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Front Pages

Athens Journal of Education

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The ***Athens Journal of Education (AJE)*** is an Open Access quarterly double-blind peer reviewed journal and considers papers from all areas of history. Many of the papers published in this journal have been presented at the various conferences sponsored by the Education Unit of the Athens Institute for Education and Research (ATINER). All papers are subject to ATINER's Publication Ethical Policy and Statement.

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The current issue is the first of the eleventh volume of the *Athens Journal of Education (AJE), published by the Education Unit of ATINER.*

Gregory T. Papanikos
President
ATINER

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20-23 May 2024, Athens, Greece

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- **Dr. John Spiridakis**, Co-Editor, Athens Journal of Education & Professor, St. John University, USA.

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- Abstract Submission: **30 January 2024**
- Acceptance of Abstract: 4 Weeks after Submission
- Submission of Paper: **22 April 2024**

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- **Dr. John Spiridakis**, Co-Editor, Athens Journal of Education & Professor, St. John University, USA.
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Teaching Mathematics based on Integrating Reading Strategies and Working Memory in Elementary School

By Farideh Hamidi[*], Shokoofeh Soleymani[±], Sara Dazy[•] & Maryam Meshkat[°]

This study strived to determine the effectiveness of integrative teaching of reading strategies and working memory on basic math and problem-solving skills. It is a quasi-experimental pretest-posttest study carried out on 50 second-graders from Chahashk Shandiz village in the academic year of 2020-2021 who were randomly selected by cluster sampling and randomly divided into experimental and control groups. The intervention was performed by cellphone software through virtual education in two steps. The experimental group underwent integrative training for 20 sessions, but the control group did not receive any intervention. Colored Progressive Matrices (1956) and a researcher-made story problem-solving and arithmetic skills test were used to collect data. Descriptive statistics (mean and standard deviation) and one-way multivariate analysis of covariance were used to analyze the data. The results showed that the integrative teaching of reading strategies and working memory enhanced the basic math skills, with an effect size of 0.67 in second-grade elementary students ($P<0.001$). According to the results, integrative teaching improved students' problem-solving skills but did not affect their skills in arithmetic operations. Therefore, second-grade elementary teachers can use this method to enhance their story problem-solving skills.

Keywords: integrative teaching, reading strategies, working memory, basic math skills

Introduction

Whenever political and educational leaders speak or write about how the economic success of nations depends on the academic success of their students, the focus turns to mathematics (Pellegrini, Lake, Inns, & Slavin, 2018). Basic math skills the prerequisites for learning and understanding math (Fernandez-Abella et al., 2019). Mathematics education faces two crucial challenges. Firstly, more than half of the world's children do not currently learn the essential numerical skills needed for independent living in modern societies. Second, there are millions of children who need guidance and extra attention to learn, even in a good learning environment (Rasanen, Haase, & Fritz, 2019).

Basic mathematics refers to a wide range of basic concepts such as counting (like 1,2,3); quantity (more and less); shapes (circle, square, etc.); spatial relationships (up and down); size (long, short, larger and smaller); pattern discovery (Patterson,

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2018). Children's basic math skills do not develop in isolation from other cognitive competencies. Research has shown that basic math skills are related to executive functions. Success in mathematics is predicted by actual knowledge of a particular field, procedural skills, conceptual understanding, and general executive performance skills (Cragg et al., 2017; Belarski & Babik, 2020). Working memory and math calculation skills (Friedman et al. 2018) and symbolic basic numerical skills (number line and magnitude comparison) are related to executive functions of the brain (Gashaj, Oberer, Mast, & Roebers, 2019) and literacy (Ghasemi et al., 2019).

Many math tasks, such as memorizing counting units, carrying out mental calculations, or understanding a math word problem, require temporary storage of information during processing or transfer of data to long-term memory (Lewis, Wilkinson, & Witt, 2022). Wickstrom, Fesseha, and Jang (2020) found students with learning difficulties supported by The Individualized Education Plan [IEP] were more likely to show a decline in math achievement from grades 3 to 6.

Another factor influencing the development of math skills is the ability to read. Numerous studies have shown that reading skills play a role in mathematical performance (Marasigan, 2019; Mutaf-Yıldız, Sasanguie, De Smedt, & Reynvoet, 2020, Salihu, Aro, & Rasanen, 2018). Jordan, Kaplan, Locuniak, and Ramineni (2007) found that reading difficulties impaired children's math development. Reports also suggest that weak reading skills, reading comprehension and mathematics are related and share common cognitive background (cited by Salihu, Aro, & Rasanen, 2018). Another thing that proves the connection between reading and math is when students have trouble solving story problems. Such students may fail to solve the problem despite sufficient computational skills (Swanson, Lussier, & Orosco, 2015). As the cognitive processes involved in solving math problems are different and more numerous than basic computational skills (Zhang et al., 2022), students need to integrate several cognitive aspects to solve math story problems. In other words, they must extract important information through text comprehension, succeed in adequate mental representation, and continue the process (Agarwal, 2022).

Narrative as a game design feature constantly yields mixed results for learning in the literature. Based on the literature (Bruner, 1964; Darejeh, Marcus, & Sweller, 2021; Dickey, 2006; Ke, 2016), the narrative in this study serves as a set of events, tasks, and outcome feedback. In simulated real-world scenarios used for the active representation of problem-solving through storytelling, the results showed that students who use visual-schematic representation in word problem-solving are up to six times more successful than students who do not use it. Interestingly, Fung and Swanson's (2017) research showed that the working memory storage component predicts problem-solving accuracy in a fully intermediate model. The direct effect of the working component of working memory was entirely mediated by the criteria of reading, calculation, and fluid intelligence. These results challenge the idea that basic skills and fluid intelligence fully mediate the effect of working memory on higher levels of processing, but also the notion that the executive component plays a significant role in higher-order processing.

Programme for International Student Assessment (PISA) study has shown that reading comprehension is vital in solving math problems (Mevarech, Verschaffel, & De Corte, 2018). However, knowledge of mathematical strategies is not the only metacognitive skill that might be beneficial for solving complex word problems in mathematics. Given the importance of reading literacy for solving these types of tasks, it is reasonable to assume that knowledge about reading strategies may also be helpful (Strohmaier, Kuhl, & Schiepe-Tiska, 2022).

Work-integrated learning (WIL) is a national priority and a strategic direction for Australian universities. The preliminary qualitative phase comprised a literature review, workshops, and interviews. Examples of emerging WIL models, both curricula and co-curricular, were clustered into five models: micro-placements, online projects or placements, hackathons, competitions and events, and incubators/ start-ups and consulting. This paper outlines these models and summarizes defining features, enablers, challenges, and opportunities (Kay et al., 2019).

The integrative curriculum in elementary school has an influential role in presenting scientific concepts and creating fundamental structures (Yousefivaghef, Seif naraghi, & Naderi, 2021). Owing to the current state of education in our country in terms of the presence of a high number of students in the classroom, the lack of educational space, the existence of two-shift schools, and the shortage of primary school teachers, officials have turned their attention to integrative approaches (Zaraii Zavarki & Toofaninejad, 2017). Zaraii Zavarki and Toofaninejad (2017) compared the effect of integrated teaching on elementary student's learning in mathematics with the traditional (face-to-face) method. Results showed that integrated learning positively affects the teaching-learning process and enhances achievement.

This study focuses on maximizing reading comprehension by reducing the limitations of working memory. Many studies have examined the effects of basic mathematical skills and the factors affecting the improvement of basic mathematical skills (Ghasemi et al., 2017; De León, Jiménez, & Hernández-Cabrera, 2020; Salihu, Aro, & Rasanen, 2018), and integrative education (Nedaee & Hosseinzadeh, 2022).

De León, Jiménez, and Hernández-Cabrera (2020) examined the predictive role of basic numerical math skills in a study entitled Factor Analysis of Basic Mathematical Skills Indices. In this study, basic math skills included number comparison, subtraction, one-digit calculation, multi-digit calculation, and spatial value. The findings of this study explain basic counting skills are a suitable criterion for evaluating numerical ability.

Salihu, Aro, and Rasanen (2018) conducted a study entitled 'The relationship between math skills and reading comprehension.' This study examines the contexts for the success of children's math skills and focuses on the relationship between comprehension and mathematics. The findings illustrate a high correlation between introductory math and reading skills of fourth-grade students and propose that mathematics and reading problems may arise from a similar cognitive background.

Ghasemi et al., (2017) investigated the effectiveness of counting and recognition strategies instruction on the number skill of pre-schoolers with math problems. Results showed that training counting and recognition strategies have

been very effective in improving the number skills of children with math problems and could play a proactive role in solving math disorders**.** Strategies instruction of counting and number recognition for children with math difficulties will have a preventive role in future math disorders.

Nedaee & Hosseinzadeh (2022) investigated the effect of integrated math training with movement games on the progress of mathematics learning and cognitive function in students. The results showed that mathematics education through movement games increases the scores in mathematics, speed, and accuracy. Such training also reduces errors of attention. The study also showed a significant improvement in math scores and cognitive functions of accuracy, speed, and engagement in the experimental group.

Aragón et al., (2021) conducted a study to analyze the predictive contribution of variables (working memory, processing speed, vocabulary) in the mathematical performance of numbering, comparison, calculation, and understanding of mathematical concepts in preschool children. The study included 158 preschool students (ages 52 to 64 months). The results showed that working memory had the highest predictive effect on basic mathematics.

Fong & Swanson (2017) conducted a study to investigate the components of working memory that predict word problem-solving. The study aimed to explore the effects of the subsystems of the central executive system, phonetic loop, and spatial visual sketch-pad on word problem-solving in children aged 6 to 10 years. This study also examined whether the components of working memory can be tested by reading, calculating, and fluid intelligence. The results showed that all three subsystems of working memory indirectly predict word problem-solving, and among these, the phonological loop has a direct and significant effect. The results also showed that fluid intelligence moderated the relationship between working memory and problem-solving. In addition, reading and computing completely moderated the effect of the operating system on problem-solving accuracy. Nevertheless, few studies have integrated cognitive strategies into the curriculum in Iran.

Research findings suggest that working memory and reading are two influential factors in students' success in math. Despite the limitations of working memory, training programs must be designed to be compatible with and make the most of working memory capacity. Therefore, the present study seeks to investigate the effectiveness of integrated teaching of reading strategies and working memory on the basic mathematical skills of elementary students.

Hypothesis 1: Integrative teaching of reading strategies and working memory improves the problem-solving skills of elementary students.

Hypothesis 2: Integrative teaching of reading strategies and working memory improves the math skills of elementary students.

Method

This research is a semi-experimental pretest-posttest with a control group. Integrative teaching of reading strategies and working memory is considered an independent variable, and basic math skill is a dependent variable with two components; solving the arithmetic story problem and arithmetic operations.

Participants

The participants of the study are 50 female elementary school students. The students are 8-9 years old and studying in the second grade in the village of Chahashk Shandiz in the academic year 2019-2020. The students had Iranian (65%) and Afghan (35%) ethnicity. The study was carried out at a public school, and all students had an average IQ (between 100-110) as assessed by the Colored Progressive Matrices (RCPM). Two groups were formed using random cluster sampling. Each group was considered a cluster, and one group was randomly selected as the experimental group and the other as the control group. Furthermore, according to the following formula, the estimated sample size for each group was 24 individuals. The d-score was 5% of the maximum score that subjects received by responding to the Arithmetic Problem-Solving Test as a dependent variable. Based on the calculated formula, 24 people were estimated for each group, and to prevent the drop of the subjects, 25 people were estimated in each group and a total of 50 people in the sample.

d= (5% 33) =6.6
Z=1.96
SD=4.070
S=16.56
95% – Z score=1.96

$$n = \frac{s^2.Z^2}{d^2} = \frac{274.39 * 3.84}{43.56} = 24$$

Then, the pre-test (researcher-made problem-solving test and test of addition and subtraction calculus operations with transfer and without transfer) was performed on both groups. The experimental group then underwent 20 sessions of treatment. They were given training on how to use reading strategies and memory strategies using a cell phone. But the control group received traditional instruction. The intervention was performed in two stages: a virtual platform and cellphone software. The software included instructional videos that categorized story problems into four situations. In the next step, the student added the given information to the software and found the answer to the problem with the help of software diagrams. At the end of each level, there were interactive exercises that assessed students. The educational and interactive content of the software comprising 51 slides, was completed and practiced. Each session presented several problems, and the student completed the problem with the help of diagram boards. Although there were levels of formative training and questions and answers, the teacher had direct supervision over the learning and practice process, which lasted for 20 sessions.

The post-test was administered to both control and experimental groups, and the resulting data was analyzed.

Data Collection Tool

The **Colored Progressive Matrices (RCPM)** test is designed for children 5 to 11 years of age, the elderly, and mentally and physically impaired individuals. This test contains sets A and B from the standard matrices, and an additional set of 12 items; AB. Most of the items are presented on a colored background to make the test visually stimulating for participants. However, the last few items in set B are delivered as black-on-white; in this way, if a subject exceeds the tester's expectations, the transition to sets C, D, and E of the standard matrices is facilitated. This test of 36 geometric shapes is designed as a whole for accurate cognitive assessment of children. Test scores are zero and one. Ghazali, Chen, Kader, and Kadir (2018) reported bivariate correlation analysis showed that the RCPM sets A, AB, and B were well correlated; set A with set AB ($r=0.811$, $\rho<0.001$). A total of 115 valid retests were collected, and both bivariate correlation analyses showed a good correlation ($r=0.77$, $\rho<0.001$).

Arithmetic Problem-Solving Test is a researcher-made test that has been prepared according to the objectives of the second elementary arithmetic book and includes a variety of one-position and combination problems in addition and subtraction operations. The problems and questions in the second-grade elementary textbook were scrutinized. Vanderbilt story problems (Dazy, Kadivar, Abdollahi, & Hassanabadi, 2018) were used to design the questions. Ten problems were specified, a specification table was prepared, and the content validity was specified. Elementary teachers approved the problems which were then used as pre-test and post-test in this study. The Cronbach's alpha calculated to illustrate the reliability is 0.74. The item difficulty, and item discrimination of the questions were also checked.

Addition and subtraction arithmetic test with transfer and without transfer: The researcher designed arithmetic test was based on the objectives of the second-grade math teacher's handbook. Therefore, the pre-test consisted of double-digit additions and subtractions with transfer and without transfer questions, and the post-test comprised three-digit and two-digit questions. The table of specifications for the test questions was drawn and its validity approved by Shandiz elementary Education Supervisor and several second-grade elementary teachers. The reliability as calculated by Cronbach's alpha was 0.81.

Procedure

The implementation protocol of this method is taken from the schema theory in solving problems (Marshall, 1995). Integrative training is implemented in two stages with the help of a computer. Marshall explores a new system of schema development and studies the applicability of the concept as a unified basis for understanding learning, instruction, and assessment. The theory's prescriptions for teaching are direct, and its application to evaluation suggests new directions for tests. After examining the roots of the approach in earlier work by philosophers

and psychologists, the author supports the main features of her theory with experimental evidence from students learning to recognize and solve arithmetic story problems. She describes individual performance with traditional empirical studies as well as a computer simulation. Computer simulation reflects a new approach to modeling cognition. Marshall's model links neural networks with symbolic systems to form a hybrid model that uses pattern matching of sets of features as well as logical step-by-step rules. The first stage of the study is carried out using researcher-made software. The first part deals with teaching problem schemas in four main situations. The second part does not provide additional instructions but acts as a practice area and is followed by practicing skills and monitoring potentials and possible challenges by the instructor. In order to ensure the clarity of the procedure a guide was prepated and approved by an educational technology expert. This training protocol includes two stages of software programming on the mobile phone. The second stage of the study was carried out using diagram boards (boards in which a diagram of four positions is drawn) to help the young participants. Each step of the educational video game is based on a combination of reading strategies and matches the working memory, and consists of two parts: training and interactive exercises. The intervention in the experimental group lasted from November to March. Due to the virtual nature of the activities in two separate groups and the use of software on personal mobile phones, there was no possibility of error in transferring the lesson to the control group. The educational program of integrated training in reading strategies and working memory is provided in Table 1.

Table 1. Integrated Teaching of Reading Strategies and Working Memory

Sessions	Aims and contents
1	Necessary permits, pre-test, explanation of work steps to families, and installation of software
2&3	The first chapter comprised increasingly complex strategies, stories, and the creation of schemas. Aim: To form a schema of 4 problem situations and identify the type of problem
4	Interactive Exercise Chapter One (Position Identification) Aim: Practice and generalize what you have learned through drag and drop exercises. Answers are accompanied by feedback.
5&6	Chapter 2 training (shape and elements of 4 positions) Aim: To help illustrate the problem and understand the content, identify essential problem information, and data relevance.
7	Interactive Exercise Chapter 2 Step 1 Exercises: Identify the problem diagram. Step 2: Put the problem information in the diagram
8&9	Teaching Chapter 3 (Integrative Problem) The training consists of 3 steps. 1- Primary and secondary situation 2- Specific and uncertain information 3- Relationship between chart elements and planning to achieve the answer to the problem
10	Teaching Chapter 4 (Performance) 4 Problem Situations. Aim: The importance of recognizing the position and location of the unknown part in the diagram and its effect on the correct choice of mathematical operations.
11	Interactive practice of the third and fourth chapters. Aim: Practice and generalize what has been learned through interactive exercises of problem software
12&20	Protocol Step 2 (Exercise) Aim: Practice and evaluate what has been learned. If necessary, teacher rehabilitation training. At this stage, problem-solving is done with information presented on a map.
21	Perform post-test. Assessing the problem-solving ability of the sample and control groups

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Results

At the end of the training, a post-test was given to both groups, the descriptive (mean, standard deviation) and inferential (multivariate analysis of covariance) statistics were calculated using SPSS22 software. Table 2 presents the descriptive statistics of scores for problem-solving and arithmetic skills divided by groups. Table 2 shows that the average of the experimental group after the intervention has significantly improved compared to the control group, but arithmetic skills do not show significant improvement.

Table 2. Descriptive Indicators of Pre-Test and Post-Test Scores of Basic Mathematical Skills (N=50)

Variables	**Group**	**Pre-test**		**Post-test**	
		Mean	**Standard deviation**	**Average**	**Standard deviation**
Problem-solving skills	Control group	5.56	2.16	6.24	2.50
	Experimental group	5.87	1.63	8.48	1.67
Arithmetic skills	Control group	8.56	2.06	8.84	2.24
	Experimental group	8.36	2.36	9.34	0.98

According to the present study, a multivariate analysis of covariance was used to control the effect of pre-test and post-test. The results of the Shapiro-Wilk test showed the normal distribution of variables ($P>0.05$). The Levene's test of equality of variances of problem-solving skills ($P>0.07$, $F=44.33$) and arithmetic operations skills ($P>0.176$, $F=10.988$) are not statistically significant. Therefore, the variance of post-test error of the groups are not significantly different, and the hypothesis of homogeneity of variances in the post-test stage is confirmed. The homogeneity of the variance - covariances matrix observed was also calculated by the Box's M test ($P=0.073$, $F=1.662$, Box 25/251). The significance of the box test is higher than 0.05, so the variance-covariance matrix is homogeneous. The regression slope is the same at different levels of the independent variable. The result of the significance level of the regression slope homogeneity test between the pre-test and the post-test was 0.07 for the problem-solving variable and 0.17 for the arithmetic skills. Hence the null hypothesis is confirmed. Also, Bartlett sphericity showed that the spherical assumption had been fulfilled ($P<0.05$).

As the assumptions have been met, the multivariate analysis of covariance test was used to evaluate the effect of integrative training on the component of basic math skills (Table 3). In addition, the results of the Analysis of Multivariate

Covariance displayed a significant interaction between the two variables (F=8.067, P<0.001). The mean scores show that integrative training has improved basic math skills.

