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Adult Learning Mathematical Perspectives

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Abstract:

Learning opportunities for adults exist in a variety of settings ranging from a formal institution to a place of employment. It is important to acknowledge prior knowledge and experiences of learners, including their ability to recognize their own skills as lifelong learners. (Merriam, 1999, in Conlan, Grabowski, & Smith).

Considerations for adult development and learning include biological and psychological development including deterioration and disease processes that may occur and sociocultural and integrative perspectives on development (Merriam, 1999, in Conlan, Grabowski, & Smith). These factors and others influence teaching mathematics to young and adultsabilities to learnmathematics. This paper sheds some light on the andragogical aspect of adult learning and adult learning programs in order to understand the process of adult learning mathematics. Strategies for teaching and learning mathematics to adult learners are provided and implications are discussed.

ANDRAGOGY:

Andragogy is the art and science of helping adults learn. Malcolm Knowles is the father of andragogy as he proposed five factors involved in adult learning.

The five assumptions underlying andragogy describe the adult learner as someone who:

- Has an independent self-concept and who can direct his or her own learning
- Has accumulated a reservoir of life experiences that is a rich resource for learning
- Has learning needs closely related to changing social roles
- Is problem-centered and interested in immediate application of knowledge
- Is motivated to learn by internal rather than external factors (Merriam, 2001, p. 5, inConlan, Grabowski, & Smith).

Conlan, et. al said 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" (Merriam, 2001, p. 7, in Conlan, Grabowski, & Smith). Knowles' main focus with the development of andragogy was the notion of the material being very learner centered and the learner being very self-directed.

Principles (Conlan, Grabowski, & Smith):

- Adults need to be involved in the planning and evaluation of their instruction.
- Experience (including mistakes) provides the basis for learning activities.
- Adults are most interested in learning about subjects that have immediate relevance to their job or personal life.
- Adult learning is problem-centered rather than content-oriented.

Adult Learning Programmes:

With our ever-accelerating speed of change in both knowledge and technology, it is clear that we adults have a choice: 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, 1996).

Because few studies have examined what type of learning environment best helps adults to grow and develop, Billington 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. And 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 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, 1996).

Related studies:
Berry, Bhaird& O'Shea, 2015, 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&Jorgensen, 2015, 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.
Wilson &Noss, 2015, 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, was first proposed in Clark-Wilson. 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.

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, study. com, 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:

1. · needing to pass a course that requires maths assessment
2. · needing to pass a one-off test, such as an entry test for a course or job
3. · wanting to help children with their school work
4. · wanting to learn something that they always wanted to crack – common topics that learners mention are long division and fractions
5. · 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:

1. · explain in no more than 50 words what a percentage is
2. · draw a picture that describes how 0. 5 means the same as half
3. · explain the connection between decimals, fractions and percentages – and give examples of times when you would use one rather than another
4. · explain "place value" up to thousands
5. · explain how the metric system makes calculations easier than the imperial
6. · show a friend how to use "number bonds" and a "number line" to make their mental addition or subtraction skills more efficient
7. · 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 maths knowledge and experience, often without realizing it. For example, in spite of a lack of skills, many people will have:

1. · managed personal and household budgets
2. · used timetables
3. · shopped and cooked

4. · chosen a mobile phone and
5. · 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

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