

## Methods and Strategies of Teaching Mathematics to Adult Learners

Khalil Alsaadat

College of education, King Saud University, Riyadh, Saudi Arabia

**Abstract.** Adult learning opportunities exist in a wide variety of conditions and physical possibilities: from a formal educational institution, paid private courses to a place of work. While planning teaching of mathematics to adult person or group of people it is essential to take into account the students' previous knowledge and experience of studying this subject, including their ability to self-recognize their own skills and psychological readiness for being taught. Considerations for adult development in general and education particularly include biological and psychological aspects, also factors of deterioration and disease processes that may occur, as well as the sociocultural and integrative developmental perspectives. These and other constituents determine the whole process of mathematics teaching in young and adult peoples' abilities to study mathematics at all. This article deals with the andragogical aspect of adult education and adult education programs and is aimed at understanding the process of adult education in the niche of mathematics teaching. Specific strategies of both teaching and learning math for adult learners are provided and their implications are discussed.

**Key words:** methods and strategies of teaching, teaching mathematics, learning mathematics, adult learners, education, andragogy.

### Introduction

Andragogy is the art and science that deals with support to adults to learn. Andragogy is a theory of adult learning, which studies the specific patterns of acquisition of knowledge and skills by an adult subject in the learning process, as well as the peculiarities of the leadership of the latter by a professional teacher. Andragogy as a science generalizes the practice of adult education, it provides knowledge that allows someone to formulate and implement the main goals of adult education. It creates a theoretical and methodological basis for activities that help adults acquire general and professional knowledge, master the achievements of culture and form (or revise) life principles.

In the modern system of continuing education the main link of which is adult education, due to constant changes in the content and nature of work; dynamic accumulation of knowledge in all spheres of science, technology and culture; restructuring of public life, the development of its democratic principles, the broad involvement of man in the system of social and industrial management. Adult education is becoming more than the right, this is the key factor of success in the 21<sup>st</sup> century. It is important both for each individual citizen and for society as a whole. Adult education can shape a person and give adults meaning in life. Andragogy deals with a holistic learning process through which people develop their abilities, expand their knowledge, improve their professional skills or learn something new according to their personal needs or the needs of society.

The whole history of the formation and development of human learning as an independent area of its activity indicates that learning must be continuous and adaptive. Since the staff of enterprises is made up of adults, the training must be carried out taking into account their age, socio-psychological, national and other characteristics. This is the purpose of modern pedagogical science - andragogy - a branch of pedagogical science that reveals the theoretical and practical problems of teaching, upbringing and education

of an adult throughout his life.

In a broad sense, andragogy should be understood as the science of personal self-realization throughout life.

Malcolm Knowles is considered as the father of andragogy. He proposed five factors of adult learning. The Malcolm Knowles' five assumptions underlying andragogy consider an adult student as a person who has independent self-esteem and can self-guide his learning. The adult learner also accumulates a stock of life experience, which is a rich resource for learning. He/She has training needs that are closely related to changing social roles. The adult learner is focused on problems and is interested in the immediate application of knowledge and is motivated to learn by internal rather than external factors (Conlan et al., 2004: 43).

Malcolm Knowles used these principles to propose a program for the design, implementation and evaluation of adult learning. Since the development of his theory, Knowles has acknowledged that the principles he outlined did not apply solely to adult education. The development of the theory simply illustrates that the designer "should involve learners in as many aspects of their education as possible and in the creation of a climate in which they can most fruitfully learn" (Conlan et al., 2004: 48-49). Knowles' focus with the development of andragogy was the notion of the material being very learner centered and the learner being very self-directed.

Modern world identifies the following key positions of andragogy as a science: priority of independent training; joint activity principle; using and generalizing the spectrum of available positive life experience (both social, individual, professional); adjusting outdated experience and personal attitudes; individual approach to learning activity according to the personal needs; the elective learning principle that creates more freedom in the space of education both for a student and for a tutor; reflectivity principle; demand notion that causes psychological motivation for studying and allows to make a stress on the practical skills necessary for fulfilling some job position of making some special work in the context of incumbency; systematic learning notion; fundamental of updating learning outcomes; accent on student development.

