

Enhancing Academic Achievement of Adult Learners in Open Distance Learning Using Multimedia Materials Designed with Andragogy and Gagné's Instructional Model

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ABSTRACT

This study evaluated whether interactive multimedia learning materials designed through Knowles' andragogical principles and Gagné's nine events of instruction improve the academic achievement of undergraduate adult learners in open distance learning. The intervention, iMed, was developed for an Interactive Multimedia course to address adult learners' need for relevant, self-directed, experience-based, and systematically structured learning resources. A quasi-experimental pre-test and post-test design involved 56 non-computing adult learners enrolled at a Malaysian public university. Participants remained in two naturally occurring classes of 28 learners each. The experimental group used iMed, whereas the control group used conventional non-iMed materials. Academic achievement was measured using an expert-reviewed test comprising 15 multiple-choice questions and five subjective questions aligned with Bloom's taxonomy. Pre-test equivalence and distributional assumptions were examined before analysis, and analysis of covariance was used to compare post-test performance while controlling for pre-test achievement. The experimental group's mean score increased from 15.50 (SD = 3.33) at pre-test to 28.14 (SD = 2.35) at post-test. The control group increased from 14.30 (SD = 3.09) to 15.53 (SD = 3.76). After adjustment for pre-test scores, the between-group difference was statistically significant, $F(1, 53) = 172.39$, $p < .001$, with a reported group effect size of .77. These results indicate that multimedia materials grounded in adult-learning principles and a structured instructional model can substantially improve achievement in this course context. The findings support combining andragogy, Gagné's instructional events, and multimedia design when developing resources for adult distance learners. Because the study used a small, non-random sample from one course and institution, replication across disciplines, institutions, and learner populations is required before broader causal or generalizable claims can be made.

Keywords: multimedia learning materials, andragogy, Gagné's instructional model, adult learners, open distance learning

INTRODUCTION

Open distance learning (ODL) is a field of education that integrates pedagogical or andragogical approaches, technology, and instructional systems to effectively deliver knowledge and education to students who are physically separated from tutors and institutions of study [1]. This mode of learning offers flexibility in terms of time, pace, and space, enabling learners who are constrained by work, family, or other responsibilities to improve their knowledge and skills [2].

Moreover, distance education is a cost-effective and convenient alternative to traditional classroom learning, as

it eliminates travel costs and offers the flexibility to learn from any location [3]. Adult learners, in particular, can benefit from distance learning programs, as they can improve their standards of living and career prospects through higher pay and better job opportunities [4, 5].

Despite the growing interest and enrolment in ODL programs, adult learners face several challenges that can hinder their academic achievement and can lead to attrition [1]. These challenges necessitate intervention efforts to help adult learners master, succeed, and complete their studies. Creating an innovative educational environment through distance learning requires enhancing higher professional education with new content, advanced scientific and methodological support, innovative technologies, teaching methods, and modern interactive learning tools for students [2]. This article presents the results of the study on the effects of a specially designed and developed interactive multimedia learning material named iMed on the academic achievement of undergraduate adult learners. The study examines the combined effect of Andragogy or the Adult Learning Theory, the Gagne model, and multimedia in a learning material (iMed) of an Interactive Multimedia course. The results of the study provide insights into the effectiveness of iMed in improving the academic achievement of adult learners in ODL programs. The findings from this study is hope to be able to inform on the design and development of future interactive multimedia learning materials for adult learners in ODL programs.

LITERATURE REVIEW

Adult Learners and Open Distance Learning

Adult learners have different characteristics than traditional learners because they are aware of why and what they should learn, have diverse backgrounds and educational goals, want to reflect the experience of the process of education being passed, different responsibilities in everyday life, different experiences, and want to determine their education process and maintain it as well as personal life [6]. Adult learners excel when they can set their own course goals and take charge of their learning [7]. A notable distinction between adult learners and younger learners is that adults are typically self-directed; they prefer to manage their own decisions and be recognized for their capability to do so. In general, self-directed centres on learner autonomy where the learners assumes full ownership or responsibilities by identifying their learning needs, setting learning objectives, identifying resources, implementing learning strategies, and evaluating their own learning experiences [8].

