management to students of different maturity levels, from undergraduate to experienced engineers, and adapted to include andragogic approaches and capitalize on the knowledge and depth of maturity in mature learners.

1.0 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 [4] 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 industry. 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, engineering professionals working in industry 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 industry 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.

2.0 TYPES OF TEACHING APPROACHES

2.1 A**ndragogy**

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 [3]. Since that time, andragogy has continued to grow particularly in Europe. Knowles theory and later embodiments in Europe are based on several observation 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 must 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

- Active learning
- Problem centric
- Relevancy of Previous experience
- Relevancy of the content to life
- Emotional Connection
- Self-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 practical 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.

2.2 Project Based Learning

Project-based learning (PBL) is a pedagogical approach developed in the 1970s and initially applied to early childhood education. Lately project based learning has resurfaced and is being recognized as a path to relate engineering training to real world experience. The value of project-based learning is in training the individual with life experiences, and, in the process, mastering new ways of solving problems and generating new knowledge. Universities in many parts of the world are adopting PBL to develop engineering graduates capable of being the practical application oriented engineers needed in industry. This pedagogical approach is well established and has been reviewed extensively [5, 6, 7].

PBL is being implemented in a variety of different ways depending on the curriculum and the surrounding economic climate. Essential characteristic of projects within PBL are that the projects are central to the content being taught and not peripheral to the course, projects are focused on a driving question, the projects require transforming acquired

knowledge, the projects are largely student controlled, and finally the projects are real world problems [5].

With the introduction of projects into the learning process, students investigate problems and propose solutions over an extended period of time to acquire a deeper understand of the techniques and approaches being taught. The learner is actively engaged in the project, feels responsibility for the results and recognizes the trust placed in him. The PBL approach is often described as “learning by doing”. An additional benefit to PBL is that many of these projects are team based requiring the acquisition of and practice of interpersonal skills and increases an awareness of the complexity of interdisciplinary work.

There are many educational outcomes attributed to PBL and among them are the following:

- an ability to navigate changing conditions and to adapt to the new conditions which is a common occurrence in production activities.
- an ability to use modern computer technologies in the processing of the results.
- a thorough understanding of the theory and possession of the practical skills in the technical area;
- an ability to analyze literature in order to select the direction of the project.
- an ability to analyze results, reaching the necessary conclusions and formulate proposals.
- an ability to communicate conclusions and their basis in data and fact.

2.3 Integrating PBL with Andragogy

It is at once clear that the two approaches, andragogy and PBL, share some of the same techniques and approaches. Projects provide a pathway to the relevancy that mature learners seek, projects are learner centric, properly designed projects require active participation, engage the learner emotionally and are usually fun (sometimes only in retrospect). The value of project based education is a preparation for reality, a bridge between theory and the real world [2]. At the same time, the combination can create supplemental benefits. When projects are used in adult education, particularly for participants from industry, the projects can provide an opportunity to create something of direct value to their company as a result of the educational experience. Moreover projects can be created that require interdisciplinary teams and the development of interpersonal skills alongside the exploration of technical knowledge.

3.0 ANDRAGOGY/PBL IMPLEMENTATION

3.1 Fulbright Grant for Project Management Curriculum at NArFU

The context for the studies in this paper is a Fulbright specialist grant to Northern Artic Federal University to create a curriculum of study in project management and system engineering using a combination of teaching techniques from project based learning (PBL) and andragogy. The curriculum was intended to be used with university students as well as practicing engineers returning for continuing professional education. Three classes

with very different demographics were part of the program: 1) a class of twenty two multi-disciplinary faculty from all institutes from NArFU, 2) a class of seventeen undergraduate and first year masters students from three NArFU institutes (energy and transport, oil and gas and economics) and 3) a class of participants from regional industries including a pulp and paper mill, the Russian post office and banking. The curriculum content for all three was essentially the same project management tools described below. The toolkit includes project management tools ranging from systems engineering, from lean philosophy to skills in team interpersonal techniques, personal conflict management skills and communication. In each class, team projects were used in the course exercises and served as platforms to exercise the new skills. For the faculty (1) and younger student (2) classes, prolonged interdisciplinary projects were undertaken and pursued beyond the class. For the industry intensive workshops, the goal of the workshop was limited to the completion of an integrated project plan on real projects, several taken from their professional areas involving billions of rubles. The ultimate goal of this grant was to create a sustainable training program of courses and seminars with capable coaching practices.

The instructional approach was a comprehensive integration of andragogic and pedagogical techniques and methods of individual and team work (lectures, discussions, round tables, brainstorming, search methods, research methods, independent work and teamwork) that allowed students to actively participate in learning, analysis and finding solutions to problematic situations. This approach required active engagement of each participant and ensured a high level of involvement of all participants in the educational process. Individual responsibility is coupled with team based, project oriented responsibilities into an integrated learning opportunity. This approach was even more challenging, as it is implemented in a very traditional Russian structure of education.