Table 3. Analysis of Univariate Covariance of Integrative Training on Other Problem Solving and Arithmetic Skills

Variable	Groups	N	Average	Standard deviation	Sum of squares	df	F	Sig	Eta squared
Problem-solving	Exp.	25	8.48	1.675	54.294	1	11.509	0.001	0.204
	Cont.	25	6.24	2.505					
Arithmetic	Exp.	25	8.88	1.878	0.402	1	0.139	0.001	0.003
	Cont.	25	8.84	2.249					

Table 3 clearly illustrates a significant difference between the two groups in both problem-solving skills. According to the results, the mean of the problem-solving post-test of the experimental group is 8.48, and the control group is 6.24, which showed that with controlling the pre-test, the problem-solving of the experimental group in the post-test is significantly higher than the control group. Also, the results of integrative training in the post-test phase between the experimental group and the control group are significant in terms of the scores of total arithmetic skills (F=0.139, P< 0.001). Consequently, integrative training has significantly improved arithmetic skills.

Table 4. Analysis of Univariate Covariance of Integrative Training on Addition and Subtraction Skills

Variable	Groups	N	Average	Standard deviation	Sum of squares	df	F	Sig	Eta squared
Addition	Exp.	25	4.82	0.387	0.614	1	1.117	0.296	0.179
	Cont.	25	4.44	1.003					
subtraction	Exp.	25	4.52	0.790	0.022	1	0.019	0.892	0.052
	Cont.	25	4.40	1.354					

As seen in Table 4, among the evaluated components of arithmetic operation skills, the significance of addition and subtraction is not confirmed. So, the results of integrative training in the post-test phase between the experimental group and the control group are not significant in terms of the component of arithmetic skills (F=1.117, P<0.296; F=0.019, P<0.052). Therefore, integrative training has not significantly improved addition and subtraction skills.

Discussion

Memory on the basic math skills of elementary students. In the post-test phase, integrative training affected the linear combination of the dependent variables. The present study also confirms the results of previous studies on the effectiveness of integrative education (Agarwal, 2022; Kay et al., 2019; Ke, 2016; Nedaee & Hosseinzadeh, 2022; Yousefivaghef, Seif naraghi, & Naderi, 2021). The significant improvement in the problem-solving skills of the experimental group is consistent with the research of Huang, Zhang, Chang, and Kimmins (2019) and Dazy, Kadivar, Abdollahi, and Hassanabadi (2018). This study did not find a significant difference between the control and experimental group on

arithmetic operations, which is inconsistent with the study of Dazy, Kadivar, Abdollahi, and Hassanabadi (2018).

The effectiveness of integrative teaching on story problem-solving skills indicates that students need to integrate several cognitive aspects to solve mathematical story problem-solving. They can fail in the face of a problem for various reasons, including lack of textual and word comprehension, insufficient emotional control when facing the problem, fixation on a solution method, lack of motivation, computational issues, and difficulty in mental functions. The lack of a management strategy is the most crucial obstacle to using rules in problem-solving. Integrative teaching in this project is a step-by-step strategy for problem-solving based on Piaget's cognitive theory. The story problems have different superficial features but similar structures that are organized in long-term memory. The student learns the concepts and structure and acts more successfully in the face of new story problems based on previous experiences with similar problems (Marshall, 1995).

On the other hand, understanding the content is considered the first step in solving the problem. In other words, students must understand the actual language and information in the problem, then extract the data from the story and apply it to the equations for a logical solution (Swanson, Lussier, & Orosco, 2015). According to research on the importance of comprehension in problem-solving, one of the most effective ways to improve students 'problem-solving skills is to teach reading strategies, which improve readers' comprehension. Reading strategies, such as strategies for complex repetition and review tasks, semantic expansion, and organization, lead to a better understanding of the text and the formation of more robust schemas in problem representation, which results in significant information storing in long-term memory. Students are more successful in dealing with story problems by organizing information to reach a solution. In other words, this is consistent with the cognitive theory of news analysis that learning at the highest level of processing is done meaningfully in long-term memory (Fung & Swanson, 2017).

Cognitive load theory asserts that education is effective if it is commensurate with students' working memory capacity. Therefore, training should use the maximum capacity of working memory. Three types of cognitive load are imposed on the learner's working memory; intrinsic load, external load, and dependent load which are assumed to be cumulative (total cognitive load = intrinsic load + external load + dependent load). Consequently, cognitive overload occurs when the overall cognitive load exceeds the learner's working memory capacity. In the present study, applying reading strategy techniques and problem-solving diagrams has reduced the cognitive load. In addition, in the introductory stages of this study, it was emphasized to use story problems with similar themes and numbers (Marshall, 1995). New content should be taught taking into consideration working memory capacity. Therefore, when the student is faced with a similar problem, she has learned to focus on the solution method, the necessary strategy, and so on. In other words, the external load of the problem is reduced. Still, when the student is confronted with a story theme and similar numbers, she learns that the keyword method for problem-solving such as increase, add, more, etc., has to make sense in

the context of the problem.

Nevertheless, in story problems, it is vital to identify the information necessary to solve the problem. Misunderstanding of a story problem leads to incorrect solutions and arithmetic operations of addition and subtraction, etc. Integrative method uses diagrams for each problem strengthening the student's accuracy in correctly placing the problem data and ultimately understanding the content and choosing a practical strategy for carrying out each step.

Problem-solving requires remembering small pieces of information and processing new information to strategize a solution that requires working memory resources (Fung & Swanson, 2017). To solve a mathematical problem, we store both the components of the problem and the information in the long-term memory related to that problem in the working memory. Due to the multi-stage nature of mathematical story problems, working memory plays an essential role in solution accuracy (Fung & Swanson, 2017).

The post-test scores of the experimental and the control groups on arithmetic skills showed no significant difference. Dazy, Kadivar, Abdollahi, and Hassanabadi (2017) found that the effect of problem-solving training on algebraic operations was positive. In this integrative method of training, in addition to paying attention to reading strategy and working memory, the use of diagrams is emphasized. Exercise at this stage was expected to improve the performance of arithmetic operations because, in the second stage of integrative training, the student had to place the problem information in the chart sections. In each exercise, the student is taught that the answer to the problem requires different solutions depending on the location of the information in the graph. Practice leads to a better understanding of addition and subtraction, followed by improved calculation.

Another reason for the present results can be the parents' focus on addition and subtraction as it is the chief educational goal of the book. Therefore, parents have had more practice with students in e-learning in this area, helping students to cover possible mistakes resulting in no significant difference between the post-test results of the experimental and control groups.

Conclusion

The present study showed that the integrative teaching of reading strategies and working memory has been influential in improved basic math skills. In the study of number components related to basic mathematical skills, the effectiveness of the integrated training of reading strategies and working memory on the problem-solving skills of arithmetic was confirmed. These results are indispensable when considering the poor performance of students in the TIMSS and PIRLS Tests and the challenges facing teachers in this field. The integrative approach can be effective in times when distance education is needed, such as the outbreak of Corona virus. Therefore, teachers are recommended to improve student performance by using the present teaching method, which leads to meaningful learning instead of maintaining a problem-solving practice. Regarding the second hypothesis of the research, the effectiveness of integrative teaching of reading strategies and working memory on students' arithmetic skills was not significant. In this section,

it is necessary to conduct research in normal educational conditions in schools to examine the present findings further.

Due to the outbreak of the coronavirus and the closure of face-to-face training, there is a possibility of interfering factors such as family guidance of test results, especially during the pre-tests. Virtual education may have hampered the results of integrative teaching. In the second phase of the integrative training, which provided face-to-face practice, a small number of students were present and had the opportunity to ask and answer questions and clarify any ambiguities. The rest of the students watched the video of the sessions.

The present study was performed on average second-grade elementary students. This method can also be tested on students with learning disabilities. Also, it is suggested that this research be done in normal conditions in face-to-face classes with the careful supervision of the teacher. The comparison of such a study with the present one can be interesting. In order to improve external validity in this research, it is suggested to use a factorial design in which gender, two types of teaching methods and classes as independent variables be executed. Therefore by using this design, we implement different teaching methods and to be able to more confidently generalize results to all elementary schools. It is also suggested to expand this study with a large sample of high school students using the three variables of cognitive knowledge, understanding and problem solving. In addition, it is necessary for elementary teachers to learn this method in -service education classes with integrative teaching of basic mathematical skills.

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The Importance of Teachers Training in Relation to the Socialization of Children with Special Education Needs in the Mainstream Classrooms

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This article aims to highlight the importance of teachers training about inclusiveness by relying on statistical differences in teachers' perceptions of who are trained in the last five years and those who are not, in the realm of inclusive education as regards the socialization of SEN children with their class peers. The approach of this study was quantitative, and sample extraction is carried out through the stages sampling method. For the data collection, it was used a Likert scale with a Cronbach's coefficient alpha reported 0.86. The dimension of this research, "Teachers' perceptions as regards the socialization of children with SEN with peers" consists of three factors, respectively (1) "Teacher perceptions as regards the adaption of children with SEN to the group of peers", (2) "Teachers' perceptions as regards the participation of children with SEN in managing the situation", (3) "Teachers' perceptions as regards the social participation of children with SEN with their peers". The results of the "Mann-Whitney U Test" revealed significant differences in the perception of trained and untrained teachers, as regards the three factors of the study.

Keywords: teacher's training, children with SEN, inclusive classes

Introduction

During the last 15 years, the education system in Albania was challenged by the need to provide inclusive education for every child, especially for children with disabilities (CWD) and those with special educational needs (SEN) in mainstream schools. Following the ratification of the UN Convention on the Rights of Persons with Disabilities in 2012, as well as based on the guidelines of the European Community and of the documents published by reputable organizations such as UNESCO, UNICEF, and ODIR, the first step undertaken was to align the legal and policy framework with the International Conventions, to provide access and quality inclusive education for these children in mainstream schools, so they are no longer segregated in special schools. In addition, the mainstream school staff in cooperation with the school community and local education' decision-makers, have been investing in serious efforts to improve access, culture, practices, and policies, in mainstream kindergartens and basic education schools, where CWD or SEN children are enrolled, to welcome these children and support them to reach their best potential.

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In this light, one of the most important challenges remains teacher training and teacher professional development (PD) in the issues that are related directly to the socialization of these children in mainstream classrooms. Although studies have been conducted in this area, it remains necessary to study specific aspects of this issue. During the research work for the writing of this article, not enough studies were found in this field to support the results obtained from this study. For this reason, the results obtained from this study are a very valuable contribution that would help to clarify the main milestones on which training curricula, for the PD, should be built. By the same token, from this PD, teachers can gain knowledge and practical skills in the field of inclusiveness, which will serve them to increase the quality of classroom work for all students.

This paper is extracted from wider research, carried out in basic education schools in Albania, which aims to identify if there were any differences between the perceptions of teachers who received training in the last five years in the field of inclusiveness, compared to the group of teachers who did not receive training, in terms of the level of participation of SEN children in-class activities, as well as the level of socialization of the SEN children with their class's peers. The study was conducted in the middle schools of 38 cities and towns across the country.

Review of Literature and Research Papers

The Importance and Effectiveness of Inclusive Education

Inclusive education as defined in the Salamanca Statement promotes the "recognition of the need to work towards 'schools for all' or institutions which include everybody, celebrate differences, support learning, and respond to individual needs" (UNESCO, 1994). According to UNESCO, an inclusive education system is a system that has developed schools based upon "a child-centered" pedagogy capable of successfully educating all children, including those who have serious disadvantages and disabilities (UNESCO, 2012). Additionally, inclusive education is endorsed on two foundations: the rights of children to be included in mainstream classes and the intention that inclusive education is more effective (Lindsay, 2011). At this glance, the development of more inclusive schools (Mattson & Hansen, 2009) is one of the challenges for the educational system today (Ainscow, Booth, & Dyson, 2006). Meanwhile, some factors, are still vocal about the value of segregated education (Meynert, 2014), all actors of the community, schools, and families, are working to develop the relationship between them, because this is the fundamental base to include these children in mainstream education settings (Kozleski et al., 2015) under the framework of inclusive education philosophy (UNESCO, 2012). By the same token, researches show that children with SEN have a lot of academic benefits from inclusion (Avramidis, Bayliss, & Burden, 2002), and inclusive programming can be effective for some children with moderate disabilities (Manset & Semmel, 1997). Some other researchers pointed out that children with intellectual disabilities, perform better than their analogous segregated children, mostly in academic attainment and social

competence (Freeman & Alkin, 2000). Inclusive education influences slightly positively in the school attainments of children without SEN (Szumski, Smogorzewska, & Karwowski, 2017), and inclusion has its impact on children (Shogren et al., 2015).

For a Better Climate in the Inclusive Classes

In the framework of improving the school culture and school effectiveness (Dessel, 2010; Hargreaves, 1995), the value of diversity is promoted, by nurturing the spirit of mutual respect (Koutsouris, 2014) and tolerance between children and community entitlement (Ainscow, Booth, & Dyson, 2006), and by providing equal opportunities for all children without discrimination in education settings (Jacobs, 2010). This spirit is leading children to know each other for what one can do, rather than what s/he is not able to do, and therefore is beneficial in this regard, and improving peer social interaction (Koegel et al., 2012). The merit of such schools is not only that they can provide quality education to all children; their establishment is a crucial step in helping to change discriminatory attitudes, create welcoming communities, and in developing an inclusive community (Skidmore, 2004). In a certain respect, for authors, such as Nutbrown and Clough (2009), inclusion must be seen as a process of continuous improvement. This process is a state of becoming' where all the actors involved, the school and the family, are working together to improve the various challenges they encounter (Nutbrown & Clough, 2009).

Teachers' Attitude toward Children with Special Needs

Breaking negative trends to include children with special needs in mainstream classrooms is not always easy (Persson, 2013). And this comes for a few reasons. In the first place are the difficulties faced by children with special educational needs during the learning process, which must be addressed through the design of individual program development (LeRoy & Simpson, 1996). But a very important element that needs to be taken into consideration is the teachers' attitudes towards these children (Lee, Yeung, Tracey, & Barker, 2015; Gash, 1996; Leyser & Abrams, 1982; Hammond & Ingalls, 2003). Some studies pointed out that teachers show positive attitudes towards children with disabilities (Avramidis & Norwich, 2002; Leatherman & Niemeyer, 2005), and this factor is very important for the inclusion process (Beacham & Rouse, 2012). In a certain respect, other researchers stressed that the positive attitudes of teachers and willingness to care for these children in the classroom (Dinnebeil, Mclnerney, Christine, & Juchartz-Pendry, 1998), are very salient factors concerning how successful inclusive practices will be (Stafford & Green, 1996; Saloviita, 2020). But according to other researchers, there are teachers with lack awareness regarding children with autism (Al-Sharbati et al., 2013), and they lack the knowledge, skills, and expertise necessary to support children with SEN (Black-Hawkins, 2012). And yet, one very important challenge is that teachers need to reduce prejudice (Marks, 1997).

Professional Development (PD) of Teachers Regarding Inclusiveness and Special Education Training

Teachers have a very important role in inclusive classrooms, given that teachers' action plays a crucial role in setting the tone (Forlin & Jobling, 2003), and promoting participation and achievement in the classrooms (Rouse, 2017). Teachers' training and professional development in this regard also play an important role (Lee, Yeung, Tracey, & Barker, 2015), and preparing teachers for inclusive education is very complex (Miskolci, Magnusson, & Nilholm, 2021; Ricci & Fingon, 2017). In this aspect, teachers who are in the early stage of their professional careers must pay more attention to responding to new challenges, such as applying new policies and practices regarding the inclusion of SEN children. More important is to adapt mainstream lessons to all the children (Kirk, Gallagher, Coleman, & Anastasiow, 2012). And yet, literature in this realm emphasizes the importance of teachers' preparation to work with SEN children, by revising teacher education programs (Florian & Rouse, 2009). In this light, the OECD (2012) report, encourages the quality of teaching, especially concerning staff that works in inclusive classes, as one of its most important goals. At first, the emphasis is put on setting out explicit goals and regulations that orient the use of resources in areas of priority; coordinating the resources and the involvement of parents to make informed choices; helping staff to enhance instructional strategies; and helping parents to understand better the child development. Furthermore, another priority is to promote further training for school staff, by advancing qualifications, professional development, and improving the working conditions (OECD, 2012).

Scholars too, find very important the pre-service training and ongoing in-service professional development in the field of inclusive education (Sokal & Sharma, 2014; Arthur-Kelly, Sutherland, Macfarlane, & Foreman, 2013; Browder, et al., 2012; Campell, Gilmore, & Cuskelly, 2003). These relate closely to the improvement of teaching quality in inclusive classrooms (Sokal & Sharma, 2017). Moreover, according to many researchers, it is essential to encourage open debates and discussions in the workplace, among teaching staff (Ferrante, 2017), about all the challenges they face in the daily routine of working with SEN children. Open debates can be the starting point for teachers to enable the learning environments, by feeling free to express their questions and ask for help, and share the best experiences and skills (Tedam, 2013), so they can solve their challenges (Gash, 2006). Part of the PD curriculum of all teachers should be at least one course about working with SEN children. All teachers need a foundation in individualized learning needs, classifications of SEN, and practical teaching methodologies (Losert, 2010).

Methodology

The research employs the quantitative research method. The part of the research that is used to develop this paper, aims to analyze the differences in the

perception of teachers who are trained in the last five years and those who are not, as regards the level of socialization of SEN children with their peers in inclusive classrooms.

Population and Sampling

In the Albanian education system, one or two SEN children are enrolled in mainstream classes, and therefore the number of SEN children is almost the same as one of the teachers working in inclusive classes. From this population, a sample of 351 teachers has been extracted. The probability method of stage sampling was used to select the sample from the whole population. It includes selecting the sample in stages, which is, taking samples from samples (Cohen, Manion, & Morrison, 2011). Subsequently, from each educational district, 10% of the teachers who work with SEN children were randomly selected. Only for Tirana city, and Tirana district does the sample represent 20% of the respective populations, due to the highest number of SEN children in these geographic locations and consequently the highest number of teachers who teach in these classes. The main criterion applied to select the teachers for the sample was for a teacher to have at least one SEN child in his/her class. Analyses of the sample show that 88.3% of teachers who teach in inclusive classes hold a bachelor's degree, and 11.7% hold a master's degree. In the function of the inferential analyses, the sample was divided into two groups; the first group has attended training in the inclusive education field in the last five years and the second group did not. 47% of the teachers report that they had attended training in the last five years in inclusive education, and 53% report that they did not attend any training in this field.

Data Collection

Data collection for this study was carried out over a period of three months. Questionnaires were distributed to teachers in open envelopes, together with an information letter. In the informative letters, teachers were informed about the nature of the study, its goals, and the nature of their voluntary participation. After teachers completed the questionnaire, they returned the envelope sealed to the front desk of their respective schools. During this phase, there was no intervention or interaction with the participants. For data collection was used the Likert scale. All items to design the scale for data collection originally came from a standardized questionnaire (Grift, 2007). All items from this scale were adopted for the Albanian context and were piloted twice, to improve its' alpha coefficient. From all items of the scale, six factors were extracted to carry out the factorial analyses. The result of data analyses reveals differences between the two groups of teachers in three factors. These factors are: "Teachers' perceptions as regards the adaption of children with SEN to the group of peers", "Teachers' perceptions as regards the participation of children with SEN in managing the situation", and "Teachers' perceptions as regards the social participation of children with SEN with their peers". These three factors compose the dimension of the research: "Teachers' perceptions about the level of socialization of SEN children with peers in inclusive

classes". The items were grouped into three sections. The first block of items sought information on "teachers' perception regarding the adaption of children with special needs to the group". This block consists of 14 items. The second block asked for information about "Teachers' perceptions as regards the participation of children with SEN in managing the situation". This block consists of 24 items. And the third block asked for information on "Teachers' perceptions as regards the social participation of children with SEN with their peers". This block consists of 18 items.

For all items that include the three main factors, reliability analyses were performed (Table 1). The reliability coefficient has been greater than the value of 0.7 (Cortina, 1993). Table 1 summarizes the Cronbach' coefficient alpha for the three factors.