Adult learners return to learning for a variety of reasons. One of the salient reasons is the highlight of gaining a second opportunity at gaining a university qualification besides attaining professional advancement, cognitive interest, intellectual stimulation, fulfilment, and adjustment [9]. There is also secondary motivation that includes personal development, lifestyle and income enhancement, inspiration from relationships within and outside the family, the desire to have a social responsibility, overcome physical/mental challenges, and develop new hobbies.

Apart from that, one of the recommendations made by the Organization for Economic Co-operation and Development (OECD) to Japan in addressing both its ageing population and its dwindling workforce is to “invest in lifelong learning to support the good foundation skills among older and younger Japanese adults and reduce inequalities in training participation by age, skill and type of employment contract” [10]. This shows that adults and the ageing, at least in Japan, may need to involve in lifelong learning to be able to still serve the needs of the community and the industry. Generally, adults who attend distance education also want to spend or want to complete their degree to fulfil their personal satisfaction that they will be able to solve the most challenging things that they have started and never thought of quitting [11]. Adult learners face various challenges in trying to complete their studies. However, distance education allows learners who have work, family, and different obligations to update their knowledge and skills associated with their job by sparing travel costs and permitting a flexible timetable [6]. In addition, by enrolling in the distance learning program, adult learners can improve their standards to acquire higher remuneration, a better vocation, and a better life.

Challenges and Issues

Distance learning has become a popular mode of education, enabling learners to improve their knowledge and

skills at their convenience. However, there are several challenges faced by distant learners, including issues such as low computer self-efficacy, skill deficits, work and family responsibilities, inadequate support, insufficient interaction, unsuitable course requirements, and a lack of technological and pedagogical support, all of which can hinder their learning experience and increase dropout rates [6]. Among these challenges, course content or learning materials is a critical factor that directly affects the learners' experience [2, 6, 12].

Research has shown that the design of learning materials does not always meet the needs of learners, leading to dissatisfaction and increased dropout rates [11, 13].

In an open distance learning (ODL) setting, the learning material or the content is central to the learners' academic journey, and a properly developed learning material can positively impact the learners' academic achievement and their distance learning experience [14]. Understanding learners' background is crucial in the preparation of learning materials, as individuals have differences in different aspects of learning needs, experiences, and learning environments [14, 15]. Designing effective distance learning resources hinges on tailoring instructional content to the specific profiles and needs of remote students. When course materials directly resonate with the lived experiences of these learners, they serve as far more powerful drivers for sustained academic motivation [6]. Developers of learning materials for ODL should be cautious with the design of online courses, ensuring that they are based on sound instructional design approaches to facilitate result-oriented and self-paced learning [16]. Instructional materials should be designed to accommodate the diverse needs and characteristics of all learners [6, 17]. Such carefully designed material has the potential to enhance learning effectiveness, independence, self-efficacy, motivation, performance, and outcomes by enabling students to study content independently, leading to increased self-efficacy and improved learning results.

Learning materials that are poorly structured or organized, or conceptually or fundamentally weak undermines or inhibits the acquisition of knowledge. On the other hand, well-developed materials can be utilized with the goal that data is effectively encoded, stored, recalled, and utilized in different ways. In the end, information from the learning materials will be what the learners need to remember. Therefore, learning materials must be created, integrated, and presented in a way that allows learners to have the necessary positive effect. Moreover, developers of learning materials for adult learners should be aware of the importance of andragogy, which is the art and science of helping adults learn as mentioned by Knowles (1980) in Ekoto and Gaikwad (2015) [18]. Adult learners have different learning needs, experiences, and learning environments compared to traditional learners. Therefore, the design of learning materials for adult learners should be based on andragogy principles, like self-concept, self-directed learning, prior experience, readiness to learn, and problem-centred orientation as mentioned by Knowles. Adult learners excel when they set their own goals and take ownership for their learning, so andragogy emphasizes hands-on, engaging methods, recognizing the uniqueness of individual learning experiences and necessitating educator collaboration to tailor teaching strategies to each learner's needs [7]. Concisely, the development of learning materials for ODL is a critical factor in the success of a learning program. Developers should consider the learners' needs, background, and learning styles, and incorporate andragogy principles in the design of learning materials for adult learners. Effective learning materials can promote an active learning environment, encourage learner-content interaction, and improve learners' motivation, engagement, and learning outcomes. Therefore, it is essential to invest in the development of high-quality learning materials to enhance the learning experience of ODL learners.