### **Adult Learning Programmes**

With our ever-accelerating speed of change in both knowledge and technology, it is clear that we adults have a choice (Sharon and Sharon, 1994). We either continue to learn throughout our lives, or we allow our skills and knowledge to quickly slide into obsolescence. The same principle applies to companies: Those who fail to continually teach and train employees quickly slide into obsolescence.

Private employers spend \$210 billion a year for training, while the government spends an additional \$5 billion. These numbers have increased many times, but are these training programs doing the job? Some are; some are not. Highly effective adult learning requires certain conditions. The question is what are those conditions? (Billington, 2004).

Because few studies have examined what type of learning environment best helps adults to grow and develop, Billington (2004) conducted a four-year study of this question. Why connect growth with learning? Because significant learning and personal growth are inseparable, growth is learning. The term growth here refers to the maturity of our thought processes. Just as children develop from simple to complex thinking, we adults can continue to mature in the way we think. In addition, the way we think affects our character development, moral judgment, interpersonal relationships, impulse control, self-concept, and how well we function in our environment. Yet we have all

noticed that not all adults continue to grow; some cease to learn; thus they cease to grow.

The study investigated which factors in adult learning environments best facilitate adult growth and development. Sixty men and women who began doctoral programs when between ages 37 and 48 participated. They completed two tests measuring adult development, a questionnaire, and 17 were interviewed. All measures revealed the same results. It was as though this research snapped multiple pictures of a barely visible phenomenon from various angles, and when developed, all pictures revealed the same clear image.

Billington (2004) said that, results revealed that adults can and do experience significant personal growth at mid-life. However, adult students grew significantly only in one type of learning environment; they tended not to grow or to regress in another type. What was the difference? The seven key factors found in learning programs that stimulated adult development are:

1. An environment where students feel safe and supported, where individual needs and uniqueness are honored, where abilities and life achievements are acknowledged and respected.

2. An environment that fosters intellectual freedom and encourages experimentation and creativity.

3. An environment where faculty treats adult students as peers--accepted and respected as intelligent experienced adults whose opinions are listened to ,honored, appreciated. Such faculty members often comment that they learn as much from their students as the students learn from them.

4. Self-directed learning, where students take responsibility for their own learning. They work with faculty to design individual learning programs which address what each person needs and wants to learn in order to function optimally in their profession.

5. Pacing, or intellectual challenge. Optimal pacing is challenging people just beyond their present level of ability. If challenged too far beyond, people give up. If challenged too little, they become bored and learn little. Pacing can be compared to playing tennis with a slightly better player; your game tends to improve. But if the other player is far better and it's impossible to return a ball, you give up, overwhelmed. If the other player is less experienced and can return none of your balls, you learn little. Those adults who reported experiencing high levels of intellectual stimulation (to the point of feeling discomfort) grew more.

6. Active involvement in learning, as opposed to passively listening to lectures.

Where students and instructors interact and dialogue, where students try out new ideas in the workplace, where exercises and experiences are used to bolster facts and theory, adults grow more.

7. Regular feedback mechanisms for students to tell faculty what works best for them and what they want and need to learn--and faculty who hear and make changes based on student input.

In contrast, in learning programs where students feel unsafe and threatened, where they are viewed as underlings, life achievements not honored, those students tend to regress developmentally, especially in self-esteem and self-confidence. In programs where students are required to take identical lockstep courses, whether relevant to professional goals or not, and where they are often expected to spend several years working on a dissertation that is part of a professor's research project instead of on a topic of their choice, they grow less. In other words, students grow more in student-centered as opposed to faculty-centered programs.

A clear and simple mini-lab on effective and ineffective adult learning environments can be observed in English-as-Second-Language classes for new immigrants. In classes where students feel safe, where lessons are focused on current language needs, where students are asked for input on what helps them most to learn, where students are actively involved in interesting and fun exercises, where there's lots of laughter and congeniality, students of all ages and backgrounds learn English fast and well. In classes where students are made to feel inadequate and threatened, little is learned. These findings support the thinking of Malcolm Knowles, recognized as the father of adult learning; his trailblazing work underlies many of our most effective adult education programs. He reminded us that in optimal adult learning programs, where adults learn best, both students and faculty also have fun, for it is exhilarating to really learn (Billington, 2004).