Table 1. Alpha Coefficient and the Factors for All the Research Factors

The dimension of the study	**Factors of the research**	**Alpha coefficient**
"Perceptions of teachers (trained/not trained in the last five years) in the relation of the socialization level of children with special needs with peers in inclusive classes."	"Teachers' perceptions as regards the adaption of children with SEN to the group of peers."	0.84
	"Teachers' perceptions as regards the participation of children with SEN in managing the situation."	0.96
	"Teachers' perceptions as regards the social participation of children with SN with their peers."	0.81

Data Analysis Procedure

The data collected from the survey was transported into the computer statistical package SPPS, version 23. Before reviewing the data, assumptions for the statistical analyses were performed. The data have been examined for normality (skewness and kurtosis), as well as for any missing data. A two-tailed alpha level of 0.05 was set and used for all statistical tests.

The analyses of the three factors that compose the dimension resulted in a violation of one of the assumptions that are very crucial to carry out parametric techniques. From all five assumptions that were needed to perform the parametric tests, four were met, and one was not. Thus, the level of measurement criteria was met, (a continuous scale was used), for data collection probability sampling was used, all the observations were independent, and the homogeneity of variance assumption was met, (Levene's test). The assumption that was not met for the three factors was the normal distribution. The test of Normality performed for the three factors was significant. Results from Kolmogorov - Smirnov statistics, reported sig. value less than 0.05.

For this reason, nonparametric tests were used to investigate the differences between groups. In Table 2, the research question of this article, the main factors

of the study, and the type of inferential statistical analysis performed are presented in a summarized way.

Table 2. Research Question, Variables, and Analytic Procedures

Research Question	**Variables**	**SPSS Procedures**
Are there statistically significant differences between the perceptions of trained and untrained teachers as regards the level of socialization of SN children with their peers in inclusive classes?	"Teachers' perceptions as regards the adaption of children with SN to the group of peers." "Teachers' perceptions as regards the participation of children with SN in managing the situation." "Teachers' perceptions as regards the social participation of children with SN with their peers."	Mann – Whitney U test

Results

To respond to the research question: - "Are there statistically significant differences between the perceptions of trained and untrained teachers as regards the level of socialization of SEN children with their peers in inclusive classes?", the Mann-Whitney U test was conducted. This analysis was done to reveal the differences in the perceptions of two groups of teachers. The first group was teachers that were trained in the last five years about several topics such as inclusiveness, or the socialization of SEN children with their peers in inclusive classes. Teachers have received various qualifications in this field offered by universities or training which belong to the PD of teachers and are provided by licensed organizations. The second group was composed of teachers that are not trained for this aim.

Table 3. Descriptive Statistics for the Variable of Training in Inclusive Education in the Last Five Years for Each Factor

Ranks				
	Participation in training sessions in inclusive education topics, in the last five years	**N**	**Mean Rank**	**Sum of Ranks**
Teachers' perceptions as regards the adaption of children with SEN to the group of peers.	Yes	164	222.20	36440.00
	No	173	118.57	20513.00
	Total	337		
Teachers' perceptions as regards the participation of	Yes	164	224.17	36763.50
	No	185	131.41	24311.50

children with SEN in managing the situation.	Total	349		
Teachers' perceptions as regards the social participation of children with SEN with their peers.	Yes	165	217.49	35885.50
	No	186	139.20	25890.50
	Total	351		

Table 4. Results of the Mann-Whitney U Test for Each Factor

Test Statistics			
	Teachers' perceptions as regards the adaption of children with SEN to the group of peers	**Teachers' perceptions as regards the participation of children with SEN in managing the situation**	**Teachers' perceptions as regards the social participation of children with SEN with their peers**
Mann-Whitney U	5462.000	7106.500	8499.500
Wilcoxon W	20513.000	24311.500	25890.500
Z	-9.769	-8.588	-7.230
Asymp. Sig. (2-tailed)	0.000	0.000	0.000
a. Grouping Variable: Training in inclusive education in the last five years			

Table 5. Results of Medians for Sorted Cases of Each Factor

Report				
Participation in training sessions in inclusive education topics, in the last five years		Teachers' perceptions as regards the adaption of children with SEN to the group of peers	Teachers' perceptions as regards the participation of children with SEN in managing the situation	Teachers' perceptions as regards the social participation of children with SEN with their peers
Yes	Median	36.00	24.00	23.00
	N	164	164	165
No	Median	29.00	15.00	19.00
	N	173	185	186
Total	Median	32.00	19.00	21.00
	N	337	349	351

A Mann-Whitney U test was conducted to compare the score of the perception of teachers who were trained, and the teachers who were not trained in the last five years. This test revealed a significant difference (Tables 3 and 4) in the perception of teachers that were trained (Md = 36.00, n = 164) (Table 5), from the perception of teachers who were not trained, as regards the adaption of children with special needs to the group of peers (Md = 29.00, n = 173), U = 5462.000, z = -9.769, p = 0.000, r = 0.53).

In this case, it is also important to report the effect size, to make it possible to have a standardized measure of the size of the effect that is observed. The equation to convert z-scores into the effect size estimate, r, is as follows (Field, 2013)

$$r = z/\sqrt{N}$$

For "Teachers' perception as regards the adaption of children with SEN to the group of peers," z = -9.769 and N = 337; therefore, the R-value is -0.53. Based on Cohen criteria of 0.1 = small effect, 0.3 = medium effect, 0.5 = large effect, the value of 0.53 is a large effect size (Cohen, Manion, & Morrison, 2011). 53% of the variance in the perceptions of teachers as regards the adaption of SEN children with the group of peers is explained by participation in training sessions in the field of inclusive education with this topic.

The Mann –Whitney U test revealed a significant difference (Tables 3 and 4), in the factor of "Teachers' perception as regards the participation of children with SN in managing the situation", between teachers who were trained and those who were not. Thus, for teachers that were trained (Md = 24.00, n = 164) (Table 5) and this differs significantly from the perception of the teachers who were not trained (Md = 15.00, n = 185), U = 7106.500, z = -8.588, p = 0.000, r = 0.45).

For the factor "Teachers' perception as regards the participation of children with SN in managing the situation," z = -8.588 and N = 349; therefore, the R-value is -0.45. This value would be considered a medium effect size using Cohen's criteria. 45% of the variance in the perceptions of teachers as regards the participation of children with SEN in managing the situation is explained by their participation in training sessions in the field of inclusion education.

The Mann –Whitney U Test is also used for the third factor. This test revealed a significant difference (Tables 3 and 4), in the factor "Teachers' perception as regards the social participation of children with SN with their peers," between teachers who were trained and teachers who were not trained. Thus, for teachers that have been trained (Md = 23.00, n = 165) (Table 5) and for teachers that are not trained (Md = 19.00, n = 186), U = 8499.500, z = -7.230, p = 0.000, r = 0.38).

For the factor "Teachers' perception as regards the social participation of children with SN with their peers," z = -7.230 and N = 351; therefore, the R-value is 0.38. This value would be considered a medium effect size using Cohen's criteria. In this case, 38% of the variance in the perceptions of teachers as regards the social participation of children with SEN with their peers is explained by participation in the training sessions, in the field of inclusion education.

Discussion and Implications

The main purpose of this study was to identify if there were any differences between the perceptions of teachers who received training in the last five years in the field of inclusiveness, compared to the group of teachers who did not receive training, in terms of the level of participation of SEN children in-class activities, as well as the level of socialization of the SEN children with their class's peers. Based on these statistical results, the importance of PD of teachers in the field of inclusiveness can be argued. One of the most significant results of this study was the result that pointed out that teachers that have been trained in the last five years in the field of inclusiveness differ significantly from their colleagues who were not

trained, as regards their perception of the adaption of children with SEN to the group of peers, and 53% of the variance in their perception is explained by this variable. In addition, 45% of the variance in teachers' perceptions regarding the participation of children with SEN in managing the situation is explained by their involvement in training sessions in the field of inclusiveness. From the last result of the research, it can be concluded that teachers that have been trained in the last five years in the field of inclusiveness differ significantly from the teachers that have not been trained, as regards their perception of the social participation of children with SEN with their peers. 38% of the variance in their perception is explained by the training received in the last five years.

These results show that the training that teachers should receive in the field of inclusiveness has a very important role in improving their perceptions regarding the association of children with special needs with the group. In this light, studies have shown that the degree to which teachers understand inclusiveness often depends on their level of knowledge and skills (Lawson, Parker, & Sikes, 2006). In a certain respect, teacher training in inclusiveness concept as well as in education and care for SEN children should take a special place and become a priority (Cameron & Jortveit, 2014), in the agenda of those institutions which design in-service teacher training policies and strategies, because as supported by studies, having knowledge in inclusiveness after qualifying had a positive impact on teachers' attitudes to inclusion (Boyle, Topping, & Jindal-Snape, 2013). In such a way, teacher training and PD in these specific topics will not be provided sporadically and at ad-hoc bases, but in a unified agenda and systematic approach across the country. The training can address different issues, such as designing special needs instruction; promoting children's participation in learning and teaching; reducing exclusion, discrimination, and barriers to learning and participation; developing cultures, policies, and practices to promote diversity and respect for everyone equally; developing practical skills for educating children of diverse abilities (Cologon, 2012), and learning from best practices. Furthermore, regardless of what can be perceived as quite difficult, the implementation of inclusive education in practice is achievable (Buli-Holmberg & Kamenopoulou, 2017).

At the end of this article, it is important to highlight some implications that should be taken into consideration:

Leading institutions of education should establish mechanisms, to facilitate and encourage the employment of young teachers, who were either graduated or are certified as specialized teachers for SEN children.

The in-service teacher training curriculum, as well as the tests used in Qualification Tests for the in-service teachers, should necessarily include literature and questions that relate to special needs education and the education of SEN children. This action becomes a must for every teacher regardless of the subject s/he is specialized to teach, for as long as s/he is either teaching or will be soon teaching SEN children in the class.

All Teaching Universities in Albania should unify the curriculum for the pre-service teachers' children, to equip them with the necessary knowledge and skills to teach in special needs classes. Theoretical concepts and practical hands-on

methodologies should be combined in a balanced way, to be fully beneficial for future teachers.

Conclusions

As a summary, at the end of this paper, some conclusions could be presented. The survey and data collection were conducted in 38 cities and towns in Albania. The sample consisted of 351 teachers, all of them teaching in inclusive classes. The sample selection was made through the stages sampling method. This sample was divided into two subgroups, based on their participation in training sessions on an inclusive education topic, in the last five years. A level of statistical significance of 0.05 was set, to evaluate the results of all statistical tests. Statistical analysis of the data revealed significant differences in the scores of teachers that were trained in the last five years and those who were not trained in the field of inclusive education, as relates to the three factors of the study. Thus, teachers who were trained differ significantly from the teachers who were not trained, as regards their perception of the adaption of SEN children to the group of peers, and 53% of the variance in their perception is explained by participation in the training sessions on an inclusive education topic, in the last five years. As regards teachers' perception of the participation of SEN children in managing the situation, 45% of the variance in their perception is explained by receiving training in the last five years. Last but not the least, as regards teachers' perception of the social participation of SEN children with their peers, 38% of the variance in their perception is explained by receiving training in the last five years.

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Is there a Link between Teacher Salary and Educational Achievement? An Analysis in OECD Countries

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This paper uses data from the Organization for Economic Co-operation and Development (OECD) and employs multiple regression models to investigate the relationship between teacher salary and educational achievement in mathematics and science across 30 countries. After controlling for alternative wage opportunities and two macroeconomic factors (GDP per capita and educational expenditure as percentage of GDP), the results reveal no significant relationship between teacher salary and educational achievement in mathematics and science. These findings imply the need to look beyond a single policy, such as higher salaries, in favor of policy strategies that address working conditions and other challenges facing new teachers.

Keywords: teacher salary, educational achievement, OECD, PISA data

Introduction

The main purpose of this study is to investigate the relationship between teacher salary and student achievement using the most recent available data from OECD countries.

Teacher salaries represent the largest single cost in formal education and have an important impact on the attractiveness of the teaching profession. They influence decisions to enroll in teacher education, to become a teacher after graduation, to return to the teaching profession after a career interruption (OECD, 2005). Many countries are looking to increase the supply of teachers, particularly those with an ageing teacher workforce by offering more attractive salaries and career prospects. These countries are also trying to retain the most competent and qualified teachers to ensure a well-qualified teaching workforce with the view to increase school performance and student achievement. This paper contributes to the debates by using teacher salary data unavailable in previous studies to account for alternative labor market opportunities that affect the opportunity cost of choosing to teach and explores the relation between teacher salary and educational achievement in OECD countries. It also accounts for two macroeconomic factors (GDP per capita and educational expenditure as percentage of GDP). We find no significant relationship between average teacher salary and national achievement in mathematics and science for both new and experienced teachers.

Over the past decades, discussions about education policy have in part focused on how to improve educational achievement both within and across schools. In this context, several issues such as reducing class sizes, providing more school inputs, incentive-based policies, or increasing the quality of teachers have been largely discussed (Azam & Kingdon, 2015).

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In order to ensure both quality teaching and sustainable education budgets, educators, policy makers and researchers are increasingly interested in understanding the relationship between school resources and student performance.

The interest in examining the relationship between teacher salary and student achievement comes from several sources. First, from an economic perspective, investing in teacher quality and generally in education is perceived as way that can potentially increase economic growth, promote income equality, and reduce poverty (Barro, 1991; Gupta, Verhoeven, & Tiongson, 2002). Education is also considered as a pathway to generate various externalities, related for example to its effect on economic growth or its value for a well-functioning democracy, thus justifying an important component of public intervention (Hanushek, 1996). In this vein, recent empirical research has shown that teacher quality in school is positively associated with social outcomes such as reduced teenage pregnancy and improved quality of neighbourhood lived in (Azam and Kingdon, 2015).

Second, in most countries, an important part of the state budget is devoted to education and teacher salary accounts for between half and three fourth of education expenditure (OECD, 2019). Given the magnitude of the financial investment involved, policymakers are naturally inclined to pay attention to the link between these funds and educational outcomes. Furthermore, examining the level of teacher salary and its potential impact on student learning might provide useful information for school leaders and policymakers to improve students' chances of success and to implement policies aimed at the recruitment and retention of high- quality teachers

During the last two decades, the importance of teacher salary has been the focus of debate for many countries, particularly in the context of teacher accountability promoted by the implementation of performance-related pay schemes. The concept of linking pay to an assessment of individual performance has been adopted in many countries including, for example, England and Wales (Tomlinson, 2000), Australia and India (Kingdom & Teal, 2010). However, existing studies do not provide a clear picture of the relationship between teacher pay and student performance. Several empirical studies have demonstrated some difficulties of implementation concerning this system and the lack of support from teachers (see for example Farrell & Morris, 2004). As a result, most countries still use a standardized compensation system that determines salary level based on education level and teaching experience.

The debate about teacher salary stems also from the situation of the teacher labor market, particularly the teacher shortage and the high attrition rates reported in many OECD countries (OECD, 2005; OECD, 2013). It is generally believed that lower salaries relative to alternative occupations are responsible for teacher shortages and that higher salaries will therefore help to reduce shortages. However, there exists little empirical works devoted to the relationship between teacher shortages and teacher salary differentials.

Furthermore, an increasing number of studies have shown that low teacher salary often leads to teacher dissatisfaction and higher attrition rates. For instance, Figlio (1997) found that U.S. districts with higher teacher salaries tend to attract more teachers from selective colleges and with subject matter qualifications. The

OECD (2014) reports that disadvantaged schools tend to be more likely to suffer from teacher shortages and experience greater difficulties in attracting qualified teachers. Studies in different national contexts show that working conditions are consistently the strongest predictors of teacher turnover (see for example, Ingersoll & May, 2012; Ladd, 2011). More work in this vein could produce a better understanding of the determinants of teacher turnover and retention. The rest of the paper is organized as follows. Section 2 gives an overview of the literature. Section 3 introduce the method and discusses the data and variables. Section 4 presents and discusses the results. Section 5 concludes the paper.

Teacher Salary and Educational Achievement: What do we know?

In the present study, teachers refer to professional personnel directly involved in teaching to students. The definition includes classroom teachers, special-education teachers and other teachers who work with a whole class of students in a classroom, in small groups in a resource room, or in one-to-one teaching situations inside or outside a regular class (OECD, 2018).

Empirical assessments of teacher wage effects have mostly failed to provide any consistent relationship between teacher salary and student performance. For example, only nine of the sixty teacher salary studies cited in Hanushek (1986), in the tradition of education production functions, produced wage coefficient estimates that were both positive and statistically significant. In the same vein, Hanushek (1997) finds that student outcomes are not consistently related to either teacher salaries or per pupil expenditures. Using longitudinal data sets (the High School and Beyond Survey and the National Longitudinal Survey of Youth), Grogger (1996) and Betts (1995) have also produced similar results. Ballou and Podgursky (1997) also find that relative salaries have no effect on the SAT scores of teachers.

In contrast with the cited above studies, Card and Krueger (1995) used variation in teaching salaries across states and found that a 10% rise in teachers' salaries led to a 0.1 percentage point increase in the rate of return to schooling for white males born between 1920 and 1949. Loeb and Page (2000) used state-level variation in relative teachers's wages from the 1960 to 90 censuses and found that a 10% rise in the teaching wage reduced the high school dropout rate a decade later by 3-4%. A study by Kingdon and Teal (2010), in India found that higher salary was associated with higher student achievement in private schools but not in public schools. Their results showed that, after controlling for student ability, parental background and the resources available, higher salary in private schools led to improved achievement through increased teacher efforts measured by minutes of academic instruction per week, rather than through improved overall teacher quality measured by experience and training.

To the best of our knowledge, only few studies adopting a cross-national framework have examined the relationship between national average salary and national achievement level using aggregated data at a country level with different samples of countries participating in international tests such as PISA or TIMSS

(Trends in International Mathematics and Science Study). Ladd (2007) analyzed the relationship between the ratio of teacher salary to GDP per capita and national average mathematics scores in 24 countries using the 2003 PISA data and the OECD teacher salary data. Using correlation analysis, Ladd found no statistically significant relationship between these two national factors. Nir and Naphcha (2007) examined the relationship between privatization measured by private school enrollment and teacher salary level using the 2004 OECD salary data from 29 countries. They also analyzed science scores from the 2003 PISA data and found that the countries with a higher level of privatization had a higher average teacher salary, but national achievement in science was not significantly associated with teacher salary level, controlling for GDP per capita.

Akiba, Chiu, Shimizu, and Liang (2012) used national teacher salary data from OCDE and student achievement data from PISA 2006 in order to examine the relationship between average teacher salary and national achievement in mathematics and science in OECD countries. Their results showed that the countries with higher average salary for experienced teachers are more likely to have higher national achievement. However, the national average salary for new teachers was not significantly associated with national achievement level.

More recently, García and Han (2022) investigated the relationship between teacher pay and student test scores in US districts using nationally representative data. They employed state fixed effects and multilevel mixed effects models and found that both mathematics and English test scores are significantly higher in districts that offer higher base salaries to teachers, compared with those in districts with a lower teacher base salary. They also found that higher teacher base salaries reduce achievement gap between white and black students, as well as between white and Hispanic students, by raising test scores more for those minority students.

Tincani (2021) estimated an equilibrium model to simulate a reform that is planned to be implemented in Chile in 2023. Tying public school teacher wages to teacher skills and introducing minimum competency requirements for teaching is predicted to increase student test scores by 0.30 standard deviations and decrease the achievement gap between the poorest and richest 25% of students by a third.

Marchand and Weber (2020) studied how local labor market conditions for teachers affect teacher quality and, in turn, student achievement.

In this paper, we use recent available data from 30 OECD countries participating in PISA 2018 and teacher salary data from the OECD "Education at a Glance" to examine the relationship between teacher salary and student achievement.

The following research questions were addressed for our purpose:

1. How does average salary of lower secondary school teachers compare across the 30 OECD countries?
2. How did average teacher change from 2005 to 2018 in the 30 OECD countries?
3. How are average teacher salary in 2017 associated with national average student achievement in mathematics and science in 2018?