THEORETICAL FRAMEWORK

A theoretical framework offers guiding principles for designing instruction that achieves desired outcomes [19]. It generally encompasses the categorization of learning types, the elucidation of the learning process, and the identification of conditions conducive to effective learning. The rapid evolution of computer, network, and communication technologies has significantly influenced education, prompting continuous transformation within the field. The integration of technology in education provides substantial opportunities to establish impactful and efficient learning and teaching environments. However, Bashir (2017) asserts, the mere implementation of technology does not inherently ensure optimal learning and teaching conditions; rather, systematic development is essential to achieve this goal [20].

Andragogy Principles and Gagne Model

In order to optimize the learning experience for adult learners, it is imperative to tailor instructional approaches and structures to align with their unique perspectives and needs [20]. Andragogy, a theoretical framework for adult education, posits that the principles of adult learners, as articulated by Knowles, should be systematically incorporated into the instructional process for adults. These principles encompass: (1) the need to know - Why do I need to know this?), (2) the self-concept of the learners - I am responsible for my own decisions), (3) the role of the learners' experiences - I have experiences which I value, and you should respect), (4) readiness to learn - I need to learn because my circumstances are changing), (5) orientation to learning (learning will help me deal with the situation in which I find myself) and (6) motivation (I learn because I want to) [21]. These researchers further suggest that the judicious and consistent application of Andragogy principles in the development of learning materials can facilitate learners in overcoming challenges in the educational process.

Gagne's instructional design model outlines nine events to guide the planning process for learning content and activities [19]. These nine events are- 1: Gaining Attention, Event 2: Informing learners of the objective, Event 3: Stimulate recall of prior learning/knowledge, Event 4: Presenting the content, Event 5: Providing guidance learning, Event 6: Eliciting performance, Event 7: Providing feedback, Event 8: Assessing performance, Event 9: Enhancing retention and transfer. The implementation of the Gagne model in the creation of learning materials has been demonstrated to enhance the learning experience [19, 22]. Specifically, the integration of Andragogy theory and Gagne model serves as the foundation for the design and development of multimedia learning materials, referred to as iMed. This combined approach acknowledges the distinct features and practical needs of adult learners, thereby promoting a more effective and engaging educational experience.

Multimedia Technology

The incorporation of multimedia in the educational context has significantly transformed the learning process, emerging as a potent approach to facilitating e-learning [1, 15]. This methodology has been shown to enhance learner performance and improve learning outcomes. The interactive multimedia learning environment in education provides learners with non-linear navigation, enabling them to explore their learning environment at their own pace and discretion [22]. The benefits and importance of multimedia are substantial, as it simplifies abstract concepts, accommodates diverse learning styles, and allows for multiple representations from various perspectives [23]. The user-friendly nature of multimedia learning structures allows learners to allocate more time to comprehend course content. The integration of multimedia in the learning process offers numerous advantages, including enhanced students' learning [23], improve learning experience and promote a deeper understanding of complex concepts [24], improved learning outcomes [12, 17], knowledge retention, impact overall student satisfaction [24, 25], and such properly designed materials can improve academic performance learning outcomes [23].

Research Questions

This study intends to investigate the effects of a specially designed and developed interactive multimedia learning material on the academic achievement of undergraduate adult learners at a selected public university in central Malaysia. The following research questions were studied: **Q1:** What is the effect of using iMed learning materials based on Knowles Andragogy and Gagne model on the achievement of undergraduate adult learners in an Interactive Multimedia course?

