Pilot Study on the Impact of VLE on Mathematical Concepts Acquisition within Secondary Education in England

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Abstract**—**The research investigates the "impact of VLE on mathematical concepts acquisition of the special education needs (SENs) students at KS4 secondary education sector" in England. The overall aim of the study is to establish possible areas of difficulties to approach for *above or below* knowledge standard requirements for KS4 students in the acquisition and validation of basic mathematical concepts. A teaching period, in which virtual learning environment (Fronter) was used to emphasise different mathematical perception and symbolic representation was carried out and task based survey conducted to 20 special education needs students [14 actually took part]. The result shows that students were able to process information and consider images, objects and numbers within the VLE at early stages of acquisition process. They were also able to carry out perceptual tasks but with limiting process of different quotient, thus they need teacher's guidance to connect them to symbolic representations and sometimes coach them through. The pilot study further indicates that VLE curriculum approaches for students were minutely aligned with mathematics teaching which does not emphasise the integration of VLE into the existing curriculum and current teaching practice. There was also poor alignment of vision regarding the use of VLE in realisation of the objectives of teaching mathematics by the management. On the part of teacher training, not much was done to develop teacher's skills in the technical and pedagogical aspects of VLE that is in-use at the school. The classroom observation confirmed teaching practice will find a reliance on VLE as an enhancer of mathematical skills, providing interaction and personalisation of learning to SEN students.

Keywords**—**VLE, Mathematical Concepts Acquisition, Pilot Study, SENs, KS4, Education, Teacher

I. Introduction

THE way academic practices in higher, further and school sector education responds to the influence of computer networks and technology is central to immediate and future role of educators in creating a viable teaching and learning environment in the new world. Fuller and Soderlund (2002) argue that the process of legitimising knowledge (Justification) is a social process, and whereas knowledge is related to social action, information is conceived as a flow of messages enabling the creation of knowledge [1]. At present institutions of learning are constantly questioning the results of their educational methods, searching for effective mechanisms for efficient teaching and learning that may improve and enhance the impact of education and acquisition of knowledge. The interest in supporting the process of teaching and learning in school sector units and the acquisition of mathematical concepts has led to this study with a view to addressing problems or difficulties experienced by the SENs in fostering the acquisition of mathematical concepts, using virtual learning environment as intelligent tutoring software. The driver of academic practices through virtual learning is that of the creation of one's own knowledge which amplifies the process of creating meta-conceptual understanding. Today, global concepts of technology resources have become vital in creating an environment that is engaging, interactive and personalised. It is true therefore to state that the innovation strategy in educational development depends solely on intellectual and pedagogical model technological developments. The virtual learning environments (VLEs) platforms have been developed to enable knowledge management, allowing the sharing of information and providing interactive and personalized learning to students.

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II. Survey Instruments

Cohen et al, points out that a 'pilot test' is crucial to the questionnaires success and reliability [2]. Coleman and Briggs (2000) also argue that pilot test also increases questionnaire validity and practicability [3]. The pilot study enables researcher to check for any ambiguity and misunderstanding that may arise in future. In this study, questionnaires, observation and interviews were employed. In order to ensure validity within the content construct, my questionnaires were examined prior to piloting at one school with participation of head teacher, two mathematics teachers and twenty students with a return rate of 70%. It is important to note that all participants were knowledgeable about the issue under the study; however the students were not keen on answering the questions as they view the questionnaire too large. The head teacher and the teachers completed their questionnaires after one week. The students' questionnaires were modified and later used during the observation exercise.

The survey instruments of the research consisted of the following;

1. An interview type questions for the head teacher.
2. A questionnaire for the mathematics teachers, and
3. A questionnaire/observation schedule for the SENs students.

The responses from the pilot survey which were coded and later analysed, dictated a number of modifications to the instrument. The synopsis of the content of the questionnaires is presented in table 1.

