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Research Article

Resilience Analysis in the Teen Stage: An Approach to the Situation of Schools in the Basque Country

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Abstract:

The incessant social, cultural and economic changes in which society is immersed, does require developing coping skills towards change that allow teenagers to successfully develop as active subjects of society. Within this framework, the school environment is considered an ideal scenario to work resilience in the adolescent stage. Based on these considerations, the objective of this research is the approach to the reality of adolescents and their resilience. For this reason, a descriptive analysis is carried out with 193 teenagers from various schools in the Autonomous Community of the Basque Country (CAPV). The results show significant differences in resilient capacities related to the age and sex of the participating adolescents.

Keywords: Resilience, adolescence, formal education.

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INTRODUCTION

The term resilience is applied in different contexts, generally to refer to the abilities that individuals have to face in adversity scenarios. Grotberg (1995) already defined resilience as the ability of a person to face and overcome the adversities that occur in his life, and he referred to environmental and personal factors. Along these lines, Suriá (2012, 2015) points out that it is a protective factor that people have in difficult life situations, such as being diagnosed and treated with a chronic illness, or the loss of a loved one. In addition, considered resilience experts such as Barudy (2013) affirm that "resilience is the ability to succeed in an acceptable way for society, despite a stress or adversity that normally implies a serious risk of negative results" (p.56).

However, for Connor & Davidson (2003), resilience is a multidimensional construct. These authors aim to identify the degree of individual resilience, considered as a positive personality characteristic that allows the individual to adapt. But does resilience vary according to people's vital stage?

On the one hand, placing ourselves in adolescence, Rutter (1993) already defined resilience as the set of characteristics of teenagers who do not have emotional or behavioral problems despite having been subjected to experiences of stress. In this sense, these adolescents, despite the adversities suffered, configure individual resistance responses and emerge stronger. That is, resilience, far from being the ability to deny a problem, is the ability to face and overcome, even transforming it into a positive one (Vanistendael, 1995). From this perspective, resilience focuses on social skills because it is a component to achieve socio-emotional development and because it favors school learning (Dascanio et al., 2015). Thus, resilience and social skills constitute two of the fundamental aspects in the development of the human being to face adversity on a personal, academic, family, work or social level (Donayre, 2017). Despite the absence of an agreed definition on the term of social ability, there is a general agreement on the fact that, when talking about social skills, we refer to a set of learned behaviors (Caballo, 2002).

On the other hand, adolescence is a relatively modern criteria that we must differentiate from puberty, since puberty is a biological event related to statistical criteria. However, adolescence is a broader process in which apart from psychological changes, psychosocial and emotional changes also occur. Adolescence was defined as a specific phase in the cycle of human life from the second half of the last century, being linked to political, economic, cultural changes, industrial and educational development, and the gender approach (Pineda & Aliño, 2002). The World Health Organization [WHO] (2011) understands that adolescence occurs between the ages of 10 and 19 in two phases, early adolescence (10-14 years) and late adolescence (15-19 years).

At this stage of life, the changes and evolutionary tasks that must be faced make adolescence a complicated and difficult period for young people, featuring empirical

evidence of increased emotional and depressive problems, increasing antisocial activities in some cases (Kraaij et al., 2003). However, not all people are affected equally by the stressors since the natural variability of the individual response has to do with certain mechanisms of vulnerability that can be explained in terms of resilience or resistance to adversity (Oliva, Jiménez, Parra, & Sánchez, 2008).

Several studies show that at this stage of transition there are risk factors linked to alcohol and drug use, early sexual practices or school violence (Gutiérrez & Romero, 2014; Corchado, Díaz-Aguado, & Martínez, 2017). At the same time, there are protective factors being those that mitigate or moderate risk factors on behavior and that can be of two types: the assets that are linked to internal factors such as self-esteem, and so-called resources that are located outside the individual such as family support, peer group or school (Rutter, 2006; Fergus & Zimmerman, 2005). In this sense, resilience materializes as a result when the teenager successfully exceeds the risk exposure (Corchado et al., 2017).

Likewise, in addition to the result, resilience is also identified with behavior; In the school years, adolescents develop relational social skills such as greeting, receiving criticism or expressing opinions, to do favors, a sense of humor, integrating into groups or considering points of view among others. Specifically, the most important personal qualities that facilitate resilience have been described as: a) consistent self-esteem b) positive coexistence, assertiveness, altruism c) flexibility of thought, creativity d) emotional self-control, independence e) self-confidence, feelings of self-efficacy and self-worth, optimism f) locus of internal control, initiative g) sense of humor h) morality. These and other individual characteristics associated with resilience are not innate but come from education, therefore, can be learned (Higgins, 1994; Melillo 2002).

A recent study indicates significant differences between boys and girls, showing higher resilience scores in boys (Fínez & Morán, 2017). This data is not trivial since adolescents who show resilient behavior patterns avoid problematic behaviors influencing academic achievement. Therefore, teenagers who develop social skills such as resilience are more competent, responding to school demands (Donayre, 2017; Dascanio et al., 2015; Dowswell & Chessor, 2014).