It was hypothesized that higher pay would attract the most qualified workers in the education sector, assuring a supply of high-quality teachers that improve the student achievement. The rationale for this expectation is that, as noted in Dolton and Marcenaro-Gutierrez (2011, p. 8), in most countries, medical doctors and lawyers are paid high up in the earnings distribution and as a result, these professions attract the most able young people in each cohort. There is no reason, in principle, why teaching could not be added to this list of elite profession. In other words, the propensity of young people to enter or stay in the profession is influenced by the salaries of teachers relative to those of other occupations requiring similar levels of qualification. Specifically, in OECD countries, a tertiary degree is generally required to become a teacher, at all levels of education, meaning the likely alternative to teacher education is a similar tertiary education programme. Thus, to interpret salary levels in different countries and reflect comparative labor-market conditions, actual salaries are compared to earnings of other tertiary-educated professionals (OECD, 2019). The next section will present the data and the method.

Materials and Methods

The traditional approach to specify the link between teacher salary and educational outcomes is based on the theorical framework of an educational production function model in which the outcome or achievement of student *i* who attends school system *s* as measured by test scores *is* related to environmental and school resources input. The history of this model of achievement is generally traced back to the "Coleman Report" (Coleman et al. 1966). Most of the empirical models to estimate teacher salary effects are based on permutations of the following equation:

$$Y_{is} = \propto + \beta 1 \boldsymbol{W}s + \boldsymbol{Z}s\beta 2 + \boldsymbol{X}is\beta 3 + \in is \quad (1)$$

Where Y_{is} is an outcome measured for student i who attends school s (usually the student's test score), **W**s is related to the average wage paid to teachers at school s, Zs is a vector of factors common to all students attending school system s (such as the average socioeconomic composition of enrollees), and **X**is is a vecteur of other factors that are specific to student I (such as family background). Considering that teacher salaries impact student outcomes because of their effect on teacher quality, $\beta 1$ can be interpreted as an estimate of the slope of the supply curve for teachers in quality-wage space.

Equation (1) is typically estimated using cross-sectional data so that $\beta 1$ is identified from variation in both outcomes and salaries across schools at a point in time. Our discussion and the results presented in section 4 focus on the OLS results.

Data

This study is limited to the OECD group because these industrialized countries constitute a reasonable comparison group despite some differences in their histories and cultures. To examine the link between teacher salary and national achievement, the focus will be on two main OECD sets of data. The first one represents 2017 teacher salary data from "Education at a Glance" reports (OECD, 2019). This is the most comprehensive source of comparative information about teacher salaries in different countries around the world.

It provides data on the structure, finances and performance of education systems in the 35 OECD and a number of partner countries. The second data set used is related to the national mathematics and science achievement data from the PISA (*Programme for International Student Assessment*) 2018. The survey takes place every three years, starting in 2000, thus PISA 2018 represents the seventh wave of this study. Pisa uses a two-stage stratified design sampling. In the first stage of sampling, schools having age-eligible students are sampled systematically with probabilities proportional to the school size. A minimum of 150 schools is selected in each county. Some 600 000 students completed the assessment in 2018, representing about 32 million 15-year-olds in the schools of the 79 participating countries and economies.

Variables

Teacher Salary

Teachers' salaries are the average gross salaries of educational personnel according to official pay scales, before the deduction of taxes, including the employee's contributions for retirement or health care plans, and other contributions or premiums for social insurance or other purposes, but less the employer's contribution to social security and pension.

Teacher salary data in 20017 are from the 2019 OECD "Education at a Glance" report. Two types of teacher salary variables were analyzed: (1) average salary for new teachers, (2) average salary for teachers with 15 years of experience. The salary levels for new teachers and teachers with 15 years of experience were reported in equivalent US dollars converted using purchasing power parities (PPPs). Furthermore, to interpret salary levels in different countries and reflect comparative labour-market conditions, actual salaries are compared to earnings of other tertiary-educated professionals aged 25–64-year-old, full-time workers with similar tertiary education (ISCED 5 to 8). This third (relative) measure of teachers' salaries comes from "Education at a Glance" 2018 report. Note that GDP per capita is defined as the total market value of all final goods and services produced in a given country in a calendar year divided by the population, and it is an indicator of a country's economic wealth per capita. These three variables were analyzed for lower secondary school teachers.

Educational Achievement

National achievement levels in mathematics and science were measured using national mean student scores in mathematics literacy and science literacy in the PISA evaluation administered to 15-year-olds in 2018. These students were enrolled in grade seven or higher and include students from both lower secondary and upper secondary schools in most countries (OECD, 2019). The PISA data were chosen to match the secondary school teacher salary data in 2018 in the OECD reports. National achievement level in mathematics literacy ranged from 409 in Mexico to 527 in Japan with the mean of 489. For science literacy, it ranged from 410 in Mexico to 563 in Finland with the mean of 489.

Control Variables

GDP per capita was analyzed as a control variable as it is a strong predictor of national achievement. GDP per capita in 2017 for 30 countries ranged from $20,022 in Mexico to $112,701 in Luxembourg with the mean of $43,513. Another control variable was educational expenditure as percentage of GDP. By controlling for this variable, we can assess if the country that invested more in teacher salary produced higher national student achievement or not when the educational funding level is held constant. Educational expenditure as percentage of GDP in 2017 from 30 countries ranged from 3.2 in Luxembourg to 6.6 in Norway with the OECD mean of 4.9 (see OECD, 2020, table C2.1). Finally, the study accounts for alternative wage opportunities by using as a control variable teacher salaries to earnings for tertiary educated workers.

Empirical Strategy

For the first and second research questions, teachers' average salary levels in lower secondary schools in 2017 were compared across OECD countries. For the last research question, we conducted multiple regression analyses with country as the unit of analysis. The dependent variables are national average student achievement levels in mathematics literacy and science literacy in the 2018 PISA test. Each teacher salary variable was entered into the model separately as the independent variable with three control variables: GDP per capita, education expenditure as percentage of GDP and teacher salaries to earnings for tertiary educated workers. The multiple regression analyses were conducted separately for mathematics and science achievement levels.

Results

How does Average Salary of Lower Secondary School Teachers Compare across the 30 OECD Countries?

Generally, Statutory salaries of teachers can vary according several factors, including the level of education taught, the qualification level of teachers, and the

level of experience or the stage of the career of teachers. Figure 1 shows Lower secondary teachers' statutory salaries at different points in teachers' careers for OECD member countries and partners. Specifically, it presents the average starting salary with the minimum qualification, the salary after 15 years of experience with the most prevalent qualification and the salary at top scale with maximum qualifications. As can be seen in this figure, teachers' salaries vary widely across countries. The average salary for starting teacher ranges from USD 24 893 in Costa Rica to USD 79 551 in Luxemburg, the OECD average is USD 33 498.

The salaries of teacher with 15 years of experience range from less than USD 25 000 in the Czech Republic, Hungary, Lithuania and the Slovak Republic to more than USD 60 000 in Canada, Germany, Ireland, the Netherlands and the United States, and they exceed USD 100000 in Luxemburg.

In most countries and economies with available information, teachers' salaries increase with the level of education they teach. In the Flemish and French communities of Belgium, Denmark, Lithuania and Norway, upper secondary teachers with 15 years of experience and the most prevalent qualifications earn between 25% and 30% more than pre-primary teachers with the same experience, while in Finland and the Slovak Republic they earn 36-50% more, and in Mexico, 88% more. In Finland and the Slovak Republic, the difference is mainly due to the gap between pre-primary and primary teachers' salaries. In the Flemish and French communities of Belgium, teachers' salaries at upper secondary level are significantly higher than at other levels of education (OECD, 2020, Table D3.1).

In addition to pay scales, the number of years needed to reach the top of scale is an indication of the speed of career progression and prospects. In general, the wider the range between minimum and maximum salaries, the more years it takes for teachers to reach the top of the scale. For example, although it only takes 6-8 years to start earning the maximum salary in Australia, New Zealand and Scotland (United Kingdom), the top of the scale is only about 33-53% higher than starting salaries, compared to 66% on average across OECD countries and economies with data on salaries at both points of the scale. However, this is not true of all countries. For example, while teachers with the most prevalent qualifications in both the Czech Republic and Israel will reach the top of their scale within approximately 32-36 years, maximum statutory salaries in the Czech Republic are only 32% higher than starting statutory salaries, compared to 104% higher in Israel.

Figure 2 presents teachers' salaries relative to earnings for tertiary-educated workers to account for alternative employment opportunities that are important factors in the attractiveness of teaching. Among the countries with available data, actual salaries of teachers amount to 61% and 65% of earnings of similarly educated workers in the Czech Republics and the United States. Few countries have actual salaries of teachers that reach or exceed those of similarly educated workers. However, in some countries, teachers earn more than tertiary-educated workers, for example, in Luxembourg and Portugal, teachers earn at least 30% more that tertiary-educated workers. However, some caution is warranted when interpreting the ratio. For example, in Greece the proportion of overqualified

people in their job may lead to lower average earning compared to workers with similar proficiency but who are well-matched with their jobs. This may explain that teachers' salaries are higher than those of similarly educated (OECD, 2018).

Figure 1. Lower Secondary Teachers' Statutory Salaries at Different Points in Teachers' Careers (2017) Annual Salaries of Teachers in Public Institutions, in Equivalent USD Converted Using PPPs

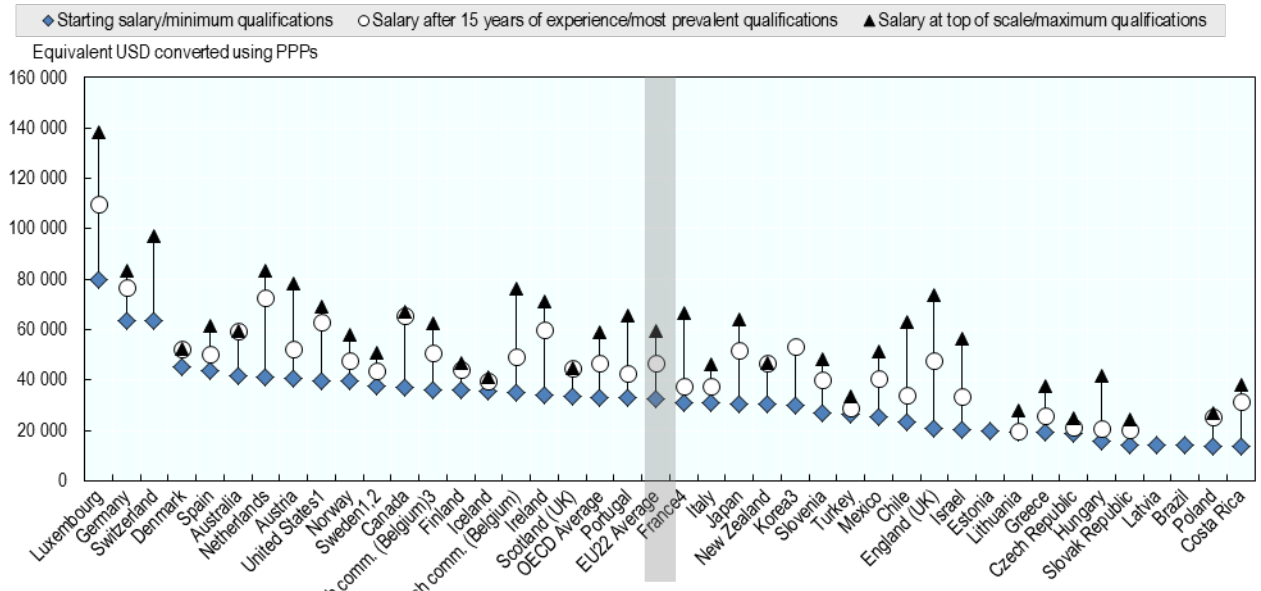
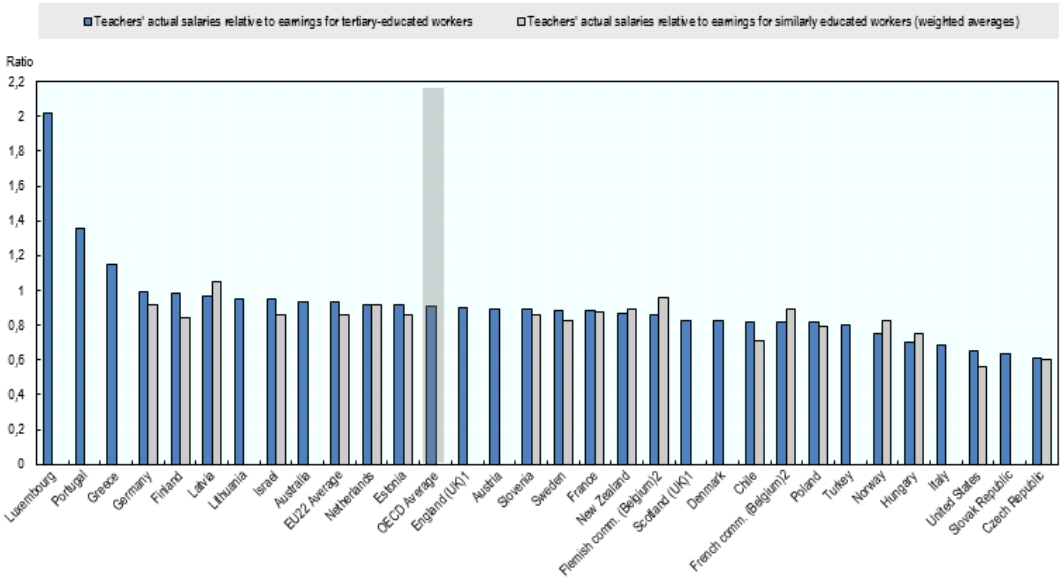


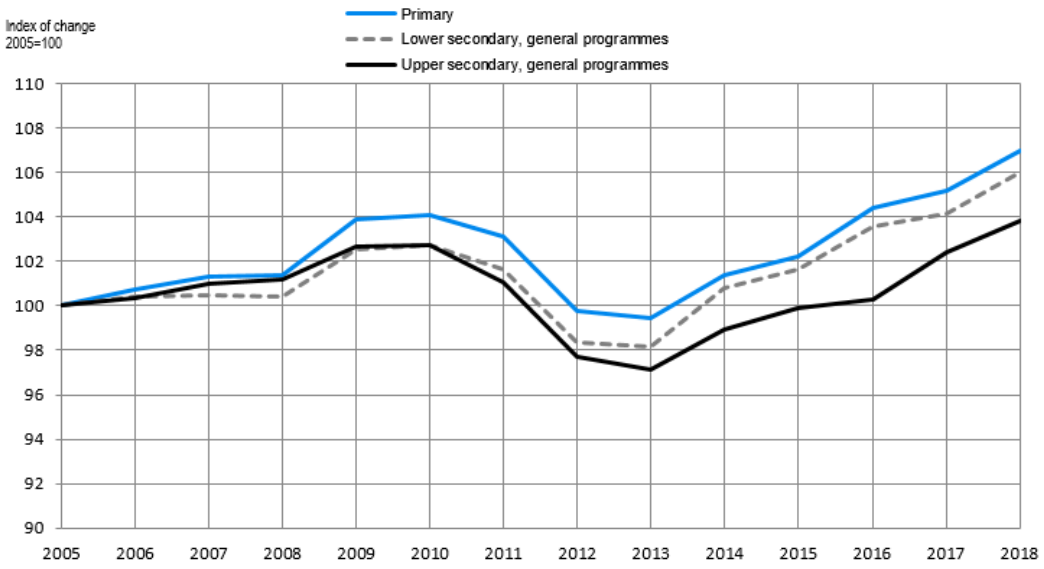
Figure 2. Lower Secondary Teachers' Salaries Relative to Earnings for Tertiary-Educated Workers (2017) Annual Actual salaries of Lower Secondary Teachers Teaching General Programmes in Public Institutions



How did Average Teacher Salary Change from 2005 to 2018 in OECD Countries?

Figure 3 shows the change in teachers' salaries in OECD countries from 2005 to 2018. Over this period for which three-quarters of OECD countries and economies have comparable data, more than half showed an increase in real terms in the statutory salaries of teachers with 15 years of experience and most prevalent qualifications. In most countries, the salary increases were similar across primary, lower secondary and upper secondary levels between 2005 and 2018. However, these overall changes in teachers' salaries in OECD countries between 2005 and 2018 mask different periods of change in teachers' salaries due to the impact of the economic downturn in 2008. On average across OECD countries and economies with available data for all years over the period, salaries were either frozen or cut between 2009 and 2013, before starting to increase again. This is so since national debt, caused by governments' responses to the financial crisis of late 2008 has put pressure on policy makers to reduce government expenditure particularly on public payrolls (OECD, 2017). As a result, teachers' salaries were either frozen or cut in some countries. Between 2005 and 2015 teachers' statutory salaries decreased in real terms in one third of the OECD countries and economies with available data. For instance, the decrease at pre-primary, primary and secondary levels reached about 10% in England and Portugal, and up to 28% in Greece (OECD, 2017).

Figure 3. Change in Teachers' Salaries in OECD Countries (2005 to 2018) Average Index of Change, Among OECD Countries with Data on Statutory Salaries for All Reference Years, for Teachers with 15 Years of Experience and Minimum Qualifications (2005 = 100, Constant Prices)



Source: OECD, Education at a Glance (Paris, 2018).

How is Average Teacher Salary in 2017 Associated with National Average Student Achievement in Mathematics and Science in 2018?

Table 2 presents the multiple regression results on the relationship between teacher salary and national achievement in mathematics after controlling for educational expenditure as percentage of GDP, GDP per capita and salary relative to earnings for tertiary education. Table 3 presents the same set of results for national achievement in science. Overall, the proportion of variation explained in national achievement by four independent variables varied from 0.14 to 0.24 for mathematics and 0.21 to 0.22 for science. In summary, we found no significant relationship between average teacher salary and national achievement in mathematics and science in 2017. Thus, we cannot conclude that investing in the salary of teachers will improve national achievement. The individual coefficients derived from the regression reveal that the variable related to earnings for tertiary-educated workers has the expected negative sign in all regressions but is not statistically significant at the conventional levels. Note also that the average salary for new teachers has the expected positive sign in all regressions but the salary for experienced teachers has a positive sign only in the science regression. We also examined the effect of omitting to account for alternative employment opportunities in the regressions. In doing this, the salary for experienced teachers become positive in the mathematics regression but remains not statistically significant. Our results are generally consistent with the evidence presented by Ladd (2007) who find no clear relationship between teacher salaries and student achievement using data from PISA 2003 test scores for OECD countries. She added that data from the Trends in International Mathematics and Sciences Study (TIMSS) present a similar picture. In the same vein, Nir and Naphcha (2007) analyzed science scores from the 2003 PISA data across 29 OECD countries and found that national achievement in science was not significantly associated with teacher salary level, controlling for GDP per capita.

Table 1. Association between Teacher Salary and National Achievement in Math in 2017

	B	(SE)	Beta
New teacher salary	**0.00**	**(0.01)**	**0.11**
Educational Expenditure	5.67	(4.64)	0.27
GDP per Capita	0.00	(0.01)	0.32
Salary relative to earnings for tertiary education	-23.3	(22.8)	0.29
R^2	0.24		
15th-year teacher salary	-3.31	(0.01)	0.03
Educational Expenditure	5.68	(4.67)	0.27
GDP per Capita	0.00	(0.00)	0.43
Salary relative to earnings for tertiary education	-21.73	(23.04)	0.27
R^2	0.14		

Note: We found no significant relationship between average teacher salary and national achievement in mathematics in 2017.

Table 2. Association between Teacher Salary and National Achievement in Science in 2017

	B	(SE)	Beta
New teacher salary	**0.00**	**(0.01)**	**0.42**
Educational Expenditure	3.48	(4.04)	0.19
GDP per Capita	2.33	(0.01)	0.02
Salary relative to earnings for tertiary education	-22.1	(19.9)	0.32
R^2	0.21		
15th-year teacher salary	**0.00**	**(0.00)**	**0.55**
Educational Expenditure	4.03	(4.02)	0.23
GDP per Capita	0.00	(0.00)	0.10
Salary relative to earnings for tertiary education	-23.28	(19.89)	0.27
R^2	0.22		

Note: We found no significant relationship between average teacher salary and national achievement in science in 2017.