TABLE 1
STUDY TOPICS WITH SYNOPSIS OF INTERVIEWS AND QUESTIONNAIRES CONTENTS

Topic	Curriculum	Head Teachers Questionnaire	Teachers Questionnaires	Student's Observation
Impact of VLE on Teaching	Curriculum and Didactive	VLE impact in School	ICT Resources in the School	Degree of curriculum differentiation
	Access to VLE	Access, use and impact to students	The use of virtual Learning Environment	Characteristics of VLE in use at school
	Characteristics of School VLE	Leadership Strategy	Impact of school version VLE	Difficulties experienced by SENs
	Impact to learning	Professional development	Benefits of VLE on SENs	Current SENs situation
Impact of VLE on Learning	Specific Achievements	Teachers Behaviour	Obstacles to VLE usage	Teachers Behaviour

III. CASE STUDY -OBSERVATION APPROACH

A small focus group of the special education needs (SENs) students with various disabilities were used to create a case study approach. Questionnaire(s) and observation tool(s) used in this study enabled me to verify techniques and to ensure they are suitable. In order to gain more insight into the impact and characteristics of VLE used by the school, I addressed both quantitative and qualitative aspects of VLE that was used in teaching and learning mathematics in the school. The operationalisation led to a standard observation scheme which includes the curriculum and didactic characteristics (whether or not specific types of VLE were used in the school for teaching and learning), and teachers behavioral characteristics in delivering teaching and managing SENs students learning.

1. Curriculum and didactic characteristics
   a) Degree of curriculum differentiation within KS4
   b) Access to VLE (number and types of computers, location, computer room)
   c) Characteristics of VLE in use (School version)
   d) Difficulties experienced by students in using VLE in mathematics lessons/class
   e) Access to VLE for support as a teaching resource and enabling assessment for learning.
   f) Ease of VLE usage, associated problems and impact on students' assessment for mathematics learning.
   g) Student's evaluation and current situation.
2. Teacher behaviour characteristics.
   a) Degree of curriculum differentiation
   b) Characterisation of learning environment (degree of pupil's centeredness)
   c) VLE's impact (Knowledge before and after VLE usage in a math lesson)
   d) Student's impression of VLE and suggestions.

A. The Direct Observation

Diebold et al (2000) insists that classroom observation has resurfaced as a method of understanding and evaluating instructional practices and for documenting outcomes of reform efforts [4]. Classroom observations provide information about the frequency and the duration of teachers and students interaction. Turner & Meyer, (2000) maintain that observational data can be used to triangulate reports of classroom practices between students and teachers [5]. Nuthall (2004) states that 'feedback' generated from classroom observation can be used by schools and teachers to reflect on the strengths and weaknesses of the instructional practices that are being used in the classroom [6]. Conversely, Stringfield & Teddie, 2004, criticized classroom observation as loosely focusing too narrowly on academic variables [7]. Concerns over classroom observation nonetheless include cost (time and money) of training observers and perhaps misuse of classroom observational data which is second most important limitation of using classroom observational process research [8]

B. Administering the Direct Observation

The participants were the special education needs (SENs) students selected from a KS4 class group. This group forms a representative part of school population. Mathematics lessons were taught to these groups over a ten day period for one hour per lesson per day. Each lesson was held in a computer and virtual learning room (lab room) set aside for this observational exercise. At the end of the period, a simple test plan was drawn by the teachers, and students answered questions on the virtual learning environment (VLE) platform. I entered the classroom unannounced and students were asked to fill in the questionnaires accompanying the test plan online. The answers were recorded and observation data was triangulated against the questionnaires and interview data from the teachers and head teacher. For the likert – scale type items, alpha scale construct was carried out and Cronbach Alpha Coefficients were calculated which shows an acceptable reliability of 0.83 [9]. The Cronbach Alpha Coefficient is presented in Table 2.