Taking into account the incessant social and cultural changes of recent years, the school environment becomes a privileged space to work resilience in the adolescent stage (Olmo-Extremera & Segovia, 2018). Certainly, the school constitutes one of the spaces of socialization that acquires more power in the construction of its own identity. Likewise, different authors (Arguedas & Jiménez, 2009; Gaxiola, González, & Gaxiola, 2013) point out that formal education in the adolescent stage influences the development process of the individual and his/her future as a citizen, as well as helps to achieve necessary tools for the integral development of his/her person.

Besides, all adolescents who attend schools could suffer or may suffer traumatic, painful and even sometimes incomprehensible situations in their lives. That is why the classrooms must not only constitute spaces where teaching-learning processes are carried out, but they must facilitate and stimulate the construction of social skills such as resilience. Indeed, the development of resilience in the school environment can come together as a novel educational paradigm in which the educational community focuses on the promotion of protective mechanisms that provide students with coping tools in adverse situations (Acevedo & Mondragón, 2005). The promotion of these protection mechanisms contributes to the development of the resilient spirit of school children, whether they are in a difficult and adverse situation, or not. The results of various studies indicate that children have more internal protective factors as well as young adults, while adolescents and the middle adulthood group have got more than external protective factors (Rua, 2018; Gonzalez-Arratia & Valdez, 2013).

In short, the school, as a promoter of well-being, should favor the strengthening of resilience, so that teenagers can develop behaviors associated with it and become responsible, committed and happy citizens. That is to say, the process of building resilience should not only contribute to better academic performance, but should contribute to the improvement of the intrapersonal and interpersonal skills of adolescents, making them able to emerge strengthened for the adversities that may arise throughout their life cycle.

Based on the above assumptions, the purpose of this research focuses specifically on a descriptive analysis of resilience in the school context of the Autonomous Community of the Basque Country (CAPV), north of Spain, to get closer to the reality and obtain significant data that help us to elaborate Educational Programs.

METHOD

Participants

The participants of this research were a total of 193 adolescents from two schools of the Basque Country (Autonomous Community of the Basque Country), 71% (n = 137) of the participants came from the public school and 29% (n = 56) from the private school. The ages of the participants were between 12 and 17 years of age (M = 1.52, DT = .51) and with a mean and standard deviation in terms of sex; M = 1.55, DT = .50. Of the total of the sample, 92.5% were born in the Basque Country and the rest were from other communities in Spain or even abroad.

Instruments

Resilience scale of Connor & Davidson, (CD-RISC, Connor & Davidson, 2003). Spanish translated version of Crespo, Fernández-Lansac, & Soberón (2014). The test consists

of the following dimensions: (1) persistence-tenacity-self-efficacy (personal perception of effectiveness); (2) control under pressure (ability to protect one's integrity); (3) adaptability and support networks (family as support network); (4) control and purpose (determine existential purposes and their quality of control); and (5) spirituality (understood as the search for meaning). The questionnaire is intended for adolescents and adults with the application time being 10 minutes. The instrument consists of 25 items (eg, I try my best to achieve anything ";" I can reach my goals "or" I know how to seek help when I need it "), which are presented in a 5-point Likert format scale where : 1 = "totally false", 2 = "rather false", 3 = "sometimes true", 4 = "often true", 5 = "almost always true".

In the beginning, the test was used primarily in the evaluation of resilience in people with a diagnosis of post-traumatic stress, although later its use was extended, currently becoming one of the most widely used international scales when evaluating the builder of resilience (Henley, 2010).

In relation to each dimension, reliability shows lower α indices than taking it as a whole (total resilience): persistence-tenacity-self-efficacy α = .78; control under pressure α = .67; adaptability and support networks α = .66; control and purpose; α = .51 and; spirituality α = .51.

Process

The approval of the Ethics Committee of the UPV / EHU [M10 / 2016/158] was obtained for the investigation. In order to manage the resilience scale and thus identify and describe the phenomenon itself among the participants, a first contact is made with the two schools via email and telephone (2017-2018). Once the directors of both centers are interested, they go to administer the tests to the participating teenagers via Google forms. On the day of the collection of the sample, informed consent was collected by the relatives of the participants, the participants themselves and the directors of the resources. Highlight that, for data collection, all the fees established by Organic Law 15/99 of Protection of Personal Data were followed. In addition, the voluntary nature of their participation was reported.

Analysis of data

The data analysis have been carried out using the statistical package SPSS v.25, several of the data have been categorized for further analysis (sex and age). Before beginning the analyzes, the assumptions of normality and homoscedasticity of variances have been verified, for the subsequent decision making to the use of parametric or non-parametric tests. In this case, the sample size is greater than 30 elements and a normal behavior will be assumed by the central limit theorem, which are confirmed with asymmetry and kurtosis indices that do not significantly depart from 0. As for the analyzes performed, highlight that they have been performed, descriptive analysis of the sociodemographic data of the

frequency in the responses of the items in addition to observing if significant differences occur in the scores of the resilience subscales according to sex and age. For this last, test t from student have been performed for independent samples. Finally, and with the sum of the total resilience (the whole of the subscales), an analysis is carried out to observe the interaction of the total resilience taking into account both sex and age.

RESULTS

Descriptive data of the sample

The sociodemographic data of the sample have been categorized, in terms of sex, 54.9% (n = 106) were girls and 45.1% (n = 87) were boys. In relation to age, 47.7% (n = 92) are adolescents aged 12 to 14 years and 52.3% (n = 101) adolescents between 15 and 17 years of age.