Conclusion

This paper used data from OECD and employed multiple regression analysis to investigate the link between average teacher salary and national achievement in mathematics and science across 30 OECD countries. Several control variables were included in the research namely educational expenditure as percentage of GDP, GDP per capita and alternative employment opportunities as proxied by salary relative to earnings for tertiary education workers. The study revealed an important variation in the level of teacher salary between countries. It also showed that teachers' statutory salaries decreased in real terms in one third of the OECD countries between 2005 and 2015 due to the financial crisis of late 2008. Furthermore, we found no significant relationship between average teacher salary and national achievement in mathematics and science in 2017. Thus, we cannot conclude that investing in the salary of teachers will improve national achievement. We must remember that our results are generally consistent with the evidence presented by Ladd (2007) who find no clear relationship between teacher salaries and student achievement for OECD countries. Nir and Naphcha (2007) also found that national achievement in science was not significantly associated with teacher salary level, controlling for GDP per capita. The policy implication that flows from this study is perhaps the need to look beyond a single policy such as higher salaries in favor of policy strategies that address, for example, teacher preparation and certification, working conditions and other challenges facing new teachers. Research has shown that these policy strategies are important for attracting and retaining skilled and high-quality teachers that have the potential to improve student achievement.

Finally, the results should be interpreted with caution because statutory salaries are just one component of teachers' compensation system and because of the presence of potential comparability issues related to data collected.

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Engaging and Retaining Students in Online Learning

By Ali Abusalem[*], Lorraine Bennett[±] & Dimitra Antonelou-Abusalem[°]

Before the COVID-19 outbreak, universities were already exploring the potential of online education. Colleges and universities throughout the world became more reliant on online learning management systems (LMSs) and videoconferencing tools like 'Zoom' and 'Microsoft Teams' during the 2020-2021 campus' lockdowns. The transition from traditional face-to-face teaching to online learning presented significant difficulties for universities, particularly those that depended heavily on international students. The project reported in this paper was undertaken in Australia in 2021 at the request of a private higher education institution. A new student-centric version of the Moodle learning management system (LMS) was created to maximise the platform's pedagogical, communicative, and informational capabilities. The purpose of this article is to demonstrate how online learning platforms that are flexible, utilise embedded interactive features and resources, and are freely available can enhance and support the delivery of quality online education. The paper discusses how well-designed learning management systems have the capacity to motivate, engage and retain students in online learning. Academics, at both the undergraduate and graduate levels, as well as those working in curriculum development and information technology at institutions of higher learning, may find this article to be of interest and value.

Keywords: online, Moodle, Learning Management System (LMS), pandemic

Introduction

Recent years have seen an adoption by educators and educational experts of active learning styles which stem from a growing understanding of the importance of emotional, behavioural, psychological, and social aspects in the learning process and in students' overall well-being and development. There is almost universal acceptance that 'participative learning', which focuses on the learner is superior to 'didactic learning', which focuses on teacher-presentation of information, for achieving most educational goals.

Against the backdrop of the world-wide pandemic and the mandatory switch to online and remote learning, this paper provides insight into the benefits of development and enhancement of a Moodle learning management system (LMS) which applied a student-centric design to improve the platform's pedagogical, communicative, and informational capabilities. In addition, the paper demonstrates how a well utilised Moodle platform can help teachers motivate, involve, and retain students by providing them with a flexible and publicly accessible online learning option. Furthermore, it illustrates how the use of educational technology

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in the classroom offers numerous opportunities to transition students into active 'learners,' as opposed to passive 'listeners'.

Aim

The aim of the project was to research, consult, design, develop, and implement pedagogically-based improvements to an online Moodle Learning Management System which would provide added support for, and engagement with, online students.

Scope

The project was supported by a competitive grant from the Australia English Fund. The designated funds were intended to encourage and assist English-language universities and colleges in making the shift to online education delivery to maintain their attractiveness to, and retention of, foreign students.

The grant was awarded to an independent Australian higher education provider which commissioned external consultants, with extensive senior-level academic experience directing and working in university-wide centres for learning and teaching, to lead the project. The consultants also drew upon the expertise and advice of a focus group of additional academic colleagues with experience in the field of learning and teaching and advanced technology application in the context of higher education.

Context

During the four months of this investigation, the consequences of the pandemic in Australia almost ground daily life to a standstill. Municipalities, organisations, and educational institutions closed. Few people ventured outside their homes unless under the direst of circumstances. University officials scrambled to keep the institutions operational by offering online and remote support. Many universities, and private higher education providers especially smaller ones, found that they lacked the expertise and infrastructure to swiftly transition to online course delivery. Everybody involved in the sector, from teachers to students, had to deal with a culture that was riddled with ambiguity, uncertainty, and overburdening duties. Many countries reported a rise in mental health illnesses among staff and students who were ill-equipped and underprepared to cope with the rapid transition to online learning and teaching.

Research Question

This paper discusses the importance of creating learning partnerships between academics and students in the online learning space. The specific research question underpinning the project was:

> How can a Moodle Learning Management Platform enhance engagement and retention of students in online learning?

Paper Outline

The following items are covered in the body of the paper.

- Review of literature on the theoretical concepts which inform the application of emerging technologies and Learning Management Systems (LMSs) in online learning, teaching and assessment practices.
- Original analysis of previous feedback on Moodle design undertaken in prior teaching activities.
- Section on the mixed methodology used in the project to incrementally develop and review the enhanced Moodle platform.
- Application of the Learning Partnerships in Adult Education (LPAE) approach and the ServQual Framework to inform the enhanced Moodle platform.
- Implementation of the customised Moodle.
- Summary of findings.
- Recommendations.
- Conclusion.
- Reference list.

Review of Literature

The goal of this project was to enhance online teaching and learning in higher education by optimising the potential resources in a Learning Management System to better assist students achieve their academic goals and increase their level of engagement with course material (LMS). Moodle, a free and open-source LMS, was selected for this project because of its ability to provide instructors, support staff, and students with a unified, safe, and adaptable platform on which to build their own unique educational experiences (Moodle Project, 2022; Lungu, 2022).

Martin Dougiamas, an Australian who participated in his country's School of the Air initiative, created Moodle. Children living in remote areas of Australia are the focus of this initiative. Its first implementation took advantage of the two-way radio network already in place within the Royal Flying Doctor Service to link up with students and provide real-time instruction. Satellite and internet technologies are being used to provide the service (Alice Springs School of the Air, 2022).

Moodle was likely influenced and shaped by Dougiamas's own experience with distance learning as a student.

In 2022, Moodle is predicted to have 340 million users enrolled in 42 million courses across 241 countries (Moodle Project, 2022). Moodle's two main selling points are its user-friendliness, thanks to its drag-and-drop interface and its creation of a collaborative learning and teaching environment, centred on the individual needs of each student.

While Moodle was the primary LMS investigated, the literature analysis also looked briefly at other learning management systems with the view that conclusions and anecdotes would hold true across a variety of LMSs, not simply Moodle.

Early Adopters

An example of an early adopter is the Open University of Canada. This organisation made a planned transition to online education which is reported in a collection of essays (Anderson & Elloum, 2004). The essays are organised into the following categories: (1) The Role and Function of Theory in the Design and Delivery of Online Education; (2) Content Development Infrastructure and Support; (3) Online Course Design and Development; and (4) Online Course Delivery, Quality Control, and Student Support.

Three of the topics highlighted during this early phase of the shift to online education were selected for deeper investigation and expansion in this literature study. They provide a brief overview of the primary data, theories, and procedures that served as the basis for the work undertaken in the project.

The Role and Function of Theory in the Design and Delivery of Online Education

According to published works, different pedagogical theories and methods of instruction inform and shape distinct features of online education. The research conducted by Watson, Skinner, Thorndike, and Hull in the early to mid-1900s laid the groundwork for behaviourist theory, which popularised ideas like conditioned response, learning by association, reward and punishment, and aversion treatment (Cherry, 2016). Positive online learning environments, fewer learning obstacles, thanks to simplified online navigation aids, incentives for appropriate replies, opportunities for repeated practise, and other tenets of behaviourism may be found in online education (Kaplan, 2017; 2018).

In learning and formative assessment when the emphasis is on learning and testing knowledge and facts, LMS technologies like online self-paced and timed quizzes, learning drills and computer games, based on behaviourism theory are valuable tools (Ally, 2004; Drew, 2019). The ability to upload recorded lecture files, PowerPoint presentations, video and audio webinars and optional readings are other features of a basic LMS that facilitates access to information.

Piaget and others, like Bruner and Neisser, believed that there was more to learning than what could be seen in terms of stimulus and response behaviours,

and so cognitive learning theory was born (Tennyson & Rasch, 1988; Barrouillet, 2015). Cognitive learning theory is a way of learning that emphasises 'thinking about thinking,' as its name indicates. Some academics have coined the term 'metacognition' to describe this phenomenon (Tanner, 2012). Opportunities for application of content, reflective activities, and deep and critical thinking are of utmost importance in a virtual classroom (Ally, 2004). E-journals, debates, discussion forums, and chat rooms are only some of the online platform features that have been influenced by cognitive theory (Winn et al., 2019).

According to the constructivist philosophy of education, students are not passive recipients of information but rather creators of their own knowledge. Dewey, Vygotsky, Bednar, and von Glasersfeld were among the first to advocate this approach. Learning, according to the constructivist, is not something that just happens. The traditional model of education, in which a teacher acts as a 'sage on the stage' has given way to one in which teachers operate more like 'guides on the side' (King, 1993). The student plays an important role in this framework.

Constructivism advocates for realistic and contextualised curriculum design in online education (Ally, 2004; Bada, 2015). Constructivism-informed online features include those that help students study and problem-solve, simulate real-world employment settings, and include assessments that make use of multi-media resources like recorded videos, narrated slide presentations, and ePortfolios. The creators of Moodle state that they were inspired by social constructivism theory while designing the platform. According to their website, Moodle is founded on the tenets of social constructivism, an educational philosophy that encourages the formation of collaborative groups to build knowledge for one another and form a microculture based on the creation and exchange of cultural artefacts with mutually understood meaning (Moodle Project, 2022).

The philosophy of learner-centred instruction is a development of constructivism. It emphasises the importance of the student's past knowledge, abilities, and experience in the learning process and supports the idea that students are active participants in that process. The demographics and cultural backgrounds of the students being taught are also considered in learner-centred theory (Schweisfurth, 2015).

Learner-centred theory is often aligned with 'humanist' and 'holistic' learning theories whereby one's own development, awareness of one's own ideals and feelings, and actualisation of one's own potential are prioritised (Johnson, 2014). Learners are empowered in a learner-centred approach by being given agency over their own education, encouraged to create their own objectives, and participating in the development of assessment criteria (Gros & López, 2016).

Flipping the classroom is one of the most well-known examples of a learner-centered approach in education. In this scenario, students access weekly assigned readings, videos, lectures, and learning exercises online in advance of each week's planned session. Online class time is used to have lively discussions and engage in collaborative activities that build on the weekly homework activities. The success of the approach depends on the online learning platform being available to all students and being large enough to store the weekly materials. A successful learning management system, whether it is used in a flipped classroom setting or

not, needs to be user-friendly and include features and tools that facilitate and enhance student learning (Akçayır & Akçayır, 2018; Jiang et al., 2020).

Prensky claims that students who have grown up in the digital era have a distinct way of learning. When asked 'how do students learn?' his attention shifts to 'what do they learn?' (Prensky, 2000, p. 156). To paraphrase Prensky's model: Behaviors are best learned through imitation, feedback, and practice; creativity is best learned through play; facts are best learned through association, drill, memory, and questions; judgement is best learned by reviewing cases, asking questions, making choices, and receiving feedback and coaching.

Whether the desired learning outcomes are knowledge-based, skill-based, application-based, or value-driven, this project and other institutions working in the online space face the challenge of ensuring and expanding the functions and features in their online learning management systems to facilitate learning activities and assessment practices which align with the nominated learning outcomes.

Design and Development of Online Courses

Many colleges and universities had already begun using hybrid and online programs prior to the COVID-19, as was highlighted earlier in this review. A case study from the School of Public Health at Columbia University emphasised that online course design, production, and delivery should be seen as an iterative process in which we constantly evaluate what works and improve the procedure, learning activities, and resources (Russell, Kane-Sample, Bhaskar, & Lewis, 2022).

The Columbia experiment recognised, and several papers affirmed, the need for cooperation among teachers, course planners, information technology experts, school officials, and students (Puzziferro & Shelton, 2008). It seems that problems arise when the shift to online education is motivated more by the 'technology' than the 'methodology' (Keengwe & Georgina, 2011). Educational literature repeatedly stresses that the technology available should be used to assist the agreed upon principles and aims, rather than the other way around (Davis, 2004).

Perhaps unexpectedly, a study of the effects of the University of the Pacific's Dental School's quick shift to online courses revealed that student performance was on par with or even higher than pre-pandemic outcomes (Zheng, 2021). The debate on the function of online engagement and interaction included into the curriculum may provide a crucial hint to the rumoured success of the school's transition to online courses. Teachers were urged to increase student-to-student communication and collaboration via the use of the learning platforms' interactive capabilities. Students cited aspects like breakout-room activities, chat sites, discussion forums, polls, and the incorporation of game play using apps, as being particularly helpful in their learning platforms (Zheng, Bender, & Lyon, 2021).

Establishing and maintaining a 'teacher-presence' is crucial in both face-to-face and online learning, according to an article on applying best practice in online learning (Roddy et al., 2017). The authors go on to discuss some of the problems that some students and teachers have when attempting to participate in online

courses due to the inherently unstable nature of the online environment. They refer to the benefit of using synchronous and asynchronous methods for communication, feedback, and engagement, provided by the learning platform, to maintain constant contact and participation with distant students.

Online Course Delivery, Quality Control and Student Support

Academic integrity, privacy, plagiarism and copyright, access and equity, compliance with the regulator's standards, governance, policy, and quality control were identified as sub-topics in a review of the literature under the broad theme of quality assurance of online learning and teaching delivery and infrastructure.

Most articles on academic honesty emphasised the need to include resources to promote scholarly practices in online education and dissemination within the platforms themselves. One strategy was to make sure that all relevant websites have extensive resources on issues like plagiarism, cheating, and copyright. Students at certain institutions were able to use Turnitin and similar plagiarism detection tools before submitting their assignments. Most policies and practices favoured educating over reprimanding and penalising.

Several publications brought attention to the access and equality concerns raised by the sudden shift to online learning that many universities were forced to make because of the pandemic. Lack of access to powerful digital devices and technical infrastructure, such as a dependable and fast internet connection, greatly restricted what could be delivered to students online in low-income and rural locations.

According to research conducted across African institutions, both faculty and students were unprepared for the rapidity and expense of the transformation due to a lack of resources and technological expertise (Vusumuzi, Sisasenkosi, & Sibanda, 2020; Mafugu, 2020). In some regions, only iPads with specific pre-installed apps like WhatsApp, Microsoft Teams, and Telegram were available (Ahmed et al., 2020). Similar difficulties accessing online courses were reported by American university researchers in poor communities (Browning et al., 2021; Ives, 2021). Based on the results of a recent study conducted in Romania, it seems that both the faculty and the students have a long way to go before they are ready for online education (Coman et al., 2022).

Another problem with quality control found in the research was ensuring that online activity complied with standards set by the government regulator and was embedded in suitable rules and procedures. A recent policy statement from the International Association of Universities emphasises the importance of having appropriate structures and policies in place, stating that 'faculty, student, and staff should be engaged, and their needs and perspectives considered to effectively and appropriately use technology in teaching, learning, research, and administration' (IAU, 2022, p. 7). For these shifts to be successful, the institution must be equipped with the resources and infrastructure necessary to steer its transition to digital.

Analysis of Feedback on Prior Moodle Enhancement Activities

In addition to the review of recent, relevant literature, the project was informed by some analysis of the project leader's earlier unpublished research into Moodle enhancement. The analysis reported focuses on feedback received from students who studied a human resource subject online which used an enhanced LMS Moodle platform. Table 1 illustrates the high level of student satisfaction to the following questions.

Table 1. Students' Feedback

	Strongly agree	**Agree**
Satisfied with the quality of the course	41.38%	55.17%
The Moodle course was easy to navigate	31.03%	41.38%
The resources provided supported learning	41.38%	31.03%
The assessment tasks helped my learning	44.83%	27.59%
The requirements of each assessment task were clearly explained	31.03%	34.48%
The feedback given on my assessment helped me to learn	41.48%	34.48%

Of even more significance to this project were the students' responses to the open-ended questions: 'What were the best aspects of the course?' and 'What aspects needed improvement?' With respect to the best aspect of the course, students cited: easy to navigate Moodle site: availability of feedback features: and convenient online access to learning resources. Regarding areas for improvement, students suggested: greater and more frequent use of online forums; more opportunities for live online discussions; and greater teacher presence in delivery of online lectures and narrated slide presentations.

Examples of the type of feedback received from staff and students when using pedagogy which utilised the interactive features of Moodle include:

> 'When I state that this is the only class that has been able to sustain my attention over the whole of the semester, I do not believe that I am exaggerating the situation in any way'. [student feedback]
> 'This is the very first time in my life that I have been exposed to various approaches to teaching'. [student feedback]
> Your Moodle site is really helpful and inviting…a very positive experience for me. [student feedback]
> The 'exceptional multimedia… in the design of the Moodle sites… the organisational framework and visual style … are an exceptionally high standard'. [colleague, Melbourne campus]
> The Course Moodle site meant that 'students could always be empowered to work together and independently towards the achievement of learning objectives. Group work, self- and peer-assessment, and the creation of class newsletters were significant features'. [colleague feedback].

These affirmations and suggestions were carried forwarded into this project.

Methodology

The project plan utilised a mixed-method approach. In addition to the input from the review of literature and feedback from previous development work in Moodle, the project methodology was informed by the Learning Partnerships in Adult Education (LPAE) approach (Sampson & Cohen, 2001), and the ServQual Framework (Wang, Luor, Luarn, & Lu 2015; Yousapronpaiboon, 2014; Abili, Thani, & Afarinandehbin, 2012).

A small focus group of experienced academics, learning and teaching specialists including the Higher Education provider's DVC (Teaching and Learning) and Information Technology Manager was established to inform, trial, and provide feedback on the project.

A team leader with extensive experience working with Moodle was appointed to oversee the project team and liaise with the various stakeholders. The leader drew upon his extensive knowledge of teaching and researching Moodle to design and develop the customised Moodle Platform. The leader also interpreted and incorporated the feedback provided by the focus group during the various development phases.

Phase 1

The initial focus group discussions noted the following high-level points which were used as guiding principles in the development of the enhanced online learning platform.

- the nature of higher education service provision is changing dramatically. Universities and private higher education providers must prioritise service provision for key stakeholders;
- students are key stakeholders and their service–related experiences need to be of a standard which ensures satisfaction;
- student voices and concerns need to be accommodated in a systematic manner, making learning a two-way process rather than a one-way flow of information;
- effort should be given to involving students in everyday social life of the institution in a respectful manner;
- higher education institutions need to be inventive in attracting and retaining students;
- satisfied students contribute to the overall competitive advantage of universities; and,
- research into service quality (moments-of-truth) identifies student satisfaction to be a principal indicator of student retention.