TABLE II RELIABILITY STATISTICS

Cronbach's Alpha	Cronbach's Alpha Based on Standard Items	N. of Items
.083	.833	86

IV. DATA MANAGEMENT AND ANALYSIS

The three phases of data management – data preparation, data identification and data manipulation, including data cleaning processes was adopted in this pilot study. In data preparation the coded survey instruments were entered into the PAWS [SPSS] version 17.0 for analysis. The data identification involves dividing texts into meaningful identifiable sections of information [10]. Data manipulation involves putting the quantitative data through the rigours of analysis that is relevant to the research questions. Data cleaning is a process of intuition – knowing where and when to stop data collection and validate your existing data for errors i.e., removing typographical errors or correcting incomplete values against known list of entries. The process of storing and coding data was made possible through the use of SPSS software which generated descriptive statistics for a set of data, enabling researcher to make comments about frequency. Analyses using descriptive statistics rely on arbitrary decisions about size and about what constitutes importance [11]. Cross tabulation was used to measure any significance between items under personal background and Cronbach Alpha Coefficient used for instrument reliability. The reliability test enables opinion on the reliability of items such as teaching and learning as goals, practices, processes and statements of opinion in relation to VLE.

V. TRIANGULATION AND VALIDITY

Triangulation refers to the use of more than one approach to the investigation of a research question in order to enhance confidence in the ensuing findings. Usually data collected from different sources reveal a range of views; researchers need to compare what respondents are saying about issues and gain their trust. I employed triangulation technique in order to cross-reference ideas for its validity, reliability and objectivity. The mixing of data types known as triangulation is often thought to help in validating the claims that might arise from an initial pilot study [12].

A. Types of Triangulation

Denzin (1970) extended the idea of triangulation beyond its conventional association with research methods and designs [13]. He distinguished four forms of triangulation:

1. *Data triangulation*, which entails gathering data through several sampling strategies, so that slices of data at different times and social situations, as well as on a variety of people, are gathered.
2. *Investigator triangulation*, which refers to the use of more than one researcher in the field to gather and interpret data.
3. *Theoretical triangulation*, which refers to the use of more than one theoretical position in interpreting data.
4. *Methodological triangulation*, which refers to the use of more than one method for gathering data [13]

VI. RELIABILITY AND VALIDITY

Different authors argue on different grounds for and against reliability and validity in both qualitative and quantitative research. Golafshani (2003) argues that, although the term 'Reliability' is a concept used for testing or evaluating quantitative research, the idea is most often used in all kinds of research. Therefore, if we see the idea of testing as a way of information elicitation, then the most important test of any qualitative study is its quality [14]. In furtherance of this support, Stenbacka, (2001) suggests that "the concept of reliability is even misleading in qualitative research. [15]. According to Stenbacka and Galafshani (2003) cited in [14], if qualitative study is discussed with reliability as a criterion, the consequence is that the study is no good". A contrasting view is raised by Patton (2002), cited in [14], who insists that "validity and reliability are two factors which any qualitative researcher should be concerned about while designing a study, analysing results and judging the quality of the study"[16]. The argument and suggestion raised by Stenbacka on validity as a criterion in qualitative research is complemented by the study carried out by Golafshani which suggests that "some qualitative researchers also argue that the term validity is not applicable to qualitative research, but [the difference being that] they have realised the need for some kind of qualifying check or measure for their research" [15]

A. Validity

Cook & Campbell (1979) argue that validity can be defined as the "best available approximation to the truth or falsity of a given inference, proposition or conclusion" [17]. Data collected from this research came from repeated questions in questionnaires, interview question and observation schedule. The PASW/SPSS analysis was based on identifying instances of occurrence based on the same repeated questions for possible unreliability. Accordingly, the reliability of the questions were tested using an Alpha Cronbach coefficient of reliability (or consistency) and the results were greater than 5. The generated data from the three instruments were compared in order to ensure comparative analysis of different sources, and thus contribute to the validity of my research. This method is described as "methodological triangulation" [2]

VII. RESULTS, ANALYSIS AND DISCUSSIONS

The results of the content analysis, interviews and questionnaires were analysed for quantitative responses and the impact of VLE on mathematical concepts acquisition of the SEN students were measured against prior knowledge.