Q2: Are there any differences in adult learners' achievement or performance based on the kind of learning materials used i.e., iMed learning materials (based on Knowles Andragogy and Gagne's model) and non-iMed (not based on the Knowles Andragogy and Gagne model)?

Significance Of Study

The presumed effectiveness of multimedia learning, in conjunction with prevailing educational theories such as

adult learning theory, is widely acknowledged within academic discourse.

However, empirical evidence conclusively substantiating the efficacy of this tripartite amalgamation remains lacking. While numerous studies have independently underscored the advantages of multimedia learning, the robustness of educational theories, and the significance of adult learning principles, little attention has been paid to their combined impact. Considering the burgeoning momentum of Open and Distance Learning (ODL), coupled with the increasing imperative for instructors to create tailored educational resources, there exists a pressing need for more definitive empirical findings. Further investigations are warranted to elucidate the specific instructional contexts and programs wherein the integration of Andragogy theory, the Gagne model, and multimedia learning engenders superior outcomes. This study is paramount in augmenting the expanding body of literature concerning the synergistic effects of these three factors within a distinct ODL course context.

METHODOLOGY

The study investigated the impact of a structured learning approach based on the Knowles Andragogy and Gagne model on the academic achievement of undergraduate adult learners in a distance education setting. It utilized a quasi-experimental approach with two groups of pre-post-test research design. The study measured cognitive abilities through an achievement test containing 15 multiple-choice and 5 subjective questions aligned with Bloom's Taxonomy levels. The questions were approved by three subject matter experts at the university. The intervention, named iMed, consisted of multimedia learning materials designed based on Knowles Andragogy and Gagne model.

Participants

The participants of the study were undergraduate adult learners in a central university in Malaysia. They were non-computing students taking an information technology and communication course in a distance education program. The study sample included 56 students divided into two groups; namely experimental (EXP) and control (CON) groups and they were accepted in their natural setting with 28 students in each group. The EXP group received the iMed intervention, while the CON group used non-iMed materials. Pre-test and post-test measurements were conducted to assess the impact of the intervention on academic achievement.

RESULTS AND DISCUSSION

There is a need to ensure that the two groups are of equivalent level. To confirm the groups' similarity, the Levene test was used to analyze the results for the groups. The test conducted indicated that the p value = .39 is significant at the $p > .05$ level. The null hypothesis states that there is no significant difference between the EXP and CON group pre-knowledge in Interactive Multimedia. Therefore, the null hypothesis is accepted. Based on the p value, it means that there is equality between the two groups in the pre-test which reflect that both the groups have the same pre-knowledge in the course Interactive Multimedia.

Pre-post-test

Once the pre and post-test assessments had been completed, the raw metrics were consolidated into Table 1 to facilitate a structured comparison. Table 1 revealed that all the students in the EXP group had benefited from the experiment and improved their academic achievement. The possible reason could be the effective and realization of the content delivery using the structured learning approach in the form of Gagne model while the emphasis of the content molded in the principles of Knowles Andragogy. The latter is certainly suitable with the expectation and requirement of the targeted adult learners. The post-test results were considerably higher (min and max marks), confirming the perceptions of better and improved performance following the pre-test. This finding agrees with what Malik and Alam (2019) and Stratton (2019) reported and highlighted on the relationship between the intervention and the outcomes [26, 27]. The post-test scores were higher than that of the pre-test scores for the adult learners in the EXP group indicating that they have become higher performers where previously their performance was approximately similar with the adult learners in the CON group during the pre-

test.

Table 1. Pre-test, post-test, and improvement scores for the experimental and control groups

Group	Pre-test achievement scores		Post-test achievement scores		Improvement in scores		
	Min	Max	Min	Max	Min (Pre, Post)	Max (Pre, Post)	Max-Min
EXP	9.00	22.00	24.00	33.00	15.00	11.00	24.00
CON	8.00	19.00	8.00	25.00	0.00	6.00	17.00

Secondly, both the p value in the pre-test (Table 2) and post-test (Table 3) for both groups indicated significant values respectively, and as such justified that the data distribution was normal. Results revealed that the students in the EXP group had improved in their understanding and knowledge regarding the content from the iMed learning material that is the multimedia learning materials based on Knowles Andragogy and Gagne model for better performance. This indicates that the adult learners found the multimedia learning materials to be reliable and helpful and they were able to understand and benefited from them.