3.2 Structural Elements of the Curriculum

As mentioned above this project was focused on training in project management and systems engineering. The tools in these two disciplines include

- development of a clearly defined scope of activities,
- establishment of a matrix of requirements with measurable results,
- brainstorming for out of the box solutions,
- in-depth analysis of the solution of the problem
- quantitative analysis of alternatives as a result of a project approach based on consensus,
- development of a task structure using Gantt charts resulting in critical path driven schedules
- analysis of failure modes (as described later, risk management was added later at the students request,
- development of a test plan for to ensure that the product or project meets the expectations and requirements.

While the instructors implemented andragogy and PBL in many areas, three course activities have been highly successful in other training venues and were used here for all

three demographics: the Skyscraper Project [1], the video “Deep Dive”[2] and incorporation of an applied project [4]. This paper will concentrate on these three elements and the feedback, observation and discussion obtained relative to the effectiveness of these instruments.

3.3 The Skyscraper Exercise

The Skyscraper Exercise was created by engineering educators from Massachusetts Institute of Technology and United States Naval Academy and it contains all the major components of the conceive, design, implement and operate (CDIO) pedagogical approach in an exciting format. The three hour exercise is to design, build and test a model skyscraper based on an historical scenario using a variety of foam blocks and pencils as the fasteners. The structure is required to support a 0.5 liter bottle of water while being tilted on a 10% slope to simulate earthquake durability. Overall height and aesthetics are the principal evaluation factors. The exercise is available at. www.cdio.org/files/document/file/Skyscraper_Template_Full.pdf with both instructor guidance and the challenge elements for the students.

The PBL outcomes include exercising of basic disciplinary knowledge about structures, anticipating and mitigating risks through concurrent testing and research activities, maximizing team performance through organization and delegation of tasks, allocating time and managing to a schedule, trading off technical performance within a defined and fixed budget and executing the design strictly according to the design documentation. To enhance this project and capitalize on the experience of mature learners, this project was extended to include group discussion on the issues and experience during the project. The groups were asked to reflect on the activity, give examples in their own jobs where research and advance planning had avoided problems, and consider the impact of competing constraints placed on the solutions developed. The groups then reported back to the whole group. From the reactions of the group and the engagement of the group in

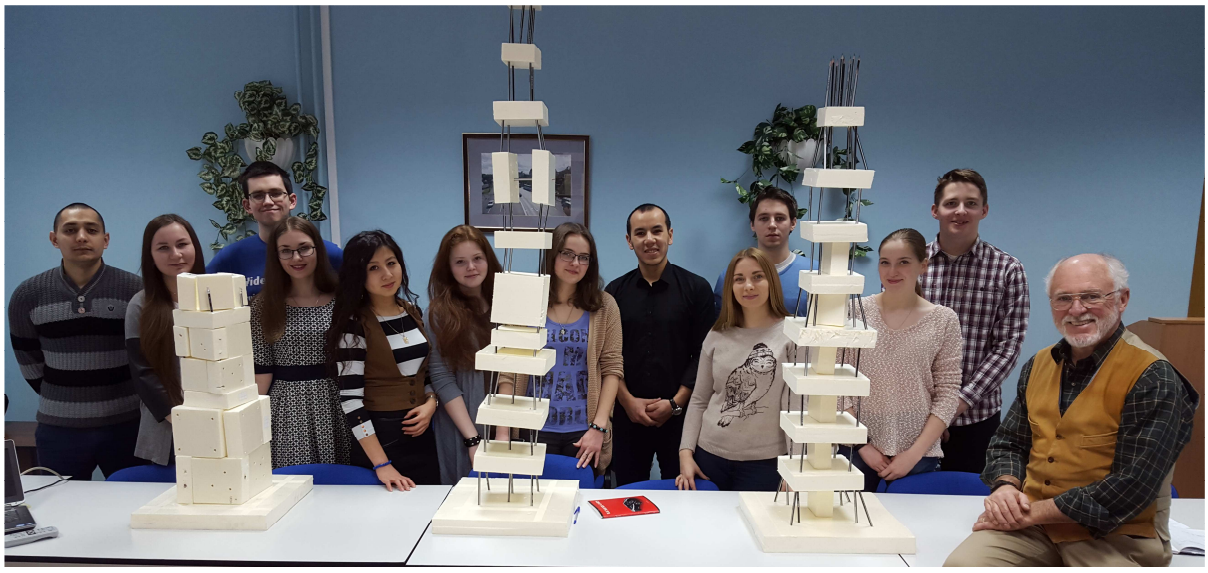

Fig. 1 Undergraduate and first year students at completion of the skyscraper project.

realizing common observations, this approach shall be expanded. From all groups, the element of competition added the dimension of fun into the learning. One of the key outcomes for this exercise was the appreciation for early research during a project to reduce risk to the project. For all groups, the budgetary constraint on the project put a damper on research spending. The student group (2) had less trouble in exploring and doing research. Innovation was stronger in the student group partly due to more experimentation (Fig. 1). The faculty group, during its reflection period, commented that they wished that they had done more research. From an instructor's point of view, this reflection was viewed as victory since an increased appreciation for preparatory research was realized. For the experienced professionals, little to no research was done ahead of