The observation trial was run in an ordinary classroom where students used standard PCs and the school version of VLE (Fronter). The students logged in and had about 10

minutes to familiarise themselves with the controls and options available within fronter platform. The teacher also logged in, and with the use of a projector delivered his lesson, explaining information in a large format for all to see. Although, the experiment was run [started] with 20 students only 14 completed. The mathematics quiz or t-test was preinstalled on the PCs and all the students filled in a questionnaire, detailing their familiarity with the use of fronter in answering the quiz, their knowledge before, and their impression after completing the case study. Most questions on the questionnaire is on a 5 point Likert- scale (Very little; Not much; Average; Quite a lot; Lots) and a few categorical questions. The questions in the questionnaire are converted to numbers on a scale from 1 to 5 to create the average score in the table 3. The students' responses in using VLE are rated high for school sector KS4 students (as they are terminal students). The details of responses to central questions for this investigation are presented in tables 3-5.

TABLE III
CHARACTERISTICS OF LEARNING ENVIRONMENT AND DEGREE OF PUPIL ENGAGEMENT IN LEARNING WITH VLE -FRONTER

Question	Mean	Valid Number	Layer Column Total Number %	Variance
Do you enjoy learning with computer?	3	14	100.0%	1
Experience of using VLE fronter in a maths class to create collaborative learning?	2	14	100.0%	2
Do you have access to computer at home?	3	14	100.0%	2
Did learning with VLE fronter improve your knowledge and understanding?	3	14	100.0%	2
Any benefits compared to traditional teaching and learning in the classroom?	3	14	100.0%	2
Did you enjoy your maths teaching using VLE fronter platforms	3	14	100.0%	2
How useful were your teachers in supporting you when you needed support?	3	14	100.0%	2
Did you have any difficulties using VLE fronter to learn.	3	14	100.0%	2
Did you have any difficulties navigating through VLE and your computer	3	14	100.0%	1
Was teacher's method and approach class-focused and student-centred?	3	14	100.0%	2
Were you truly engaged in learning mathematics with VLE fronter	3	14	100.0%	2

Table 3 investigates the degree of pupil's engagement with VLE, their happiness and teacher-student interactivity including support giving in the class. The majority of students say that they enjoy learning with VLE and computer as teacher's method approach is student centred, while class focuses is on collaborative learning, engaging, helping each other to construct knowledge themselves, as well as teacher often conducting lessons as facilitator of knowledge.

The table also shows that majority of the students felt that the usage of VLE – 'fronter' makes mathematics lessons more interesting. It is also interesting to note the mean and the variance from the table. While the mean score stays the same (3) the variance points to between 1 and 3. Generally when one variable deviates from its mean value, we would expect other variables to deviate from its means in a similar way [18]. The variance shows the dispersion of expected average of data point from its mean. The variance of 1 and 2 shows the deviation of these variables from its means, which means that the resultant outcome is different from expected, however the variance of 3 indicates that outcome equals expected. There is a strong relationship and therefore there is impact.