### Literature Review

Berry et al. (2015: 194-204) reported in their study that the provision of some level of Mathematics Learning Support is now commonplace in the majority of Higher Education Institutions in the UK and Ireland. Most of these supports were initially established with the aim of trying to address the problem of large numbers of first-year students with weak mathematical backgrounds. The centres provide students the opportunity to overcome mathematical issues in their transition from school to Higher Education. This article presents findings from a recent quantitative study at a university, where the range of supports available and levels of engagement have increased dramatically since they were first offered in 2007. They investigated if the Mathematics Support Centre there was still helping the students who needed it most; in particular, we considered students' mathematical backgrounds, the number and length of their visits and their end of year module grades.

Lowrie and Jorgensen (2015: 202-215) in their investigation explored pre-service teachers' mathematics content knowledge (MCK) and beliefs associated with mathematics education practices. An Exploratory Factor Analysis, conducted on a beliefs and attitudes questionnaire, produced three common attitude factors associated with (1) inquiry-based teaching; (2) how mathematics knowledge is acquired; and (3) the applicability of mathematics. These factors were used in subsequent multivariate analyses to determine whether teachers' mathematics competence influenced their personal mathematics viewpoints and perspectives. There was no difference between those students who had studied advanced and standard mathematics at school on the three belief and attitude measures, despite distinct differences in their MCK.

Clark-Wilson and Noss (2015: 1-25) reported in their study that the notion of the lesson "hiccup", defined as the perturbation experienced by a teacher during teaching that has been triggered by the use of mathematical technology. Hiccups which are both unanticipated and unplanned emerged from a study that sought to make sense of the process of secondary mathematics teachers' situated learning as they began to use a particular new technological tool (TI-Nspire™ handheld devices and software) in their classrooms. The high frequency of the resulting hiccups enabled a categorisation of seven hiccup types that were shown to have influenced the development of teachers' mathematical, pedagogic and technological knowledge. This article first reports and then extends this earlier work by articulating the design principles for a professional development approach within the Cornerstone Maths (CM) project that uses hiccups to try to address professional development "at scale" concerning student use of dynamic digital technologies in mathematics classrooms.

## Results

### *The Math Teacher*

Linde (2015) provided the following strategies for math teaching. She argued that math teachers have a nuanced job. They must teach the building blocks of math, such as number sense and operational skills, as well as boost students' ability to think about problems. They need to incorporate aspects of language (including reading and writing) into their subject and provide direct instruction on methods of exploration. Additionally, math teachers must motivate students to try and teach them to persevere when problems are challenging. Let's look at some of the best methods and strategies for a quality math program.

### *Methods for Teaching Math*

When we talk about a method of instruction, we mean how content is being taught. This runs the gamut from style of instruction - for example, lecture vs. hands-on - to materials used. Here are some tried and true methods for teaching math:

### *Use Visuals*

Many learners need to see a lesson in addition to hearing it. While explaining an operation or skill, use a visual or graphic to help get the point across. This can be as simple as showing the lesson on a document camera or as savvy as using a video or other technology tool.

Note that adult learners do best when instruction is paired with a visual; using a visual as a stand-alone teaching device isn't always effective. Vary your usage to keep students engaged.

### *Make Connections*

Our brains are machines that thrive on connections. In fact, long-term memory is a complicated web of neurons, or brain cells, banded together. To help learners make sense of concepts, provide them with connections to the real world or previously taught lessons. Always begin a new lesson with a reminder of the last. For example, you might say, 'Yesterday, we learned about the numerator in fractions. Today, we'll take a closer look at the other part of a fraction: the denominator.'

Also, pay close attention to how learners react to the connections you make; for example, one group might understand best when you use board games as an example, while another group might react better to an example connected to sports.