Phase 2

The LPAE approach explicitly emphasises that teaching and learning involve more than the preparation and delivery of course materials to foster engagement

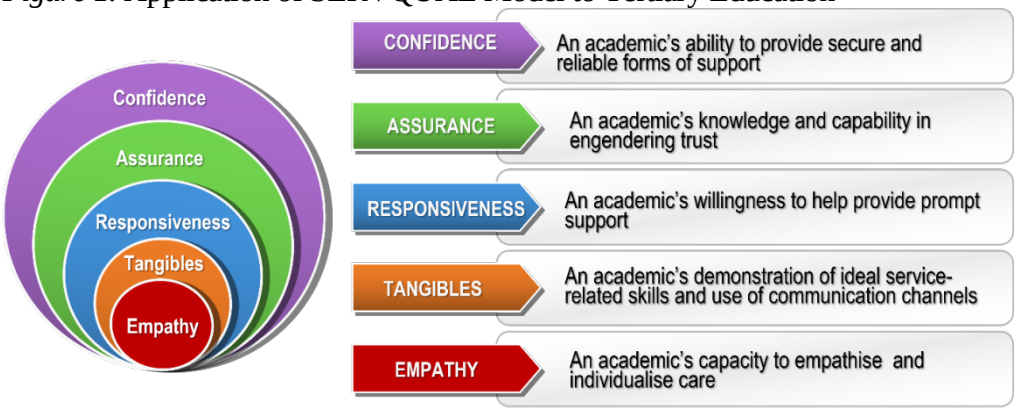
(Healey, Flint, & Harrington, 2014; Cook-Sather, 2020). A key practice in the LPAE approach is to move beyond the preparation and delivery of the course material towards fostering a spirit of collaboration, often referred to as negotiated learning partnerships. Each student is steered towards achieving an identified outcome through regular personal contact and encouragement. Engagement amongst the parties involves building trust, inclusive negotiation, and collaboration. This is viewed as the value-added component. The learning partnership is based on achieving synergy. A synergy where the whole is greater than the individual parts and the collective outcome greater than individual outcomes. Complementarity is a prime aim in LPAE whereby the partnership benefits from the contributions of diverse skillsets, intellectual resources, and accessibility (Cook-Sather & Abbot, 2016; Healey, Flint, & Harrington, 2014).

Phase 3

In this project, learning partnerships were framed and measured by service quality. The definition of quality in services that has been most quoted is that by Parasuraman, Zeithaml, and Berry (1985). Furthermore, Parasuraman, Zeithaml, and Berry (1988) offered SERVQUAL to a wide range of businesses. A tool known as the SERVQUAL was recommended to identify student expectations and measure student perceptions (Salvador-Ferrer, 2010). Expectations refer to what students feel that they should receive in the learning partnership, whilst perceptions refer to what students feel that they have received from the learning partnership. In this project the SERQUAL tool is recommended to assess the gap between student expectations and perceptions about quality online education facilitated by an enhanced Moodle platform. The challenge is to close the gap between expectations and perceptions to secure a commitment to the learning partnership (Akhlaghi, Amini, & Akhlaghi, 2012).

SERVQUAL provides the opportunity to test and analyse student expectations and perceptions in relation to the following dimensions: reliability (confidence in service); assurance; responsiveness; tangibles; and empathy. Figure 1 illustrated the application of SERQUAL to tertiary education and, in this case, was customised for online education.

Figure 1. Application of SERVQUAL Model to Tertiary Education



The following section outlines how the SERVQUAL dimensions were applied in the context of a Partnering for Learning Framework in an online Moodle environment.

The first dimension of **confidence** or reliability in service refers to an academic's capacity to provide trustworthy and dependable types of assistance and support for online learning. In terms of Moodle enhancement this relates to the provision and easy access to high-level, attractive, and relevant learning materials such as lecture recordings, lecture slides, learning activities, additional readings, webinars, videos, and online communication tools. The partnership is the tacit agreement between the teacher and student that the teacher will upload the materials and that the student will regularly access them. The built-in flexibility means that students can watch lectures in real-time or work through them at their own pace.

Another simple enhancement to Moodle which helps to build confidence is the use of consistent and self-explanatory icons to facilitate easy navigation around the site. A familiar home page with clear links to areas such as relevant policies, subject outlines, learning outcomes, assessment tasks, important dates, weekly lectures and learning activities reduces student frustration and enquiries.

The second dimension is **assurance**, which refers to the academic's capability as well as their capacity to instill trust. This dimension is linked with the concept of establishing a strong teacher presence online, the need for regular two-way engagement between the lecturer and students. Moodle features which build assurance and trust include various discussion forums, chat rooms and online tools which promote both formal and informal communication. Weekly quizzes, text-based polls and online challenge questions are fun and build an online learning community.

The third dimension is called r**esponsiveness** and it refers to an academic's desire to assist in providing rapid and prompt support. In an online environment timely and constructive feedback is essential to maintain student engagement and retention. Moodle enhancements to foster effective feedback include feedback boxes, audio, and video feedback, live and recorded feedback, and self and peer feedback. Providing interactive feedback activities in Moodle is another effective way to provide prompt and helpful assistance.

The fourth dimension is called **tangibles** and refers to an academic's ability to demonstrate optimal service-related talents and employ communication channels. In an online environment this means placing the student at the centre of the learning process. Digital learning activities and assessments need to encourage innovation, allow students to explore their interests and enable students to work with the various technologies and tools accessible through Moodle to demonstrate their learning. Group assessments are also facilitated through Moodle through the establishment of group activity spaces. Live and pre-recorded assessments using video, audio, narrated-slide presentations and mixed media presentations appeal to online learners and prepare them for the real-world.

The fifth dimension is **empathy**, which is the ability of an academic to empathise with their students and individualise their care. An issue that online students often raise and refer to in feedback is the sense of isolation and lack of

connection in an online learning environment. Moodle offers several tools to facilitate as sense of connectedness and empathy. Personalised feedback which uses the student's name, prompt response to student's emails queries and set consultation times for informal questions and discussion are some of the ways Moodle can be used to show empathy and build a learning partnership online. Some students in remote areas also have limited access to the web and internet services so consideration needs to be given to how students can participate in online learning using simple digital devices.

Implementation of the Customised Moodle

The elements adopted in the online course design are illustrated in the following two diagrams (Figures 2 and 3). The course Moodle site is designed to make the students learning experience easier. The emphasis of the design is placed on the student's easy access to information and enhancement of interaction. The new, vibrant Moodle design colourfully highlights key pedagogical features of the modules throughout the courses.

> The Objectives provide an overview of the topics to be covered in each module, giving a clear indication of what should students expect to learn.
> Activities appear throughout each module to reinforce learning with problems and practical exercises.
> Diagrams are used to illustrate key points, models, theories, and processes discussed each week.
> The weekly module Summary allows students to recap and consolidate understanding of the main points.
> Quizzes and questions are provided for self-testing, and class exercises or debates reinforce and apply student learning theory and concepts.

Furthermore, the case studies used in the tutorial activities help consolidate students' learning of major themes by applying them to real-life examples. These activities help equip students with knowledge and skills which will enable them to better address future workplace problems. Check it out (videos clips) are recommended to clarify difficult concepts. Finally, references and further reading are recommended to support the student learning journey and for additional study.

The Moodle site is designed so that lecturers can initiate a discussion in each week's discussion forum with the expectation that students provide their own postings and reflections.

Figure 2. Course Design Elements

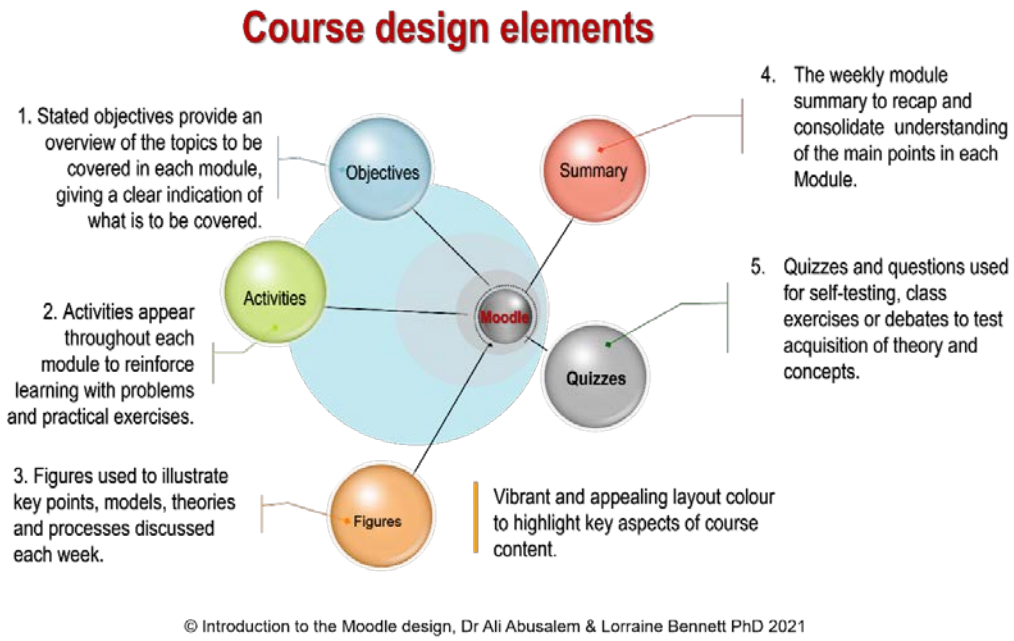


Figure 3. Course Design Elements

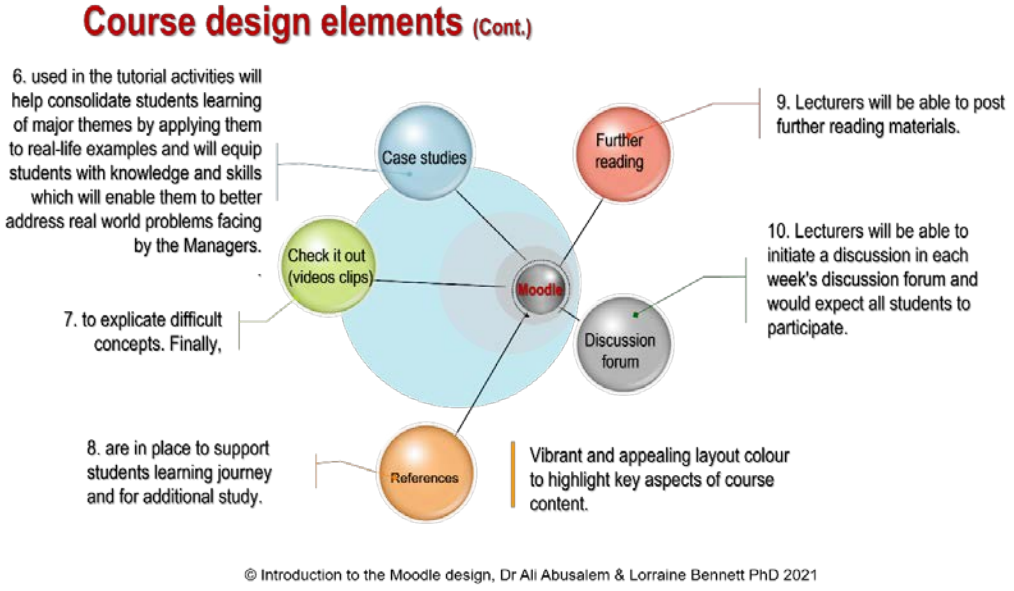
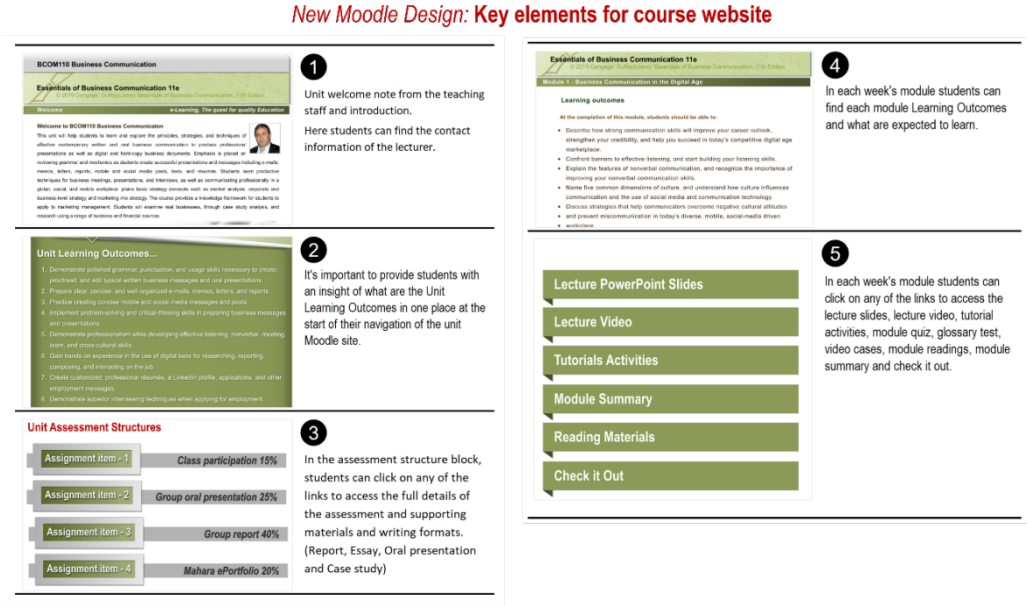


Figure 4 provides an illustration of the enhanced Moodle Home Page. The page enables students to effectively navigate the Moodle site through one-click on the appropriate icon from the home page.

Figure 4. New Moodle Design-Key Elements for Course Website



Summary of Findings

This paper reports on a project that was initiated in response to COVID-19 whereby cities, businesses and universities were closed, and education was forced to transition from face-to-face teaching to remote and online learning almost overnight.

The methodology and strategies that underpin the enhancement of the Moodle site adopt a learner-centric approach and is consistent with sound learning pedagogies. The focus on learning as a partnership between student and teacher which was informed by the LPAE model, empowers students to drive their own learning. They are given the autonomy and encouraged to draw upon the learning materials, activities, and resources available on the Moodle site according to their needs and availability. However, it is important to note that their learning is scaffolded and supported and that they are not left to work through the learning material and activities in isolation. Several avenues for interaction, engagement and communication are available on the enhanced site. These tools include discussion forums, chat rooms, feedback boxes, Q&A sites, self-paced quizzes, surveys, and polls. Interaction between student and teacher and student and student is also strongly encouraged and supported through tools such as zoom, groups and teams.

The design and development of the site was significantly influenced by student expectations and the gap between expectations and perceptions referenced in the SERVQUAL model. The elements of confidence, assurance, responsiveness, tangible and empathy, identified in the model are reflected in the enhanced Moodle site. To start with, the site is visually attractive, uses clear and consistent icons, and is easy to navigate. Access to various resources such as lecture notes, recorded lectures, learning activities, relevant academic policies and procedures,

additional readings, and so on are available from the main menus through one click.

Another major advantage of the enhanced Moodle site is that it provides both lecturers and students with a record of student access and activity. This information enables a lecturer to contact individual students as to why they have not logged in to the Moodle site and offer support. This intervention tool is vital in early detection of students who are struggling or need individual assistance. This time of proactive action can have a significant impact on student motivation and retention rates.

The course design elements described in this paper provide guidelines for enhancing learning management systems. Research shows that the rapid shift to online and remote learning during the 2020-2021 pandemic found many higher education institutions under-prepared and under-resourced. The advantage of Moodle is that it is a free access, learning management system, based on a drag-drop strategy which is relatively easy to pick up. The need for student induction and staff profession development is still highly recommended. However, in keeping with the pedagogy adopted in this enhancement project, the induction and training needs to be customised, flexible and relevant. Some students prefer to seek training at the point of need. For example, when ready to submit an assessment online they seek out information on Moodle as to how to upload their submission to the assessment drop box.

Staff training also needs to be flexible and provide options. Peer to peer learning is popular, as are small group training sessions which focus on one aspect at a time. For example, a session on how to create a quiz in Moodle or how to establish a discussion forum.

Recommendations

1. That enhancing a Moodle learning management system platform to optimise its potential for learning should be viewed as a whole-of-organisation project where commitment is demonstrated by all levels of the organisation.
2. That the development of online learning capacity is not viewed as a cost saving strategy but as a valuable addition or alternative to the organisation’s suite of education delivery options.
3. That the approach used to enhance a Moodle learning management system platform needs to be based on a partnership or a collaboration amongst the key players. It is important that decisions are based on pedagogical and technology is viewed as the means to achieve the identified learning outcomes, not the driver.
4. That the design and development of the enhanced Moodle site need to place the learner at the centre of decision making.
5. That academic staff have access to range of formal and informal, flexible professional development options to build their online learning technical skills.

6. That moving forward institutions invest in projects that investigate and research online learning platform and how they can be further customised and utilised to optimise learning and teaching in higher education.
7. That feedback from staff and students on the value and effectiveness of the Moodle platform is embedded in a continuous quality assurance plan and strategies for analysing and acting on the feedback are in place.

Conclusion

At the beginning of the paper, mention was made of the fact that online learning and teaching had become a viable form of education in the decade prior to the pandemic. However, the impact of COVID-19 on all aspects of society: work, travel, shopping, sport, entertainment, family life and especially schooling forced the world to find new ways of engaging, working, and learning. The climate shifted education from largely face-to-face learning to almost totally online learning.

The project reported in this paper describes the rationale and strategies adopted to improve the student experience of online learning, and to sustain and retain their motivation and participation in higher education. The project involved enhancing and customising a Moodle Learning Management System by placing the learner at the centre of the design and development.

The outcome was a visually attractive, easy to navigate site which optimised the features accessible through Moodle that underpin and support online learning. The project leader drew upon an extensive review of literature and a 'community of experts and specialists' to complement his extensive academic experience working in and researching the online education space. The final MLS framework owes a great deal to the willingness of online experts from throughout the higher education sector to provide input and discussions, as well as the extensive expertise of the academics involved in this project.

The specific research question asked in this paper was: How can a Moodle Learning Management Platform enhance engagement and retention of students in online learning?

The project demonstrated that there are many ways the Moodle platform can be enhanced to stimulate student engagement, sustain their motivation, and optimise learning opportunities by customising the various communication and learning tools that are available across the platform. However, the recommendations point to the need for further research and development work in the areas of enhancement of online learning management systems. The recommendations cover areas such as: whole-of-organisation commitment; online education an investment in the organisation not a cost saving strategy; online education driven by pedagogy not technology; placing the learner at the centre of online learning; academic staff professional development and the importance of collecting and acting on ongoing feedback from staff and students.

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Building Academic Integrity and Capacity in Digital Assessment in Higher Education

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The rapid spread of the COVID-19 pandemic in the first half of 2020 disrupted and changed higher education across the world, and into the future. Campuses were shut down, almost overnight. International and State borders were closed and business models that relied heavily on high-paying international students collapsed. University leaders and academics were forced to find new ways of attracting, engaging with, and retaining students. This paper describes a project that was undertaken in Australia in 2021 which investigated the implications of, and scope for online assessment in this 'new virtual world' of learning and teaching in higher education. After extensive research and consultation, the project developed a Digital Assessment Framework dubbed DASH C21, which stands for Digital Assessment Stretching Horizons for the 21st Century. The Framework is based on a set of underpinning principles and values; the Inputs. The Inputs feed into four Dimensions. These Dimensions are Practices and Pedagogies, Strategies, Emerging Technologies and Stretching Horizons. The Outputs are a series of authentic, innovative, experiential and forward looking, digital assessments, reinforced by academic integrity values. This paper will be of particular interest to higher education senior managers, academics, learning and teaching specialists, staff professional developers and curriculum designers.

Keywords: Digital Assessment Framework

Introduction

This paper describes a project that was developed in Australia in response to the pandemic and its disruption of, and impact on, the higher education sector worldwide. In Australia, as in most other countries, the rapid spread of the COVID-19 virus in 2020 caught education institutions by surprise. Universities and independent providers of higher education were ordered to close their campuses, almost overnight, and were forced to replace face-to-face delivery of courses with remote and online delivery models. While some universities had previously started to experiment with various modes of off-campus delivery using contemporary digital technologies, most were underprepared and under-resourced for the speed and extent of the change required to effectively transition exclusively to remote and online teaching and learning.

One aspect of online delivery that was particularly challenging for academics and curriculum designers, as well as being under-researched, was online assessment. The search for and creation of a theoretical framework to inform and support online assessment approaches and practices was the focus of the project reported in this paper.

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Aim

The aim of the project was to develop a framework based on a sound vision and pedagogy that could be used as a guide to design, develop and implement online assessments which would provide a valid and reliable measure of a student's academic performance as well as promote learning.

Scope

The project was funded through a small competitive grant from the Australia English Fund. The objective of the special funding was to promote and support English Language Colleges and Higher Education Providers transition to online delivery modes of teaching to enable them to continue to attract and retain international students.