Again students were asked about their Mathematical concepts acquisition before and after being taught mathematics using virtual learning environment – fronter, and the results are shown in the tables 4[a] and 4[b]

TABLE IV [A]
VLE IMPACT ON STUDENTS' MATHEMATICAL SKILLS ACQUISITION AND ACHIEVEMENT BEFORE THE OBSERVATION

Question	Strongly agree	Agree	Disagree	Strongly disagree
my maths skill was very Good before VLE usage.	2 (14.3%)	3 (21.4%)	8(57.1%)	1 (7.1%)
my maths skill was not very good before using VLE	-	10 (71.4%)	2 (14.3%)	2 (14.3%)
I find maths very difficult to understand even with VLE	1(7.1%)	9 (64.3%)	3 (21.4%)	1 (7.1%)
my maths teachers did not motivate me enough	2 (14.3%)	6 (42.9%)	1 (7.1%)	4 (28.6%)
my maths teacher did not give me feedback	4 (28.6%)	3 (21.4%)	5 (35.7%)	2 (14.3%)
maths assignment was too difficult for me	4 (28.6&)	5 (35.7%)	2 (14.3%)	3 (21.4%)
maths teacher never encouraged me in class	2 (14.3%)	5 (35.7%)	6 (42.9%)	1 (7.1%)
I was unable to do any take-home assignment.	2 (14.3%)	5 (35.7%)	4 (28.6%)	3 (21.4%)
I was less enthusiastic, unable to discover maths concepts	6 (42.9%)	5 (35.7%)	2 (14.3%)	1 (7.1%)
I was unable to see myself in control of during maths lesson.	5 (35.7%)	4 (28.6%)	4 (28.6%)	1 (7.1%)

Table 4[a]: measures the impact of VLE on Mathematical concepts acquisition and achievement *before VLE was introduced* to the students for teaching and learning. It is interesting to note students responses when asked about the

impact of VLE on their mathematical skills acquisition at school before the introduction of VLE; 6 respondents representing (42.9%) scored higher on being less enthusiastic and unable to discover mathematical concepts as compared to very few (7.1%) who strongly disagree with that statement. On the other hand, 10 students (71.4%) agrees that their mathematical skill was not very good before using VLE, while 2 students (14.3%) states that their mathematical skill was good before using VLE in their teaching and learning.

TABLE IV [B]
VLE IMPACT ON STUDENTS' MATHEMATICAL SKILLS ACQUISITION AND ACHIEVEMENT AFTER THE OBSERVATION

Question	Strongly agree	Agree	Disagree	Strongly disagree
my maths skill improved after using VLE in maths class.	2 (14.3%)	9 (64.3%)	3 (21.4%)	-
I am able to learn and understand using VLE	2 (14.3%)	9 (64.3%)	2 (14.3%)	1 (7.1%)
I am motivated after using VLE in maths lessons	3 (21.4%)	7 (50.0%)	2 (14.3%)	2 (14.3%)
I receive immediate feedback from my maths teacher	5 (35.7%)	5 (35.7%)	4 (28.6%)	-
my personal confidence and motivation improved	3 (21.4%)	6 (42.9%)	4 (28.6%)	1 (7.1%)
I can understand diagrams and charts easily.	4 (28.6%)	8 (57.1%)	2 (14.3%)	-
VLE enables me to construct knowledge , solve problems easily	4 (28.6%)	7 (50.0%)	3 (21.4%)	-
VLE enable me to discover patterns, concepts and relationships	3 (21.4%)	8 (57.1%)	2 (14.3%)	1 (7.1%)
VLE enables me to communicate critically and build knowledge. s	1 (7.1%)	10 (71.4%)	2 (14.3%)	1 (7.1%)
I can do my maths assignment and feel in control of my learning.	1 (7.1%)	9 (64.3%)	4 (28.6%)	-

Table 4[b]: measures VLE Impact on Mathematical concepts acquisition and achievement *after VLE was used* in teaching and learning. The results indicate that majority of the respondents either agree or agree strongly that VLE has had an impact on their mathematical skills acquisition after being taught mathematics on Fronter platform for two weeks; this further reflects on the student's attitudinal questions to learning than on the skills questions. On the other hand, 2 students (14.3%) strongly disagree that VLE - fronter has made any impact on their mathematical concepts acquisition. Furthermore results indicate overall impact linearity increment on mathematical skills acquisition *after* students were first introduced to the use of VLE –Fronter, than *before* the introduction.