In relation to the items that have been most frequently answered by these and these teenagers are the following: "I take pride in my achievements". The first item belongs to dimension (1) persistence-tenacity-self-efficacy (personal perception of effectiveness). Note that these items have been answered among Likert responses (1-5) with an average higher than 4.16 in the total sample.

Resilience based on sociodemographic variables

The following Table 1 shows, on the one hand, the different subscales of total resilience and gender differences. In this way, it can be seen how there are statistically significant differences between the persistence-tenacity-self-efficacy dimensions, specifically boys (*M* = 32.11, *DT* = 4.46) who show a higher average than girls (*M* = 30.73, *DT* = 4.66).

Table 1
Subscales of gender-based resilience

VD	Sex	*n*	*M*	*DT*	*t*	*p*
Persistence-tenacity-self-efficacy	Boy	87	32.11	4.46	1.52	**.038***
	Girl	106	30.73	4.66		
Control under pressure	Boy	87	24.13	4.10	2.44	.140
	Girl	106	23.25	4.12		
Adaptability and support networks	Boy	87	20.15	3.05	.99	.187
	Girl	106	19.60	3.14		
Control and purpose	Boy	87	12.00	2.05	.30	.319
	Girl	106	11.71	1.86		
Spirituality	Boy	87	5.91	1.57	.95	.474
	Girl	106	6.10	2.04		

*p<.05**

Therefore, Table 2 shows, the different subscales of the total resilience and the differences according to age categorized (12-14 and 15-17 years), again showing significant differences in persistence-tenacity-self-efficacy, specifically younger adolescents, 12-14 years (M = 32.13, DT = 4.40) and those showing a higher average than older adolescents (M = 30.73, DT = 4.66).

Table 2
Subscales of age-based resilience

VD	Edad	*n*	*M*	*DT*	*t*	*p*
Persistence-tenacity-self-efficacy	12-14	92	32.13	4.40	2.67	**.008***
	15-17	101	30.52	4.66		
Control under pressure	12-14	92	24.83	3.90	.59	.556
	15-17	101	23.48	4.33		
Adaptability and support networks	12-14	92	20.27	2.89	1.93	.055
	15-17	101	19.41	3.24		
Control and purpose	12-14	92	11.91	2.04	.54	.592
	15-17	101	11.76	1.87		
Spirituality	12-14	92	6.15	1.89	1.02	.308
	15-17	101	5.88	1.80		

*p<.05**

Resilience based on sex and age

The following analysis shows the interaction according to the sex and age of the participants in the sample. In this way, the interaction between total resilience and independent sex and age variables is observed together. As can be seen in *Figure 1*, the interactions of both variables together do not show significant differences, F (1,189) = .13, p <.91, however, separately, the age variable is the one that shows significant results with the total resilience, F (1,189) = 4.26, p <.040.

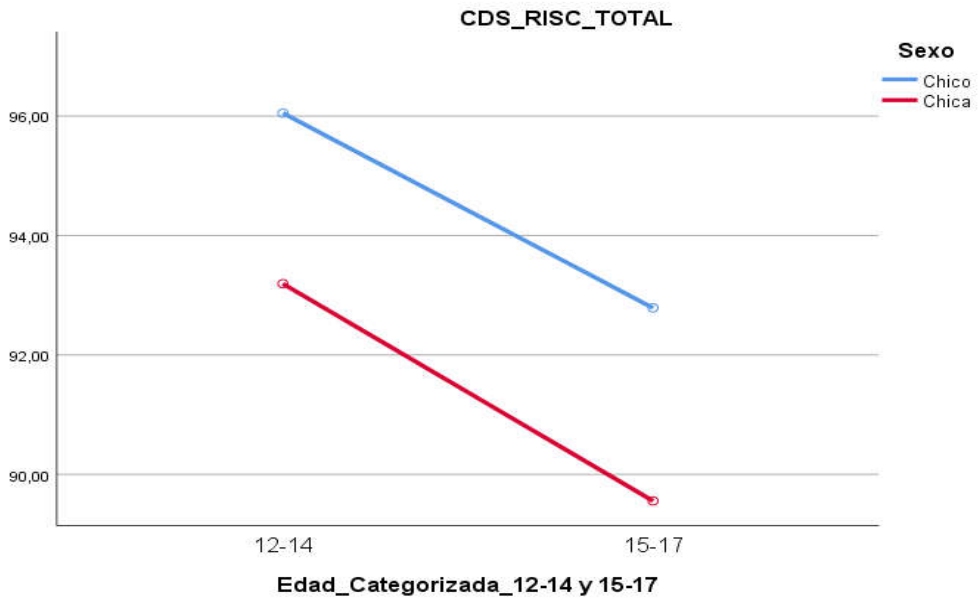

Figure 1. Total Resilience and its interaction with sex and age

DISCUSSION

The results reveal that as age increases, resilience shows lower scores. That is, the degree of resilience could be decreasing as age increases. Certainly, as it has been shown through the results obtained in the present study, adolescents between 12 and 14 years of age, in terms of the persistence-tenacity-self-efficacy dimension, show higher scores than the teenagers of the 15 to 17 year old section. In addition, when the interaction of total resilience with sociodemographic variables is performed, it is age that shows significant differences. It should be noted that there are not many previous investigations that allow us to establish causal relationships between the age variable and resilience. However, we could say that our findings are in correspondence with the scientific literature, since there are several investigations that point to this relationship, so it is expected that, at an older age, the resilience of adolescents will be lower (Bragado, 2010). Therefore, it can be affirmed that age is a variable that must be taken into account as recent studies do (Rua, 2018).