The grant was provided to an independent higher education provider in Australia. It was led by an external consultant with years of senior academic experience leading and working in university-wide centres for learning and teaching, supported by an academic colleague, with specialised skills in the application of advanced technologies in higher education contexts.

While the initial focus was on developing an online assessment framework for the provider institute, and subsequently other Australian-based higher education institutes, the Framework, has potential to be used universally. Its application to other countries and contexts is recommended as an extension to the project, along with further monitoring, evaluation and refinement of the Framework's potential to build academic integrity and capacity in digital assessment in a range of higher education environments.

Research Question

The central research question addressed in this project was: Drawing upon sound pedagogy, lived-academic-experience, research and knowledge of contemporary digital technologies, is it possible to develop a 'fit for purpose' Digital Assessment Framework to guide and support the design of authentic, innovative, valid and reliable online assessment practices for the higher education sector?

Paper Outline

The paper contains the following areas:

– a brief description of the context in which the project was undertaken;

- a review of literature which researched assessment approaches and protocols more broadly before focussing on digital and online assessment, as well as key literature on pedagogy and best practice in assessment;
- a section on the methodology used in the project to incrementally develop and review the emerging assessment framework;
- a description of the ultimate Digital Assessment Framework (DASH C21), highlighting the key inputs, dimensions and outputs of the Framework;
- an outline of the dissemination artefacts of the project which are based on four, narrated slide presentations converted to MP4s;
- the staff professional development workshops and toolkit developed to support the implementation of the Framework and finally,
- recommendations for the application of the Framework and future developments followed by a project conclusion and list of references.

Context

The project was undertaken over a four month period at a time when the impact of the pandemic in Australia had almost brought life as we knew it, to a standstill. Cities, workplaces, restaurants, sporting and entertainment venues and education facilities were closed. All but essentials workers were confined to their homes. University management scrambled to keep Institutes operating through remote and online modes of delivery. Many higher education providers, especially small providers, found that they did not have the inhouse expertise or resources to instantly flip to online delivery of courses. Designing and administering appropriate online assessments was particaulty challenging for many higher education operators, especially in courses that relied heavily upon examinations and essays for assessments. The atmosphere, reported by staff and students across the sector, was peppered with confusion, uncertainty, high workloads often resulting in added stress and pressure. Reports of mental health issues rose as staff were forced to redesign their curriculum for online learning and grapple with new technologies to deliver their courses.

Accessing staff across the sector to provide input and feedback on the project phases was often difficult due to their added workload. However, the willingness of many assessment specialists to provide feedback and comment contributed significantly to the final framework outcome.

Review of Literature

The review of literature utilised an iterative approach whereby each phase in the project led to examining further studies or articles related to the challenges faced in designing the online assessment framework. Initially, the scan for scholarly texts, research papers and journal articles adopted a wide lens to capture seminal and recent studies on assessment theories and practices in higher education more broadly. Subsequent scans zoomed in on emerging trends in online assessment

constructs, practices and research across the sector. The methodology involved identifying and analysing examples of best practice in online assessment which were evidence-based and well documented. Limitations of the review of literature are that it focused on accessible web-based sources from publications written in English. It is acknowledged that the literature identified and analysed represents a narrow slice of what might be available. However, it was considered to be sufficient to identify key themes relevant to the central research question.

The main themes identified in the literature on assessment and, particularly online and digital assessment, informed the structure and content of the final Digital Assessment Stretching Horizons Framework for the 21st Century (DASH C21) developed in this project. The following sub-sections describe these main themes.

Assessment Philosophy and Concepts

Initially, the review focused on literature and research related to assessment philosophy, protocols, principles, and concepts. One of the most informative studies was a Learning and Teaching Project undertaken by a team of Australian-based academics funded by a grant from the Australian Learning and Teaching Council (ALTC). The project, entitled *Assessment 2020 Seven propositions for assessment reform in higher education* (Boud and Associates, 2010), drew upon the expertise and experience of researchers, academics, learning and teaching specialists and senior academic managers across several universities. This project focused on the need to reconceptualise and redevelop assessment practices in higher education and strongly promoted the concept that while assessment needs to measure learning achievements, in addition, assessment should be about how to improve learning and performance and grow from assessment outcomes and feedback (Boud and Associates, 2010).

The seven propositions identified in the ALTC project were:

- assessment is used to engage students in learning that is productive;
- feedback is used to actively improve student learning;
- students and teachers become responsible partners in learning and assessment;
- students are inducted into the assessment practices and cultures of higher education;
- assessment for learning is placed at the centre of subject and program design;
- assessment for learning is a focus for staff and institutional development; and
- assessment provides inclusive and trustworthy representation of student achievement (Boud and Associates, 2010, pp. 1-4).

The ALTC project invited academics to use the seven propositions to stimulate further thinking on how to redesign assessment in higher education to meet current and future needs and provide valuable learning experiences. While the rationale and seven propositions did not directly reference online assessment,

they became an important starting point for the development of an early iteration of the digital assessment framework created in this DASH C21 project. In particular, the seven propositions informed the 'Principles' identified within the initial draft Online Assessment Framework. This draft framework was circulated to selected domestic and international academic and curriculum experts for comment and feedback.

The Seven Propositions project, discussed above, inspired the establishment of the Centre for Research in Assessment and Digital Learning (CRADLE) at Deakin University in Australia. The website reports that currently researchers at this Centre are investigating improvements in higher education assessment in the context of a rapidly expanding digital environment (CRADLE). The Centre has a strong focus on scholarship and research and offers doctoral studies in assessment related areas such as 'the digital world and its impact on learning and teaching', 'feedback and feedback practices' and 'assessment security and academic integrity' .

A recent publication from the Centre, entitled *Re-imagining University Assessment in a Digital World* (Bearman et al., 2020), draws attention to the exciting possibilities that to date, are largely under-utilised, to refresh and reenergise assessment by drawing upon contemporary technologies to contribute to digital assessment design and implementation. This observation helped shape the 'stretching horizons' dimension within the DASH C21 Framework.

In search of an international perspective, a recent article by Shea, Richardson, and Swan (2022) highlighted that fact that due to the rapid transition to online learning forced on higher education institutions around the world, many institutions lacked conceptual, empirical and practical knowledge and experience in designing and implementing online learning activities. This article recommends a more mainstream focus on online pedagogy, bringing together learning and teaching, educational technology, and educational psychology communities, with a view to a joint understanding and collaborative model of online learning. It recommends as a priority, a framework explicitly for the purpose of guiding online teaching and learning design, implementation, and research.

Approaches to Online Assessment

The review of early studies on the adoption of online assessment identified standardised online assessments requiring responses to true/false, yes/no or multiple choice questions. These early adapters were confident that using technology to elicit quantitative responses would provide valid and reliable measures of knowledge (Gikandi, Morrow & Davis, 2011). However, even where the use of standardised online assessments were widespread, there were serious doubts amongst academics as to whether these simple approaches to assessment design result in an accurate measure of the desired learning outcomes (Banta, 2007). In contrast, a study undertaken by Rezaei (2015) found that when students are exposed to weekly quizzes, their conceptual learning improves and they perform much better in summative assessments.

Online assessments have also been used for some time for personality and psychological assessment. A quick web search reveals that several online assessment tools are readily available for assessment of skills and knowledge, for self-assessment, for 360 degree assessment, for personality and aptitude testing and for and individual development. Buchanan (2002) and Chuah, Drasgow, and Roberts (2006) reported that practitioners are less confident about the validity and reliability of using technology tools to assess qualitative measures such as attitudes, opinions and ethical views.

The findings from a study by Bennett et al. (2017) conducted pre-pandemic, which interviewed 33 academics with respect to their experience with 'technology-supported' assessment reported mixed success, with one of the key challenges being the desirability of pedagogical guidance early in the assessment design process and preparedness to work through an iterative design process.

The message taken from this feedback and later studies on the introduction of digital assessment is that a technology should not drive the assessment design but be selected based on the assessment context and its capability to accurately assess the level of a student's academic achievement and support positive learning (Anderson, 2016).

The Pedagogy of Online Assessment

The rapid transition to remote and online teaching, due to the forced closure of university campuses in 2020-2021, resulted in the research spotlight being sharply focused on the pedagogy of online learning and assessment. Some of the research themes and questions explored and reported in recent scholarly literature on online pedagogy include:

- the impact of online delivery and assessment on the quality of learning;
- how to engage effectively with students online;
- how to design pedagogically sound online activities and assessments;
- how to support student online learning; and,
- how to ensure academic integrity of assessments and assessment processes (Martin & Borup, 2022).

Another approach which is also relevant to online assessment is the notion of teaching through assessment (Edwards, 2010). In this approach assessment design starts with identification of the learning outcomes and aligned online assessment tasks and the curriculum and teaching strategies are selected to achieve the assessment requirements.

A study by Archambault, Leary, and Rice (2022), stresses the importance of blending content knowledge with engaging learning activities leveraged by contemporary technologies. The five foundational pillars of online pedagogy identified in this article include the ability to: 'build relationships and community, incorporate active learning, leverage learner agency, embrace mastery learning, and personalize the learning process' (p. 1).

The importance of foundation pillars for effective learning such as establishing student attention and retaining engagement, providing active learning tasks, scaffolding learning, promoting time for practice and mastery of skills and designing personal and authentic learning and assessment activities are reinforced in academic literature which references contemporary neuroscience research (Willis, 2006; 2007; Jensen, 2008; Sousa, 2011; Hardiman, 2012; Weinstein & Sumeracki, 2018).

These scholars also acknowledge the importance of minimising barriers to learning such as avoiding cognitive overload, providing culturally appropriate learning activities, designing incremental learning activities and taking into consideration environmental and resource constraints such as access to technology and internet services when designing learning activities and assessment tasks (Sweller, Ayres, & Kalyuga, 2011; Hardiman, 2012).

Assessment Practices Powered by Academic Integrity

More recently, studies and reviews on online assessment have focused on academic integrity and how to mitigate academic dishonesty and misconduct such as cheating, contracting out assessment tasks and student collusion (Green et al., 2010; Holden, Norris & Kuhlmeier, 2021). With the pandemic forcing all courses to move to remote or online delivery and assessment, the potential and opportunities for cheating are thought to be rising (Down, 2022). However, as suggested in the recent literature further fine-grained research is required to confirm whether academic misconduct is more prevalent in online assessment and whether it is across the board or correlates more highly with certain discipline areas, levels of study and student demographics (Newton, 2018).

In Australia, the higher education regulator the Tertiary Education Quality and Standards Agency (TEQSA) has recognised academic integrity as a priority area and, as a result has funded projects and sponsored and published specific Guidelines on Academic Integrity and the implications for Online assessment.

The Australian Government's publication, TEQSA Guidance Note on Academic Integrity (2019) specifically refers to the International Centre for Academic Integrity's definition of academic integrity cited on the ICAI's website: 'a commitment, even in the face of adversity, to six fundamental values: honesty, trust, fairness, respect, responsibility, and courage. From these values flow principles of behaviour that enable academic communities to translate ideals to action'.

The Australian Government funded Academic integrity toolkit (Bretag, Curtis, Slade, & McNeil, 2020) provides a series of useful resources, a professional development workshop with slides and case studies, policies and benchmarking studies to assist and support staff in designing and managing online assessment. One of the main messages promoted by the academic integrity team is the importance of 'taking an educative, rather than punitive, approach to dealing with academic integrity breaches'.

A recent article in an Australia newspaper reports the account of a 'whistle-blower' who claims that large numbers of students in major Australian Universities

have used illegal out-sourcing services to engage in academic misconduct and contract cheating (Down, 2022). The claims, verified by the reporter, sound a warning to higher education institutes across the nation and internationally, reaffirming the importance of guarding the academic reputation and standing of the sector.

The TEQSA Guidance note also reinforces a statement frequently found in the literature that upholding academic integrity is central to quality across the sector and that reputational damage to even one provider, can impact the reputation of the entire sector (Bretag et al., 2011).

The need to develop a digital assessment framework based on academic integrity principles and values was foremost in this project and was a key consideration in the design and development of the DASH C21 Framework and why the Outputs are informed by, and enveloped in, 'Academic Integrity'.

Online Assessment Challenges

An interesting international perspective on the challenges faced in designing and implementing online assessment is reported in a study conducted at Sultan Qaboos University in Oman (Al-Maqbali & Raja Hussain, 2022). This study analysed the data collected from 60 academic staff surveys and from, semi-structured, follow-up interview with four respondents.

Challenges of online assessment that directly impacted on the academics included large class sizes, the time required to design appropriate online assessment instruments, and the need to develop strategies for assessing group work and practical assessments. Challenges that impacted upon the quality and academic integrity of online assessment outcomes included students refusing to turn on cameras, incidents of cheating and incident of imposters impersonating students.

The study concluded that the challenges threaten the academic integrity of online assessment and the principles of validity, efficiency, fairness, reliability and variability. The authors recommended further investigation of each of these challenges and the exploration and development of alternative, flexible assessment strategies linked more closely to the online curriculum and learning activities. They suggested more scrutiny of students' performance and progress throughout the semester to build up their knowledge of a student's capability. In addition, they recommended that further thought be given to avoiding single, heavily-weighted online assessments.

Systems and Platforms which Support Online Assessment

Not only did the pandemic force academics to quickly reconceptualise and redesign their assessment for online contexts, in many cases it also forced IT managers to review the capacity of their Institute's Learning Management System (LMS) and to audit the installed features of this platform to optimise online assessment processes. A study by Topuz, Saka, Fatsa, and Kurun (2022), aimed to identify the main characteristics of online assessment systems and platforms by

systematically analysing online assessment studies indexed by Google Scholar in 2020. The analysis focused on supported IT platforms, the security features and the overall common features of the online assessment systems.

The findings of this analysis revealed that some of the online assessment systems were not mobile-friendly and did not provide for smooth transition of student data. It was proposed that the ideal platform was one that supported mobile devices but also enabled integration of e-Learning data. With respect to security, the analysis identified the use of security features such as authentication of students through ID cards, disabling copy and paste functions, using semi-automatic monitoring functions, and analysing video, image, voice and screen records. The common features of online assessment platforms identified by Topuz, Saka, Fatsa, and Kurun (2022), included applications that supported multiple choice and true/ false questions, and 'Frequently Asked Questions' (FAQ), 'Help' and 'Technical Support' modules. The basic tools required to engage with online assessment platform were a webcam, microphone and internet and data sharing method.

The recommendations are silent on two important factors related to the effective use of online assessment platforms. Firstly, there is no mention of the need to provide academic staff with professional development to build their capacity to maximise the engagement and feedback features available to them on the platform and second there is no mention of the potential of well-crafted online assessment design to minimise cheating. However, the Topuz report does refer to the importance of listening to the student voice and taking into consideration students' needs and concerns regarding online assessment platforms.

Other studies into IT systems and platforms which support online assessment refer to the importance of features such as assessment Drop Boxes which assist in submitting and tracking assignments, systems which allow students to run their work through Turn-it-in to pick up and rectify unintentional instances of plagiarism prior to final submission and a range of feedback features such as Chat, and synchronous and asynchronous audio and video feedback (Chang & Kuo, 2022; Majid, 2020).

Online Assessment Opportunities for Innovation and Creativity

Another cluster of articles which examine online assessment are those which recognise the growing opportunity to expand the variety of assessment tasks using online tools. These articles explore the added opportunities for innovation and creativity provided by the application of contemporary technologies. These opportunities include submission of pre-recoded audio and video files, photographic files, digital posters, narrated slide presentations, computer generated proformas and models, to name just a few. Twenty years ago, in an article by Robles and Braathen (2002), the authors provide several pedagogically-sound techniques for designing innovative online assessments. However, they also recognise that online assessment presents its own challenges and that lecturers need to work hard to engage with students, monitor progress from afar and ensure that students are not disadvantaged due to limited access to advanced technologies and the internet.

A more recent educational psychology journal that dedicated an issue to *Diverse Lenses on Improving Online Learning Theory, Research, and Practice* contains a series of articles which investigate the challenges and opportunities of online learning (Educational Psychologist, 2022). Greenhow, Graham, and Koehler (2022) adopted an interdisciplinary approach to research into online learning by drawing upon educational technology, educational psychology and the learning sciences. They explore the challenges that are faced by academics using digital and internet-based technology to mediate learning interactions and they also recognise the new opportunities for learning and assessment made more accessible through contemporary technologies. Their research lenses for innovative online assessment include *community, engagement, pedagogy, equity,* and *design-based research.*

Other new trends in online assessment identified in the literature include a preference for authentic assessments. A useful working definition of authentic assessment, found on New Jersey Institute of Technology's website, is 'authentic assessment designed to measure whether a student can successfully transfer the knowledge and skills gained in lectures to various contexts, scenarios, and situations' (NJIT, 2022).

Activity-based online assessment, often referred to as experiential assessment based on Kolbs' (1984), approach to experiential leaning is also encouraged. This assessment format is thought to keep students motivated and physically engaged in the assessment process and allows students to explore and reflect upon the assessment topic using emerging digital tools (Anderson, Gupta, Buenfil, & Verinder, 2022; Kolb & Kolb, 2018; Murphy, Fox, Freeman, & Hughes, 2017).

Forward Looking Assessment

The Output section of the DASH C21 Framework provides a wide range of digital assessment formats and approaches which push the conventional essay and examination pattern to also include interactive presentations, visual and audio presentations as well as text-based assessments. In the Framework these assessments are captured by the themes of innovation, experiential, authentic and forward looking. The notion of forward-looking is to equip students with the knowledge and skills that they will need in 21st Century workplaces. The concept of deploying contemporary technologies in learning and assessment activities in line with workplace and social spaces is strongly supported in Australia by leading academics such as Hillier (2019) and Crisp (2012).

Online Assessment Design

Initially, the literature review into what factors contribute significantly to the effective design of online assessments revisited the research and studies which draw upon contemporary neuroscience on how the brain learns, and how it stores and retrieves information to inform their practice. Factors which promote learning and lead to high levels of academic performance frequently referenced include the

desirability of immediate engagement with the topic, scaffolding learning through incremental activities, providing choice, ensuring frequent opportunities for practice and mastery, setting achievable tasks, and acknowledging and celebrating achievements.

The value of incorporating these features into online assessment design seem obvious, starting with encouraging student input into how they wish to demonstrate their achievement of learning outcomes. This is sometimes referred to as co-creation of assessment and assessment rubrics, and while initially, for some academics it may be disempowering, most who engage in this approach report very positive outcomes. Students appear to be more motivated and are clearer about the assessment expectations (Doyle, Buckley, & Whelan, 2019; Deeley & Bovill, 2017).

Another reported advantage of reconceptualising assessment design, whether it is for face-to-face or online assessment is that clever design can assist in minimising opportunities for cheating and academic misconduct (Wehlburg, 2022). For example, assessments which involve staged submissions such as a phase 1 submission of a marketing proposal, phase 2 submission of a marketing plan and stage 3 implementation of the plan enable the student's progress to be monitored and question along the way. Assessment designs which required students to draw upon personal experience and personal activities can also be easily verified through knowledge of that student, or through follow up discussion with the student. When pre-recorded audio or video presentations are set as assessment tasks a requirement for the student to appear in the video as the presenter is another way assessment design can reinforce authenticity (Darby, 2020).

Online Assessment Aligned with Learning Outcomes

In 2009 The European Centre for Development and Vocational Training (Cedefop), defined learning outcomes as 'statements of what a learner knows, understands and is able to do after completion of learning' (p. 9). Educators around the world, including those in the higher education sector, have responded to this shift in educational philosophy and practice by placing the learner (student) at the centre of learning rather than the content.

The importance of demonstrating that the set assessment effectively demonstrates the desired learning outcomes is a relatively new concept in academia. For many years, the traditional forms of assessment were examinations and essays and in some discipline areas, laboratory or practical work. Students prepared for assessment by attending lectures and tutorials and practising old examination papers.

With the expansion of assessment formats such as partner and group assignments, project plans and reports, oral presentations, journal reflections and posters, the need to explicitly align these forms of assessment with learning outcomes became apparent. This need is reinforced even further as contemporary technologies offer further opportunities for online assessment such as ePortfolios, recorded video and audio presentations, eJournals and ePosters.