Table 2. Descriptive statistics and Kolmogorov–Smirnov normality results for pre-test achievement by group

Group	N	KS		M	SD
		Statistic	P		
EXP	28	.10	.20	15.50	3.33
CON	28	.10	.20	14.30	3.09

Table 3. Descriptive statistics and Kolmogorov–Smirnov normality results for post-test achievement by group

Group	N	KS		M	SD
		Statistic	P		
EXP	28	.12	.20	28.14	2.35
CON	28	.13	.20	15.53	3.76

Ancova

ANCOVA (Analysis of Covariance) is a statistical test to determine the covariance between variables. It is a measure of changes in variables and how strong the relationship is between them. Table 4 presents the comparative analysis of the adult learners' post-test academic achievement. Here, an analysis of covariance (ANCOVA) was applied to isolate and compare the performance variations between the EXP and CON group. It is seen from Table 4 that $F=172.39$ and $df=1$ which means that there is a statistically significant difference at the significance level (.05) between the average scores of students in the EXP group and the CON group in the pre-posttest application of the achievement test. This is in favor of the post application. It means that the students' achievement in the EXP group increased after applying the intervention which is the iMed learning materials (in which the design and development were based on the Andragogy theory and Gagne model). Such significant difference demonstrates that the overall performance post-test scores of the adult learners in the EXP group are higher than the overall performance of the CON group. In other words, the intervention used in the EXP group affected the overall performance. The effect size value was calculated at .17 and was high.

Table 4. ANCOVA results for post-test achievement while controlling for pre-test achievement

Source	Type III Sum of Squares	df	MS	F	p	Effect Size
Pre-Test	71.00	1	71.00	6.98	.01	.17
Groups	1753.11	1	1753.11	172.39	.00	.77
Error	538.96	53	10.16			

CONCLUSION

This study aimed to examine the impact of a combined intervention incorporating Andragogy theory, the Gagne model, and multimedia in a specially designed learning material (iMed) for an Interactive Multimedia course targeting undergraduate adult learners. The experimental design allowed for a comparison between the EXP group, utilizing iMed based on Andragogy and Gagne model, and the CON group, using non-iMed materials that did not incorporate this theory and the model. The Levene test confirmed that both groups had equivalent pre-knowledge in Interactive Multimedia ($p > .05$).

Post-test results revealed that all students in the EXP group benefited from the intervention, demonstrating improved academic achievement. This improvement can be attributed to the effective content delivery using the structured learning approach of the Gagne model and the alignment with the expectations and requirements of adult learners, as per Knowles Andragogy. The ANCOVA test results indicated a statistically significant difference ($p < .05$) in favour of the post-application, with a high effect size (.17) between the average scores of the EXP and CON groups. This suggests that the iMed intervention significantly improved the overall performance of the adult learners in the experimental group compared to the control group.

These findings support previous studies highlighting the positive outcomes of the Gagne model in structuring learning activities [19, 28] and the effective use of Knowles andragogy regarding adult learners [7, 29]. In conclusion, the combination of Andragogy theory, the Gagne model, and multimedia in the learning materials have a positive impact on adult learners' academic achievement. To maximize the potential of multimedia technology in distance education, educators must consider sound educational theories and instructional design approaches.

The findings should be interpreted within the scope of this study. The participants were drawn from one course at one institution, and the classes were not randomly assigned. As a result, the findings may not apply in the same way to learners in other institutions, disciplines, or programmes, and the design does not support strong causal claims. Future studies should involve larger and more varied samples across institutions and fields of study. Where conditions allow, random assignment would provide stronger evidence of the effect of interactive multimedia materials. Future research could also combine achievement tests with interviews, observations, and learner feedback. This would help explain how learners use the materials, which features they find useful, and why the materials may influence their learning and achievement in open distance learning.

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