### *Use Assessments*

Math is typically a progression-based subject. Skills build one upon another, and the order in which they're taught is predetermined. Because of this, a math teacher doesn't have to think much about what to teach when, but it is necessary to use assessments to determine student understanding. Formative assessments, or informal assessments meant to check in on student learning and drive future instruction, should be used frequently. This can help teachers identify students who struggle and allow additional small group or one-on-one instruction.

Formative assessments aren't usually taken for grades. Adult learners need to feel comfortable with their exploration of a subject without fear of their performance being used for grading.

### *Focus on Strategies*

As we'll talk about later, math is all about problem solving using strategies. Sometimes, there's only one way to solve a problem, but many times, there are multiple avenues to the answer. When teaching, model several strategies for understanding and exploring a concept. Encourage students to apply high-level skills

when given problems and focus on the thought process involved in the solution. Although math usually only has one right answer, being able to reason through the steps to find the answer is the most important part of being a successful math student.

#### *Teaching Math Strategies*

As discussed above, we want our learners to be mathematical thinkers. This means they need to think strategically about solving math problems. A strategy, then, is a way teachers instruct for maximum benefit. Teachers use strategies to help learners learn math as well. Thinking about how to best deliver a lesson is foremost in quality teaching (Linde, 2015).

#### *Implications*

The national adult literacy agency discussed teaching mathematics to adult learners they stated that Many people say that they had negative experiences of learning maths

in the past – usually at school. For someone to return to education in maths is often a huge step and can be motivated by a number of factors, such as:

- needing to pass a course that requires maths assessment;
- needing to pass a one-off test, such as an entry test for a course or job;
- wanting to help children with their school work;
- wanting to learn something that they always wanted to crack – common topics that learners mention are long division and fractions;
- wanting to better themselves generally.

If someone wants to return to learning they have probably overcome many barriers already. If someone needs to learn then they might have some anxiety.

Of course, for some learners maths may be something they never had the chance to learn formally or achieve certificates in, so don't assume that everyone has been scarred. Some people even enjoy it.

#### *Maths Anxiety*

Many tutors recognise the phenomenon known as “maths anxiety”, “fear of maths” or “mathsphobia”. Students often avoid maths because of what appears to be a genuine fear of a subject they associate with worry, demoralisation and even humiliation. Recent research from the University of Chicago identifies that people who experience anxiety about doing maths register actual pain during brain scans.

Tutors need to recognise, but not over-dramatise, the emotional baggage that some of their learners might bring to their learning.

Ask potential or new learners about their purposes in returning to learning and to ask, simply, “How did you find learning maths in the past?”

If they tell you that they had a difficult time:

- explain that they are not alone in having had an unpleasant experience of maths learning;
- describe the way in which they can learn maths with you and what they can expect;
- explain that if they struggle with understanding maths you will do your best to;
- explain in different ways and never to be afraid to ask for help again and again;
- try to encourage them to focus on the maths they already use in their daily lives and say that you will build on what they already know and do.

It is a sad fact that, although people use a lot of maths in their daily lives, when you point this out to them they will say, “That's just common sense”. It seems that many of us see maths as being, by definition, the “difficult stuff” that we cannot do. Also, maths tutors need to have the language to describe concepts in several different ways, and

make connections with learners' existing knowledge and between different maths topics. If you're new to tutoring numeracy/maths, it would be worth taking time to prepare yourself with a few refresher exercises for yourself. Try these challenges:

- explain in no more than 50 words what a percentage is draw a picture that describes how 0.5 means the same as half;
- explain the connection between decimals, fractions and percentages – and give examples of times when you would use one rather than another;
- explain "place value" up to thousands;
- explain how the metric system makes calculations easier than the imperial;
- show a friend how to use "number bonds" and a "number line" to make their mental addition or subtraction skills more efficient;
- explain when you would use a pie chart to display data.

It's possible that you won't be familiar with some of the terms in these challenges above.

In conclusion, adults bring to learning a wealth of math's knowledge and experience, often without realizing it. For example, in spite of a lack of skills, many people will have:

- managed personal and household budgets;
- used timetables;
- shopped and cooked;
- chosen a mobile phone and read a gas meter.