Regarding the sex variable, as shown in the results of this study, it is boys who have higher scores than girls in the dimension of persistence-tenacity-self-efficacy (Fínez & Morán, 2017). In fact, statistically differences were found significant regarding gender; however, they point out the opposite to other previous studies, where resilience is shown to be greater in women (González-Arratia et al., 2009; Morales & Díaz, 2011).

Therefore, it is persistence-tenacity-self-efficacy, the dimension of resilience that shows significant differences in both sex and age. This dimension aims to analyze the persistence of tenacity and self-efficacy of people to achieve their goals, so that this result

may be linked to what Vanistendael (1995) already commented, that is to say, the ability to overcome adversity and transform it into positive.

This study affirms the need to work on resilience in the different educational programs, being that, as Caballo (2002) pointed out, human beings are "social animals" that we spend much of our time in interaction with other people, that is why our lives is partially determined by the range of our social skills. In this way, resilience can be worked to help people find key points in their future integral development, as pointed out by some authors (Arguedas & Jiménez, 2009; Gaxiola et al., 2013). In short, it seems especially relevant to continue the development of research focused on studying the variables linked to the resilience and emotional health of people in general.

Finally, highlight how through this preliminary study an approach has been made to the social ability of resilience in adolescence, in order to obtain significant data that help us design and implement Educational Programs and guide us in future lines of investigation.

CONCLUSION

Resilience framed within social ability is a behavior that can be learned and therefore taught. In this sense, we put the focus on education to influence in the different stages of adolescence so as to they could enter strengthened into adulthood. In addition, we find in the Educational Programs the key to developing this capacity in an equitable way in the different sexes avoiding the culture of the gender roles established.

In order to achieve this objective, we consider a key point designing and developing Educational Programs implemented on a consolidated theoretical foundation. In addition, to achieve structured programs from the empirical base it is necessary to expand the sample.

Regarding the limitations of the present study, we would like to point out that it is a preliminary study conducted only in a particular autonomous community, and with a reduced sample statistically. However, it helps to have a vision of the phenomenon studied and to have it as a reference for future studies.

Being the case of a preliminary study conducted only in a particular autonomous community, the results obtained are only descriptive and with a small sample size, this can sometimes create biases in the study. The analyzes have been used to evaluate the scale used as well as the dimensions that compose it, in order to verify reliability. However, since it does not show many statistically significant results, it is proposed to use this same reduced scale of 10 items to identify predictive variables that can help identify resilience in the classroom.

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Research Article

Strategies to Improve English Vocabulary and Spelling in the Classroom for ELL, ESL, EO and LD Students

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Abstract:

Vocabulary and spelling are two of the most important skills to achieve success in an academic setting. This review of 15 articles highlights classroom interventions that successfully enhanced vocabulary and spelling skills among ESL, English Only, English language learners (ELL), and learning disabled (LD) students. The strategies that enhanced vocabulary skills were reading strategies, story book reading strategies, and memorization strategies. The strategies that enhanced spelling skills were Cover, Copy, Compare (CCC) and writing strategies. Results showed that the strategy of storybook reading enhanced the vocabulary skills among both English Only and ESL students. Writing strategies resulted in spelling skill improvement for students with LD. Future research should focus on the CCC strategy application to improve their vocabulary skills for ESL students who also have LD.

Keywords: Strategies, vocabulary, spelling, learning disabilities, English as a second language, English-Only

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INTRODUCTION

Among the thousands of languages spoken around the world, English has become the primary global language of the 21st century. As one of the most widely distributed languages, English is used internationally by native and second language speakers in great number. English is the main language of communication in international diplomatic relations Crystal (2003). Two of the most important components of learning English are spelling and vocabulary. Wilkins (1972) summed up the importance of vocabulary by writing, "while without grammar very little can be conveyed, without vocabulary nothing can be conveyed" (pp. 111–112). Similarly, Jaspers et al. (2012) remarked on the important relationship between spelling and learning English.

Vocabulary and Spelling

It is necessary to briefly lay out what is meant in the current paper by the terms "vocabulary" and "spelling." Vocabulary can be defined as the words of a language, including "single items and phrases or chunks of several words which convey a particular meaning, the way individual words do" (Lessard-Clouston, 2013, para. 2). These lexical chunks include such phrases as "good morning" and "nice to meet you" and they are the key to communication and developing student skills (Sánchez & Manchón, 2007). The stronger students' vocabularies are, the more complex material they will use that will benefit them, allowing them to communicate and understand others much better. A student's understanding of a vocabulary word's meaning and usage (depth) can vary from shallow (merely recognizing a word and/or using that word in a basic way) to deep use (ability to use the word in a multitude of contexts) (Carlo et al., 2004).