Fig. 2 Enthusiastic mature learners with the Skyscraper project from Russian faculty and industry (Arkhangelsk, Russia, 2015-2016

time (Fig 2). This lack of experimentation was surprising but points out some of the limitations arising from work experience. In the discussion that followed, it became apparent that what was displayed as overconfidence stemmed from the feeling that the project was too simple and their experience was sufficient. During the construction phase, problems became apparent pointing out the penalty for not experimenting and, though the task was simple, advanced experimentation was an important activity. Once again, perhaps this was a good outcome if this renewed awareness is reinforced and carries over into their workplace. Overall the use of this instructional tool was a success and the differences in maturity level resulted in different takeaway learning outcomes.

3.4 The Deep Dive

Another of the tools that was used in this curriculum was the video, “The Deep Dive”. This video was first aired on ABC on July 13, 1999. In this video the process of developing new ideas is applied to the task of re-designing the grocery store shopping cart. The video covers all phases of product development: researching the problem, brainstorming solutions, generating prototypes of the solutions and testing it in the real world. For a classroom of young learners, it is common for the instructor to guide the students to conclusions based on his/her perceptions and experience. For mature learners, the situation was flipped. Once again in groups of five to six, the group was asked to give their observations asking questions such as: what would work in their plant? What would not work? What was their experience with innovation, brainstorming? What were the problems? What creates a culture that encourages innovation? What destroys innovation? In both the faculty group and the industry group, the difference in Russian management and leadership styles from American styles became immediately apparent. Admittedly the management style in the video is very unique for even America but in Russia this open, innovative culture where good ideas are welcomed from all levels in the organization even if these ideas are the opposite from the boss’s ideas is unheard of. The more mature students came with a cynicism about the management culture that they had experienced. Not surprisingly the younger students were much more open to the idea and seemed to embrace it quickly. Once again experience in real life put a major damper on what could be possible.

In these examples it became apparent that the experiences of the mature learner had both positive and negative influences on the learning process. The mature learner had formed an opinion about what was possible and what was not, mostly from a culture point of view which is what these two exercises tapped into.

3.5 Embedded Real Projects

Finally the third element of the merged andragogic/PBL approach used in this series of training was the incorporation of an actual project into the training, in other words, being able to apply the lessons being taught immediately on a real project. For the purposes of this paper only the extremes in maturity demographics are discussed here.

For the younger students, ideas for these projects were solicited and based on group interest, four teams were formed. The project topics were all around societal challenges:

a comic book for young children on recycling, a video and presentation for 10-13 year old children on energy conservation, a website to foster interest in international foods using videos and recipes and finally a book aimed at four year olds forming healthy attitudes about children with disabilities. These teams worked on the projects for eight weeks taking the project from conception to completion. Three of the teams fully completed their project while the fourth team fell short of full completion. This training was the first experience that this group of students had had on project management. Project plans were made and the teams executed on the plan. Reflection at the end of the project centered on how much effort should go into the planning phase to make the project a success. Inadequate planning resulted in last minute Herculean efforts to complete the project. Overall the planning was good enough to be positive reinforcement for doing early project planning.

The group of participants from industry also had projects to which to apply the curriculum. For one third of this class, this training was also their first introduction to project management. This group of students reflected immediately on how important it was to be able to apply the tools and learn to use them with mentoring of the instructor. The concepts were understood more quickly that the young student group and the tools were effectively applied. The other two thirds of the participants had experience in project management and had used the scheduling tools being demonstrated. They also applied these tools to existing projects that they were involved in at their plant and had just been initiated. However their experience with projects allowed them to recognize that projects do not go as planned and lead them to request tools in risk management, i.e. how to deal with and mitigate risks resulting from tasks being impacted both negatively and positively by a changing environment. To meet this need, the class was then given exercises in the process of risk management and applied these new tools to their projects assessing types of risks and their sources and developing proactive mitigation actions.

These are just three examples where established tools and exercises in project based learning has been applied to project management and extended with andragogy techniques to appeal to the mature learner with surprising results. The evolution of the curriculum demonstrated that the mature learner can take charge of their education and development. However their experience can sometimes act as barriers to new approaches.

4.0 SUMMARY

Courses in project management have been implemented in all the institutes of NArFU. The introduction of integrated andragogic/PBL techniques applied to project management has added interactivity, effectiveness, independence and involvement of students in the learning process while promoting the formation of key competences of future specialists. Feedback from the students varied from highly enthusiastic from the younger students to interesting from external industry professionals depending on their age. The skyscraper project is being used in several of these courses to integrate the tools of project management and demonstrate their effect on efficiency and performance. The mature learner comes with experience that can reinforce as well as inhibit learning. In this study

it became clear that applying these techniques for the younger students can also have positive impacts with different outcomes.

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