In table 5; participants (the special education needs (SENs) students) were asked to express their feelings and perceptions, evaluation and suggestions on the current use of virtual learning environment - fronter (school version) in teaching and learning of mathematics in the school. The questions are categorical questions that require students to record a yes or no answer.

TABLE V
STUDENTS' PERCEPTION, EVALUATION AND SUGGESTION ON THE USE OF VLE IN MATHEMATICAL LESSONS

Question	Yes/No	Count	Column N%	Table Total N%
Do you think you learned something new from the use of VLE?	Yes	12	85.7%	85.7%
	No	2	14.3%	14.3%
Do you think VLE may enable you to attain higher grades in maths?	Yes	11	78.6%	78.6%
	No	3	21.4%	21.4%
Do think VLE should be made available to all students?	Yes	9	64.3%	64.3%
	No	5	35.7%	35.7%
Do you think teachers have the ability to help students in the learning with VLE platform?	Yes	9	64.3%	64.3%
	No	5	35.7%	35.7%
Were you motivated while solving maths problems in the VLE	Yes	11	78.6%	78.6%
	No	3	21.4%	21.4%
Do you think VLE enables you to develop problem solving skills?	Yes	9	64.3%	64.3%
	No	5	35.7%	35.7%
Do you thin VLE may enable your school achieve better grades in GCSE exams?	Yes	12	85.7%	85.7%
	No	2	14.3%	14.3%

The result shows that majority of students (9 – 12) representing 64.3% up to 85.7% agrees that they have learned something new from the use of VLE (fronter) and that VLE would enable their school to achieve better grades in their GCSE exams. However, 3 respondents (21.4%) disagrees having learnt something new from the use of VLE – fronter; they were neither motivated nor expect higher grades in mathematics exams.

VIII. DISCUSSION

Based on the findings of this study, the researcher concludes that virtual learning environment (VLE) can impact positively on the special education needs students' conceptual

understandings in mathematics. Technology (VLE) has proved effective in motivating students learning and providing ammunition for students to see themselves in control of their learning. In a value-driven virtual learning environment, teachers and learners ethically evaluate technology in order to be consistent with their learning needs. This may require both parties to develop tacit knowledge with respect to self or personalised-learning and peer learning. The concern for all stakeholders in education with the development of the critical thinking of the special education needs (SENs) students is an enduring theme.

Learning and teaching technology is here to stay and the virtual learning environments (VLEs) platforms have proven to impact on students learning.

IX. Conclusion

The purpose of this pilot study was to investigate the relative impact of virtual learning environment on the special education needs (SENs) students' mathematical concepts acquisition within the school sector education in England. The participants followed mathematics curriculum in order to learn concepts.

The study shows that VLE fronter has the functionality to support student's mathematic learning, enabling acquisition of mathematical concepts. The study indicates that use of virtual learning environment (VLE) had some degree of impact on KS4 students mathematical concepts acquisition, for instance, an indication of significant effect in moulding SEN students' attitudes and motivation, creating individual student's access to mathematical concepts reality which has thus strengthened the student - teacher, student-student and student-school learning support and partnerships. The conclusions that I may draw from the student feedback on the study is that overall, students felt that they learned as much from VLE platform - fronter and enjoyed as much than the traditional classroom teaching, which met the requirement from the teacher, of greater engagement and increased motivation for the acquisition of mathematical concepts. The study also demonstrates that students are actively engaged and stretched in the class through differentiation, for example setting achievable targets for the SEN students. There is evidence that mathematics lessons designed for specific learning purposes can be engaging and motivating for students. The study highlights the recommendation and suggestions pertinent to policy makers. The impact of effective and efficient use of VLE has short-term and long-term positive effects on special education needs (SENs) students' personal mathematical concepts actualisation. In order to get the most benefits from using the VLE, it's important that the platform is embedded into the school curriculum, rather than simply strapped on.

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