Spelling is another important term for this review. According to Erion et al. (2009), spelling is a vital pre-requisite skill for people to be able to express themselves through written communication as opposed to oral communication. Erion et al. (2009) continues by expressing the great importance of acquiring the skill for reading fluency in this process. In addition, Kosmac (2010) adds to the conversation by informing us that learning to spell is not just important, but fundamental to acquiring further academic knowledge. Yet, according to Van Scoter and Boss (2002), acquisition of these skills is difficult, especially for students with LD. Troia and Graham (2003) explain that while writing is a complicated task to attain for both children and adults, it is even more challenging for students with LD, in particular putting their ideas into writing.

Challenges of Learning English

The English language is complex to learn because often times it can be challenging to spell a word correctly and use it in a sentence properly. If a child is able to spell, recognize, and use a word in the proper format written and verbally, then the child has mastered that word. According to Cook (1999), the true goal of the English writing system reaches beyond spelling and pronunciation in communication and the final test is whether or not

meaning is able to be conveyed and understood. English can be tricky because there are many words that sound the same when pronounced but are spelled differently and, therefore, have a completely different meaning. For example, the words rain, rein, and reign all have very different meanings but all sound the same and may be a point of confusion for a user of English vocabulary.

Because the English language is complex to master, the best way for a person to achieve true understanding, according to Plester, Wood, & Joshi (2009), is to establish a connection between reading comprehension and spelling. The path to reading and writing fluently in English "is through mastering the connections between letter combinations and the sounds they represent" (Joshi & Roth, 2009, p.1).

Children who have LD are more likely to struggle with learning English, even in their native language, compared to their peers (Schwarz et al., 2000). Additionally, students with LD can be weaker in their understanding of syntax, grammar, and vocabulary, which makes learning spelling and vocabulary challenging (Cortiella & Horowitz, 2014). Similarly, ESL children with LD tend to be weaker in their native language as well (across the areas of writing, reading, comprehension, and spelling abilities), which makes learning a foreign language like English even more challenging (Ipek, 2009). Typically, to learn a foreign language such as English, a student relies on his/her knowledge of their native syntax, grammar, and sentence structure to help make sense of the foreign language he/she is trying to learn (Sparks et al., 2008). However, ESL students with LD are at a disadvantage and would benefit from language-building strategies, especially in the areas of spelling accuracy and vocabulary acquisition (Carter et al., 2013 & Schwarz, 2000). Because LD students learn best through multi-sensory, direct, intensive tactile/kinesthetic, visual, and auditory instruction (Cortiella & Horowitz, 2014), one would hope to find vocabulary and spelling strategies in the literature that utilize these learning pathways.

Purpose

The purpose of this review is to distinguish classroom interventions that successfully increase the English vocabulary and spelling skills of students who are speakers of ESL, native English speakers, and/or have a learning disability. Within the ESL speakers, there are three types of learners who have been studied in this review of the literature: students in the U.S. who were raised bilingual (also called "U.S. resident learners of English"), international students with visas to study in a country where English is the dominant language, and international students who were learning ESL in their native country (Shuck, 2013). The literature on English vocabulary-acquisition and spelling-accuracy interventions encompasses all three types of ESL students, in addition to students with LD.

Research question

Therefore, the question guiding this review is;

1. Which language-building strategies are most effective for enhancing the English vocabulary acquisition and spelling accuracy of students who are ESL, English-only (EO) speakers, and/or have learning disabilities.

METHOD

The following search engines were enlisted to locate studies for this review of research: ERIC, RefWorks, and Google Scholar. Combinations of the following keywords were used to find studies related to vocabulary and spelling interventions: vocabulary strategies, spelling strategies, English as a second language, English only, English Language Learners, foreign language, vocabulary, method, instruction, intervention, learning challenges, language learning strategies, and strategy. The search yielded over 100 studies. These results were narrowed according to the following inclusion criteria: (1) the researchers had examined the effectiveness of either a vocabulary strategy or a spelling strategy in a school or home setting, (2) the participants' ages or grades ranged from pre-kindergarten to university-level, (3) the participants were either EO speakers, ELL, had LD, or some combination thereof, and (4) the articles were either published between 1990 and 2016 in a peer-reviewed journal or were a dissertation. Using the criteria described above, 15 articles met the standard for this review.

RESULTS

In this review, the author found 15 studies of vocabulary and spelling strategies that were effective for enhancing the English vocabulary and spelling of ESL, EO, and/or LD students. This review identified traditional vocabulary strategies such as direct teaching of vocabulary through application in reading, and route memorization of spelling new vocabulary words. See Table 1 for characteristics of the vocabulary strategy studies. This review also identified innovative spelling strategies such as Copy, Cover, Compare (CCC) and writing. See Table 2 for characteristics of the spelling strategy studies.