They are likely to have used a range of strategies, often successful but sometimes flawed, as they manage the numbers in their lives. The first job of the maths tutoring is to establish what people want or need to learn. The next is to identify what they already know, understand and can do. As with all of us, learners might have picked up misconceptions or have gaps in their knowledge. It is important to uncover these misconceptions by observing how learners approach tasks, and by asking questions to check for understanding of method (NALA, 2015).

### Conclusion

Therefore, speaking about the methods of teaching mathematics for adults, it should be understood that many even adults are afraid of mathematics. Sometimes at an older age, if this is connected with the school experience of teaching this discipline, an already rooted psychological complex is formed on the basis of fear. Scientists who investigate this issue have not yet come to an agreement: this is fear due to ignorance or ignorance from fear. Today it is known that the very sense of number is inherited from parents. However, mathematical abilities can be developed in any mentally healthy person, applying a number of efforts, tactics, methods, which in integrity can be called a technique. Speaking about adult education, the advantage is prevaillingly the presence of a responsible attitude to learning, as well as a high degree of motivation. Because most often the incentive to learn math in adulthood does not come from nothing, but is caused by a specific conscious need; for example, the prospect of getting the right education or getting the desired position, work in which requires proper knowledge of mathematical skills.

The process of teaching mathematics for adults is considered based on the methodological, mathematical and methodological foundations of the methodology of mathematics, therefore it is advisable to consider it from the point of view of various aspects:

- the didactic aspect, has a binary (i.e. bilateral) character due to the interaction of

its participants; involves bilateral activities of teachers and students, a special systematic organization and management, integrity and unity; this is a system that includes as its main components: initial state, goals, pedagogical means, conditions and result; the learning process is aimed at achieving the goals of education;

- psychological aspect: the learning process is carried out in accordance with the laws of age development of students; managing the development and upbringing of students, thanks to the mental functions of learning (sensation, perception, imagination, thinking, etc.), as well as the laws of mental activity (the need-based nature of the activity, developing the nature of learning, the unity of consciousness and purpose, etc.);

- methodological aspect: the learning process is carried out using educational technologies; variable.

The specific course of learning mathematics in practice will depend on a number of related factors: age, individual or group learning, the necessary and initial level of knowledge, the technical capabilities of the teacher and students, the intensity of classes, etc.

### References

Berry, E., Bhaird, C.M.A., O'Shea, A. (2015). Investigating relationships between the usage of Mathematics Learning Support and performance of at-risk students. *Teaching Mathematics and its Applications: An International Journal of the IMA*, 34(4), 194-204. <https://doi.org/10.1093/teamat/hrv005>

Billington, D.D. (2004). Seven Characteristics of Highly Effective Adult Learning Programs. Available at: [http://jscarcella.academic.csusb.edu/E-Text\\_Shea/She0809/Supplemental/Seven%20Characteristic%20of%20Highly%20Effective%20Adult%20Learning%20Programs.htm](http://jscarcella.academic.csusb.edu/E-Text_Shea/She0809/Supplemental/Seven%20Characteristic%20of%20Highly%20Effective%20Adult%20Learning%20Programs.htm)

Clark-Wilson, A., Noss, R. (2015). Hiccups within technology mediated lessons: A catalyst for mathematics teachers' epistemological development. *Research in Mathematics Education*, 17(2), 1-25. <https://doi.org/10.1080/14794802.2015.1046476>

Conlan, J., Grabowski, S., Smith, K. (2003). Adult Learning. In: M. Orey (Ed.), *Emerging perspectives on learning, teaching, and technology* (pp. 43-51). Athens: University of Georgia.

Linde, Sh. (2015). Smart Board: Lessons and Activities. Available at: <https://study.com/academy/lesson/smart-board-lessons-and-activities.html>

Lowrie, T., Jorgensen, R. (2016). Pre-service teachers' mathematics content knowledge: implications for how mathematics is taught in higher education. *Teaching Mathematics and Its Applications*, 35(4), 202-215. <https://doi.org/10.1093/teamat/hrv008>

Sharon, Y., Sharon, S. (1994). *Group Investigation in the Cooperative Classroom*. Handbook of Cooperative Learning Methods. Westport: Greenwood Press.