Learning outcomes should drive assessment design and need to be determined prior to establishing the assessment tasks. A valuable way of verifying whether learning outcomes have been achieved and at what level, is using an assessment rubric.

The Value of Assessment Rubrics

The provision of an Assessment Rubric services two key purposes. Firstly, it enables the assessment designer to reaffirm that the assessment task aligns with the learning outcomes by ensuring that the criteria identified in the learning outcomes are embedded in the assessment task and reflected rubric (Bennett et al., 2017).

The second benefit of an Assessment Rubric is that it minimises the uncertainty and stress for students as it provide a clear picture of what is required in the task and how it will be assessed. Lack of clarity around assessment is acknowledged as one of the key barriers to effective learning and assessment performance (Willis, 2006; 2007; Hardiman, 2012).

The transference of this fundamental insight into online assessment suggests the importance of developing Assessment Rubrics which are transparent, easy to follow and clearly convey the desired learning outcomes and what the assessor is looking for.

Brookhart (2018) in a study, which involved a literature review of articles on the use of assessment rubrics in higher education from 2005 to 2017, noted surprising, that only 56% of the studies reported using assessment rubrics with students. They identified a range of descriptors from generalised statements to ones which were helpful for learning and hypothesised that the effectiveness of the rubric, largely depended on the criteria descriptors. In an earlier section of this review, reference is made to the importance of the descriptors being aligned with, and informed by, the learning outcomes.

Assessment Feedback

Throughout the literature on assessment the importance of providing students with constructive information on their performance is a constant theme (Boud & Molloy, 2013; Carless & Winstone, 2019). Frequent reference is made of the value of conducting diagnostic and formative assessment within the first three weeks of a course to obtain a measure of a student's knowledge of discipline content and academic skills. This process enables students to identify areas for improvement and also, enables staff to learn about each student's writing styles, capacity for analysis and higher order thinking, which is helpful in monitoring academic integrity and future incidents of cheating.

While diagnostic and formative assessments are frequently recommended, the practice in higher education institutes is less clear. A recent review and analysis of 188 studies identified in key academic databases reported by Morris, Perry, and Wardle (2021), suggested that few higher education providers have embedded formative assessment into their culture and practices, apart from the low-stake quizzes. They acknowledged that while formative assessment appears to be a

valuable approach to supporting student performance, higher education practitioners well might benefit from the evidence-based assessment currently being rolled out in the compulsory school sector of education.

The importance of timely feedback is another regular theme referred to within the broad discussion on feedback (Hattie & Timperley, 2007). Timeliness is discussed in term of providing feedback in sufficient time for a student to incorporate that advice into their next assessment tasks. The timeliness of feedback is also linked to research on memory and retention. The Ebbinghaus Forgetting Curve suggests that new information is more easily remembered and recalled if it is refreshed within the first twenty-four hours and that after seven days only 25% will be recalled and after one month only 10% will be recalled if the material has not been revisited (Shrestha, 2017).

The importance of providing accurate feedback on how to improve performance is another frequent theme within the literature on assessment feedback (Al-Bashir, Kabir, & Rahman, 2016; Hardavella, Aamli-Gaagnat, Saad, & Sreter, 2017). The recommendation is that feedback should provide specific advice on how to improve performance such as 'this report would have been improved if the link between theory and practice was more explicit' or 'greater reference to case studies would have improved this report' or next time' make sure that you include a conclusion which summaries your main findings'.

Online platforms provide several advantages when considering how to provide timely and accurate feedback. Most platforms or LMSs contain features that allow confidential written feedback on assessments to be posted. In addition, most enable both synchronous and asynchronous audio and video feedback. These sessions can be generic and provided to groups of students or personalised to a specific student (Al-Bashir, Kabir, & Rahman, 2016).

Giving effective feedback can be challenging and some academic staff benefit from professional development sessions and feedback tools to help them frame assessment advice. One such tool currently being trialled is the Feedback Handprint tool (Bennett, 2021). This artefact is based on an acronym inspired by the hand - **T**humb, **I**ndex finger, **M**iddle finger, **R**ing finger and **P**inky finger. The **T** is a reminder to provide ***T****imely* feedback, the **I** reinforces the need to focus on feedback which leads to ***I****mprovement*, the **M** is a prompt to provide feedback, which is ***M****eaningful*, the **R** is a reminder to use an Assessment ***R****ubric*, and the **P** stresses that the feedback should be ***P****ersonalised* to the individual student's assessment and previous performance level.

Peer and Self-Assessment

In more recent times, self and peer assessment, which can be considered another important form of feedback, has been introduced into many higher education courses. Self-assessment and co-creation of assessment tasks in linked to the notion of shared responsibility for learning whereby the lecturer and student are viewed as partners in the learning process (Adachi, Tai, & Dawson, 2018).

Studies suggest that when students are involved in designing the assessment and/or self-assessing they are more committed to the process and develop a deeper

understanding of the material (Deeley & Bovill, 2017; Adachi, Tai, & Dawson, 2018).

The value of peer-assessment and team-based assessment is also reported in the educational literature. By assessing a fellow student's work and working in teams it is suggested that students are forced to think more deeply about the assessment tasks and the qualities to look for. This process adds to their learning and overall knowledge about assessment expectations (Vogler & Robinson, 2016; Zhang, 2018).

Online assessment lends itself to self and peer assessment as many features within a regular LMS facilitate the ability to make anonymous assessments accessible to other students for feedback. The feedback is easy to record and track and can be in various forms such as written feedback, audio feedback or visual feedback. A recent study of Spanish university students (Pérez, Vidal-Puga, & Pino Juste, 2020) reported that anonymous peer assessment, using online feedback tools was valuable for learning and correlated highly with lecturers' assessments.

Summary of Literature Review

To provide some structure to the vast body of literature on assessment and specifically, on online assessment, the literature review section was signposted with the main themes to emerge from the review. These themes provided the backbone and substance for the DASH C21 Framework eventually developed in this project. The key findings from the literature review informed the Inputs, Dimensions and Outputs of the framework. As indicated, the review of literature was iterative and additional studies and resources were examined and re-examined as issues and challenges arose throughout the development of the framework.

Methodology

This project utilised a mixed research, development and collaborative approach to the design of a digital online assessment framework. It was based on a series of iterative phases which continuously informed and refined the framework which ultimately became the DASH C21 Framework.

Phase 1 – Review of Literature

This phase involved a substantial review of academic and research literature on assessment and online assessment in the higher education sector. These scholarly studies spanned a range of related themes including assessment philosophy, protocols and practices, the impact of emerging technologies on assessment design, the role of assessment feedback in learning, and the potential impact of web-based cheating and assessment outsourcing sites on academic integrity and the reputation of higher education qualifications. Initially, the review focussed on the Australian studies but expanded to international research in search

of verification and points of difference. The review of literature provided the foundations for the subsequent phases and the development of the ultimate Digital Assessment Framework (DASH C21).

Phase 2 – Preliminary Framework Concept

In this phase, an initial draft Online Assessment Framework diagram, based on the growing review of literature was created as a starting point. The framework was informed primarily, by the Seven Propositions reported in the Australian collaboration (Boud and Associates, 2010).

The preliminary framework consisted of a two dimensional matrix. On the bottom axis were seven foundational assessment *Principles* representing the principles of: engagement, feedback, collaboration, culture, learner-centred, professional development and trustworthiness. These *Principles* fed into the next layer of the matrix which contained corresponding *Practices*. The third layer identified *Implementation* strategies for the each of the Principles and Practices and the top layer offered suggestions for *Stretching Horizons* and exposing assessment design and management to new possibilities through emerging technologies and through reimagining assessment and its role in developing a culture of life-long learning.

The vertical axis of the matrix depicted cycles of quality assurance through continuous monitoring, evaluating, improving and reviewing of the framework. The quality assurance processes recommended included seeking feedback from critical friends and experts on assessment, consulting with academic colleagues, trialling aspects of the framework, seeking student feedback, undertaking data analysis, and engaging in assessment moderation and benchmarking activities.

Phase 3 – Consultation and Collaboration

Seeking external, independent advice and feedback early in the project was a deliberate strategy. It was designed to 'test' the perceived value of the initial draft framework, and at least, the concept of an Online Assessment Framework, and to elicit some guidance and direction for the subsequent project phases. The original preliminary draft Framework and a one-page concept paper was distributed to 32 people, selected by their academic profile and interest in assessment in higher education. Respondents were invited to respond to the questions in an attached survey or, if they preferred, to provide general feedback and comment. The target groups for the survey included: international learning and teaching scholars; academics working in universities within Australia; academics working in independent higher education providers in Australia; and education consultants working in the higher education sector.

The survey remained open for almost three weeks and a reminder was sent four days prior to the closure date. Of those invited to respond to the survey, 65.4% per cent provided feedback by the deadline. For reporting purposes, the number of potential respondents was adjusted to 26 people (due to outdated or wrong email addresses). Not everyone responded to every question in the survey

and some respondents simply provided an overall response, as they were invited to do, if they found this more convenient.

The respondents confirmed that whilst the pandemic had precipitated the move to online learning and assessment, the overall view was that even when the pandemic is under control, online learning will remain popular along with a shift in curriculum more focused on creativity and innovation, flexibility, problem solving, agility, critical analysis, digital communication skills and teamwork. There was general affirmation of the need to be looking forward and designing digital assessments in line with future knowledge and skill requirements and emerging technologies.

As a result of the analysis of the survey responses the following changes were made to the draft Framework:

- a new visual diagram of the graphic was designed which provided greater clarity on each of the elements and their connection with each other;
- the foundational layer, 'Principles', was expanded to 'Principles and Values';
- the number of 'Principles and Values' was increased from seven to ten with the addition of the three new Principles: 'Context', 'Pedagogy-driven Technologies' and 'Quality Assurance';
- all 'Principles and Values' were explicitly linked to Assessment;
- the initial 'Practices' layer was expanded to 'Practices and Pedagogy';
- the 'Implementation' layer was renamed 'Strategies';
- a new layer 'Emerging Technologies' was added to the Framework.

Phase 4 – Consolidating the Refined DASH C21 Framework

On the advice of the survey respondents, a new visual graphic of the Framework was created which provided greater clarity on the structure and function of the Framework. The new Framework structure made clear the *Inputs*, the *Dimensions* and the *Outputs*.

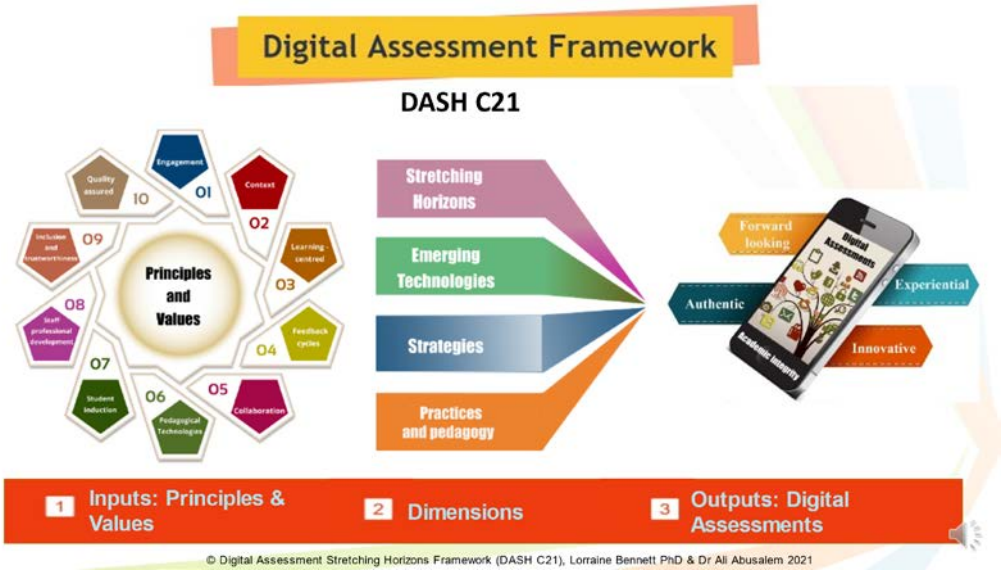
The Inputs that drive the Framework and provide the building blocks are the ten *Principles and Values.* These Qualities and Values stress the importance of *Engagement, Context, Learning-centred, Feedback cycles, Collaboration, Pedagogy informed technologies, student induction, Staff professional development, Inclusion and trustworthiness and Quality assurance,* in the design, management and implementation of effective digital assessments.

The Framework's four *Dimensions* are *Practices and Pedagogies, Strategies, Emerging Technologies* and *Stretching Horizons* (a nod to the future). They guide the application of the *Principles and Values* and inform the *Outputs* of the Framework.

The Outputs are digital assessments designed for their *Innovative* (foster creative thinking), *Authentic* (related to real-world situations, *Experiential* (involve active engagement), *Forward looking* (preparation for future workplaces/lifestyle challenges and *Academic integrity* focus and qualities.

The visual representation of the DASH C21 Framework is provided in Figure 1.

Figure 1. DASH C21



An example of how to use the Framework is described in Table 1 by applying *Contex*t as the example *Principle and Value.*

Table 1. Application of DASH C21

Input - Principle and Value **Context**	**Dimensions**	**Output**
The Context *Principle and Value* is a reminder that it is important to consider the background of your students and the prior knowledge, skills, experiences and attitudes they bring to the learning environment. Students will be more motivated and likely to perform better if the assessment has scope for them to build upon existing skills, knowledge and interests.	*Practices and Pedagogies* Implementation of pedagogies that consider the background, interests and level of a student's knowledge, skills and cultural background is important when selecting case studies and business scenarios for analysis. Students need to be familiar with the context and not be put into situations of cultural tension where they feel uncomfortable or unfamiliar with the situation. *Strategies* When considering *Context,* assessment design and requirements need to set interesting tasks which are attainable but challenge and extend the learner. *Emerging technologies* Many contemporary students have high level digital technology skills and interests. Designing innovative assessment tasks which encourage use of visual and audio technologies as alternative modes of demonstrating and communicating learning, motivates students and fosters sustained engagement in learning.	The type of digital assessments that align with the Principle of Context are ones where students can draw upon prior interests, knowledge and skills. In some cases, the assessment task may be designed to challenge or justify existing attitudes and interpretations.

	Stretching Horizons This dimension promotes opportunities to embed choice and flexibility into assessment formats. It is about exploring new assessment pathways, building confidence and encouraging creativity. It suggests experimenting with assessments formats such as video and audio pre-recorded presentations, narrated slide presentations, digital posters, diagrams, flow charts, debates, plays and poems.	

Phase 5 - Project Artefacts and Dissemination

One of the key challenges in introducing change into higher education culture and learning and teaching practice is how best to engage with staff and disseminate new information. This is sometimes referred to as bridging the gap between theory and practice or transforming project outcomes into practice. Effective dissemination is often an overlooked phase of project development.

A useful working definition of dissemination is that it is 'the planned process of understanding potential adopters and engaging with them throughout the life of the project to facilitate commitment to sustained change' (ALTC, 2011).

To support the dissemination of the DASH C21 Framework, several project artefacts were developed, the key ones being four narrated slide presentations, which have been converted to MP4 files. The presentations address the following topics:

- an introduction to the background and methodology of the online assessment framework project;
- an overview of the Digital Assessment Stretching Horizons Framework for the Twenty-First Century (DASH C21) with a focus on the Inputs, the ten Principles and Values;
- a description of the four dimensions of the Framework - the Practices and Pedagogies, the Strategies, the Emerging Technologies and Stretching Horizons which encourage staff and students to deepen their thinking and learning, to develop learning and assessments artefacts which look 'outside the box';
- a presentation on the Framework's Outputs which consist of a series of sample digital assessments which align with the Principles and Values and Dimension contained in the Framework. These examples include digital assessments which are experiential, innovative, authentic, forward looking and adhere to academic integrity policies, protocols and practices. The presentation provides several digital assessment formats which can be easily customised for use in a range of discipline units and course levels. Each assessment is underpinned by one or more of the principles and

values, and dimensions embedded in the DASH C21 Framework and highlights the potential link to sample Unit Learning Outcomes.

Phase 6 – Staff Professional Development Toolkit and Workshops

To support the dissemination of the DASH C21 Framework and to assist staff to embed the framework into practice, a DASH C21 Toolkit was also developed. The Toolkit provides a range of useful resources which can be used in staff professional development sessions or for individual self-paced learning. The intention is to continue to add to the Toolkit as new ideas and resources are identified. The Toolkit consists of two folders. The main folder contains a copy of the DASH C21 Framework, an introductory Flyer and the four narrated slide presentations specifically related to the DASH C21 Framework and the elements within the Framework.

The supplementary folder contains resources such as: 'Ice breaker' activities; a 'Feedback Handprint' tool; an original poem 'Living, learning and leading university reform in the pandemic shadow' (Bennett, 2021); a sample Assessment Rubric built around Learning Outcomes; annotated references: useful websites; and other professional development materials which can be used to support DASH C21professional development workshops or as a catalyst to spark discussion on creative approaches to digital assessment.

Recommendations

This project set out to create a resource with the potential to bridge the gap between online assessment theory and practice and to provide some tangible, digital assessment strategies and ideas. Due to the pandemic, and even prior to its impact, higher education Institutes across the world had been experimenting with, and trialling various forms of online assessment. Investigation of assessment research and studies, including online assessment, revealed that there is a growing recognition and acceptance of the notion that learning is an essential component of assessment, and that agreement on the learning outcomes should be a starting point for curriculum and assessment design. The following recommendations provide some ideas on how to implement the DASH C21 Framework effectively and areas that need further exploration.

Recommendation 1

That the implementation of the Framework is supported by extensive digital dissemination strategies, adequate investment in infrastructure and a variety of staff professional development activities and resources.

Recommendation 2

That the Framework is trialled and tested in a range of contexts, such as undergraduate and post graduate courses, across diverse discipline areas and in different cultural and socio-economic settings.

Recommendation 3

That the Framework be viewed as an evolving, dynamic Framework which will need to be modified, added to and customised to different learning environments and contexts.

Recommendation 4

That as part of ongoing quality assurance of the Framework, a wide reaching strategy is developed to capture feedback regularly on the effectiveness of the Framework from all key stakeholders. This should include feedback from students, academic staff, course-co-ordinators, IT staff, curriculum designers, learning and teaching specialists and student support staff.

Conclusion

The central research question addressed in this project was: Drawing upon sound pedagogy, lived-academic-experience, research and knowledge of contemporary digital technologies, is it possible to develop a 'fit for purpose' Digital Assessment Framework to guide and support the design of authentic, innovative, valid and reliable online assessment practices for the higher education sector?

History shows that the pandemic accelerated the transition to online learning, teaching and assessment in higher education. However, before the impact of the COVID-19 virus, academic leaders were reporting problems with traditional modes of operating within the sector. A significant book entitled: *The University Challenge: Changing Universities in a Changing World* (Byrne & Clarke, 2020), published just prior to the pandemic advocates for urgent reform of the sector. Their recommendations for change include greater application of online and digital approaches to teaching and engagement with students, more flexibility through the provision of synchronous and non-synchronous learning opportunities, a move away from invigilated examinations, greater emphasis on project and group work and assessment portfolios as evidence of learning.

The DASH C21 Framework is an attempt to support the reform agenda recommended for the higher education sector by addressing the central research question identified in this project. The findings recognise that regardless of the impact of the pandemic, the trend and appetite for digital technologies in learning and assessment practices, has gathered momentum. Like any change that happen quickly, the policies, processes and infrastructure to support the transition to digital

assessment practices and to optimise the benefits of the change, are lagging the practice. Hopefully, the DASH C21 Framework will provide some structure and direction to guide digital assessment practices based on learning outcomes.

The Framework is clearly informed by sound pedagogy, lived-academic-experience, research and knowledge of contemporary digital technologies. Whether it proves to be 'fit for purpose' and how well it supports the design of authentic, innovative, valid and reliable online assessment practices needs further testing. However, the feedback to date is very promising and it is anticipated that as the Framework is implemented and evaluated further, it will lend itself to being customised to suit the needs of a range of users across the higher education sector.

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