Table 1
Vocabulary Interventions

Name of Studies	Population	Setting	Design	Kind of Strategy	Instrument
Carter et al., (2013)	N = 3 students 15 years old Males Reading Instruction ESL & LD	Wellington, New Zealand	Group experimental	Cover Copy Compare	Word mastery
Carlo et al., (2004)	N = 254 students 10-11 years old, 5th grade Females and Males Reading Instruction ESL & EO	Four schools in California, Virginia and Massachusetts	Quasi-experimental	Direct word instruction	Word mastery Morphology
Brett et al., (1996)	N = 175 students 10-11 years old, 5th grade Females and Males Reading Instruction ESL & EO	Classroom in two urban Elementary schools	Group experimental	Listening to stories	Pre-test and post-test
Chun & Plass, (1996)	N = 160 students University students Females and Males ESL	Three universities in California	Quantitative	Short story	Questionnaires. Pre-test and post-test
Roberts, (2008)	N = 33 students 4-5 years old, preschool Females and Males ESL	Preschool	Group experimental	Home story book reading strategy	Pretest and Posttest Overall Storybook-Vocabulary Tasks
Joe (1998)	N = 48 students University students Females and Males ESL	School of Basic Education	Group experimental	Reading and retelling a text	Pre-test and post-test
Faraj, (2015)	N = 30 students University students Females and Males ESL	English Language Sulaimani University	Pre-experimental	Kramsch's procedure	Pre-test and post-test Questionnaire
Brown & Perry,(1991).	ESL students	six intact classes from the English Language Institute	Nonequivalent control.	Keywords strategy	four-choice multiple- choice

Table 2
Spelling Interventions

Name of Studies	Population	Setting	Type of Articles	Kind of Strategy	Instrument
Jaspers et al., (2012)	N = 3 students 9-14 years old Females and males Bilingual LD	Urban elementary school in the Southeast	Single subject design	Cover Copy Compare	Pre-test and post-test
Skarr et al., correct words (2012)	N = 3 students 9-10 years old, 4th grade Females LD	Urban public elementary school in the Pacific Northwest	Single subject design	Cover Copy Compare	The number of
Murphy et al., correct words (1990)	N = 9 9-12 years old, 4-6th grades Females and males LD	Resource room in an elementary school	Single subject design	Cover Copy Compare	The percent of Clinical significance
Manfred, III Test (2015)	N = 3 9-11 years old, 4-6th grades Females and males LD	Resource room in an elementary school in the Pacific Northwest	Single subject design	Cover Copy Compare	Woodcock-Johnson of Achievement
Darch et al., interviews (2000)	N = 4 7-9 years old, 2nd grade Females and males LD	Resource room	Qualitative study	Rule-based strategy	Audio tapes of
Viel-Ruma et al., (2007)	N = 2 15-19 years old, 10-12th grades, Females and Males LD	Resource room in a high school Southeast	Single subject design	Error self-correction & spelling	Error self-correction Practice sheets Weekly spelling tests Weekly post-tests
Hanna et al., (2000)	N = 2 10 years old Males ELL	Elementary school	Quantitative study	Computer assisted	Decoding accuracy instruction and speed

Vocabulary Strategies

In order to help students build their vocabulary skills, researchers have used a variety of strategies including direct reading instruction strategies, storybook reading strategies, and memorization strategies. The direct instruction strategies included direct word instruction (Carlo et al., 2004), and Cover, Copy, Compare (CCC) (Carter et al., 2013). The storybook reading strategies included listening to stories (Brett et al., 1996), video stories (short story) (Chun & Plass, 1996), home storybook reading (Roberts, 2008), and reading and retelling stories (Joe, 1998). Memorization strategies, like the Keyword strategy (Brown & Perry, 1991) and Kramsch's procedure strategy (Faraj, 2015), have also assisted students' vocabulary retention.

Direct instruction strategies

Generally speaking, direct instruction in vocabulary appears to help students increase their vocabulary and fluency (Yildirim et al., 2014). In the CCC study by Carlo et al. (2004), fifth-grade ELL students learned 10 to 12 target words each week over 15 weeks. This CCC study teaches spelling by having students look at each spelling word, cover the

word, copy the word down based on how they remembered the spelling, and then compare what they wrote to the actual spelling of the word. The practice is repeated until the student masters the spelling of each word. Carlo et al. (2004) used "word mastery" as the measure for intervention. In Carlo et al.'s (2004) study, reading comprehension skills increased to 80% when students were provided with the CCC approach to learning spelling, which led to learning new vocabulary. Improved vocabulary increases reaching comprehension.

In a second study by Carter et al. (2013), participants were three 15-year-old ESL and LD reading students who learned 15 new words over the course of one week, in three 25-minute periods. The students were taken into a resource setting and given the set of words to learn at the first intervention. The teacher taught the spelling as direct instruction, and the students practiced alongside the teacher. Then, as independent practice, the students used the CCC strategy to track their own progress. The three students did increase their vocabulary skills as a result of the intervention. Carter et al. (2013) used the measurements (word mastery) when reviewing target words. Direct word instruction was found to be effective at increasing vocabulary skills with ELL learners. In addition, the intervention was found to improve student fluency by 50%. In fact, vocabulary acquisition with these strategies (i.e. direct word instruction and CCC) was found to be related to other skills, such as reading fluency and comprehension (Carlo et al., 2004, Carter et al., 2013).

Storybook reading strategy

In these studies, the interventions included listening to stories, video stories (short story), home storybook reading, and reading and retelling stories. In the identified studies, the storybook reading approach was used with a wide age and language demographic from preschool though adults. As far as the participants in listening to stories, Brett et al. (1996) designed the interventions for EO fourth graders, and in the video stories (short story) Chun & Plass (1996) selected students who were German ESL university students. As far as reading and retelling stories, Joe (1998) selected students who were ESL adults, and Roberts (2008) selected ESL preschool children for home storybook reading

Two studies used strategies that required listening as a skill, as one is audio (Brett et al.,1996) and the other video (Chun & Plass, 1996). In the study by Brett et al. (1996), participants were EO fourth graders and they listened to stories and received explanations of unfamiliar words. The students read the stories over five days in six weeks and took the pretest and posttest for all storybooks. In the second study by Chun & Plass (1996), students were German ESL university students who listened to a story, then read the story, and searched for the meaning of identified words. The video story strategies required students to watch a video review of a German short story. After that, students read the story and looked up the meaning of each word. Finally, they engaged in recall by

writing summaries of the story. The ESL students read German texts with a number of annotations for words via text, pictures, and video. They screened a video preview offering up an overview of a German short story. They then read the story, looking up the meaning of individual words when necessary by choosing any number of available annotations (Chun & Plass, 1996). The students spent between 40-50 minutes per day for two weeks and used the pretest and posttest reading the story.

In both studies, it was found that students remembered the words and meaning, and ELL students gained vocabulary featuring previously unknown words. However, the video story strategy was only in German for German-to-English translations and the acquisition of lexicon was not deliberate and targeted, which the authors suggest would have produced an even better result of vocabulary learning (Chunn & Plass, 1996). Providing simple word explanations through an interesting story resulted in higher chances of full student engagement (Brett et al., 1996).

Two additional related storybook reading interventions took place when ESL students engaged in either book reading at home or reading and retelling a text outside of school (Roberts, 2008 & Joe, 1998). In the study by Roberts (2008), it referred to home reading after which the teacher followed with classroom storybook reading and vocabulary instruction. The students read the story in their home language as well as in English and were exposed to the same stories designed for preschool-aged children. During home book reading, the parent-caregivers read the story to their children, which was complemented in the classroom by weekly pretests and posttests. In a second study by Joe (1998), the reading and retelling strategy was a text description around the idea of "pain," which worked since students had prior understanding of the topic, regardless of their primary language background (Joe, 1998). In Joe's study, students were ESL adults and read 40-50 minutes weekly in school and completed a pretest-posttest.

As a result of Robert's (2008) study of book reading at home, children's vocabulary test scores improved after reading at home with their parents. In addition, parental involvement increased from 50% to 80% over the two 6-week sessions because they were asked to support their preschool-aged child at home. Joe's (1998) work revealed that vocabulary was being gained incidentally and learned by its participants through the process of reading and retelling a text. This then led to greater vocabulary gains for unknown words and strategies that would allow the learners and participants to develop those oral and written skills. In both studies, the interventions led to enhanced vocabulary learning through generative processing of the words and their usage.

Memorization strategies

Two studies used memorization strategies to improve vocabulary development; Kramsch's procedure (Faraj, 2015) and keywords (Brown & Perry, 1991). For the Kramsch procedure in the study by Faraj (2015), ESL students wrote down words on only one-sided color cards in their general English class. To increase student buy-in, students used their favorite colors if possible (Faraj, 2015). During Kramsch's intervention, students read Oxford Word Skills, which practices grammar by implementing correct use of words and phrases, two hours each week after they finished a unit. They measured the effectiveness of the strategy by comparison of pre-and post-tests. It is not apparent that the intervention utilized had a true impact on the effectiveness of the student's vocabulary knowledge. The article also was written incorrectly with poor grammar and sentence structure, reducing the reliability and validity.

A second study by Brown and Perry (1991), used a keyword strategy with ESL students. The keyword was, in their example, a way "to remember that carlin means old woman, [so] a subject might use the keyword car, and imagine an old woman driving a car" (McDaniel & Pressley, 1984, p. 598, as cited in Brown & Perry, 1991, p. 658). During the keyword intervention, students read target words each day for 15 minutes and used them in multiple choice comprehension tests to show recall and retention of the words (Brown & Perry, 1991). Ultimately, however, the keyword approach did prove hard for students to learn large numbers of words via this strategy.

Spelling Strategies

Seven of the studies in this review addressed improving students' spelling skills. Among the strategies used were the Cover, Copy, Compare strategy (CCC) (Jaspers et al., 2012; Skarr et al., 2012; Murphy et al., 1990; Manfred, 2015), and three types of writing strategies: error self-correction strategies (Viel-Ruma et al., 2007), rule-based strategy (Darch et al., 2000), and computer-assisted instruction (Hanna et al., 2000).

Cover, Copy, Compare Strategy (CCC)

Four of the studies appear in the context of CCC strategies (Jaspers et al., 2012; Skarr et al., 2012; Murphy et al., 1990; Manfred, 2015). The procedure used for CCC in these studies was similar to method described earlier in this paper for the Carlo (2004) study; specific differences in each study will be described.

In the study by Jaspers et al. (2012), teachers asked ELL students to compare and copy the spelled words and for students to consider words, cover them, (re)write them, and compare responses. Students participated in daily pretest/posttest interventions over six weeks. In a second study by Skarr (2012), students with LD had to remember how to spell a word when they copied the words from one column to the next, then covered the

first two columns. Following that, the students lastly checked their spelling. They put a sticker next to the word if they spelled it correctly. If not, they did not put a sticker. After that they rewrote again the correct spelling of this word three times. During the intervention, the student spelled a number of correct words through 5-10 minutes of daily one-on-one interaction with a teacher and utilized the number of correct words spelled in the writing. In the third study by Murphy (1990), students who were LD were given 14 to 18 words per unit using the CCC strategy. Three times a week they took spelling tests over 14 school weeks. In the last study by Manfred (2015), students who were LD completed spelling test questions where they were asked to spell extra words correctly. During the intervention, students worked in the classroom 60 to 90 minutes weekly over 12 weeks.

In some of these studies, writing fluency was improved due to refined spelling skills for students including ELL and LD (Jaspers et al., 2012; & Manfred, 2015); that is to say that learning good spelling together with writing skills, improves student writing overall. In addition, Skarr et al. (2012) and Murphy et al. (1990) found that the CCC strategy helped to improve skills of spelling words with the complementation of writing skills to not just improve the writing, but also to allow the learner to gain mastery writing fluency.

Writing strategies

In spelling, there is a relationship between sound in any pronounced word to the written symbol, the phonogram, which is the primary logic in language (Farnham, 1992). With this in mind, three studies showed how spelling related to writing skills (Viel-Ruma et al., 2007; Darch et al., 2000; Hanna et al., 2000). In the study by Viel-Ruma (2007), students who were LD related a correct word to a misspelled word, comparing and copying, but only if necessary via error self-correction strategies. The researchers used eight of weekly pretest/posttest interventions over six weeks. In a second study by Darch et al. (2000), students who were LD tried spelling during writing activities with a rule-based strategy. It specialized in students developing phonemic and morpheme strategies.

During the intervention, students wrote sentences using selected spelling words during sessions that lasted 20 minutes over six weeks with two rounds of interviews, one for group-specific spelling activities. In the third study by Hanna et al. (2000), students who were ELL spelled words and revised spelling errors on the text through computer-assisted instruction. This computer assisted instruction focused on ELL students' spelling, where they listened, then segmented, then coded, and after that, reviewed the corrected response. During computer-assisted instruction, the students listened to words individual one student who was the third grade in 18 weeks and another student who was the fourth grade in 21-weeks sessions of 90 minutes outside of regular school hours, then completed spelling assessments via a test (Hanna et al., 2000). In these studies, it was found that strategies such as computer assisted instruction, rule-based strategy, and error self-

correction strategies improved spelling performances and writing skills increased 70% in Viel-Ruma et al. (2007) and 92% in Hanna et al. (2000). Darch et al. (2000), Hanna et al. (2000), and Viel-Ruma et al. (2007) have focused on more helpful writing strategies with writing difficulties based on the data collected.

DISCUSSION

General Findings

The purpose of this paper was to study the effects of different approaches to teaching and improving vocabulary and spelling in students. After analyzing 15 studies, this reviewer found many strategies, such as direct instruction, storybook reading, and memorization, are effective for enhancing the English vocabulary and spelling of students who are ESL, EO-speakers, and/or LD (Nemati, 2009; Faraj, 2015 & Brown & Perry, 1991). Storybook reading strategies and CCC strategies were used most often. Also, CCC strategies (Jaspers et al., 2012; Skarr et al., 2012; Murphy et al., 1990 & Manfred, 2015) and writing strategies (Viel-Ruma et al., 2007; Darch et al., 2000 & Hanna et al., 2000) had positive impacts on student spelling skills in the classroom. The authors found that storybook reading strategies increased vocabulary growth (Brett et al., 1996; Chun & Plass, 1996; Joe, 1998; & Roberts, 2008). Roberts (2008) found the parental support at home vocabulary usage also reportedly increased from 50% to 80% between the two 6-week sessions. Students got to read the story in their native language as well as in English, leading to multiple exposures to the same material.

Practicality

Because storybook reading is designed for preschoolers, it skillfully targets early intervention of English language learning so that the young child is even more likely to be successful. CCC is well-studied and easy-to-use in the classroom to enhance spelling skills (Jaspers et al., 2012; Skarr et al., 2012; Murphy et al., 1990 & Manfred, 2015). Teachers who have used CCC before would not require much of a learning curve when executing this method. Students must practice the words until they reach 100% accuracy, which ensures that students are learning the information. The CCC strategy has already been found to be easy for teachers to implement in the classroom. In these studies (Carter et al., 2013), CCC was carried out in both special education and mainstream classrooms, and student participants were able to correctly identify more than 80% of words on all three sets.

Additional Benefits

Several of the studies improved reading and writing skills outside of the targeting skills of improved spelling and vocabulary. Some studies increased reading fluency in the subjects. In particular, the use of storybook strategies with younger children (Brett et al.,

1996; Chun & Plass, 1996; Joe, 1998; & Roberts, 2008) targeting ELL students at a young age when they were still building language, and could apply their spelling skills to the basic language that they were being taught to read. Other studies increased writing fluency as well. Students who were ELL and LD increased their writing in studies by Jaspers et al. in 2012, and Manfred in 2015. Writing improved with spelling was taught alongside writing instruction. Studies by Skarr et al. in 2012 and Murphy et al. in 1990 both found that writing fluency reached almost mastery at grade level when spelling was taught with writing. What really proved to be effective with the increase in spelling skills was to enforce teaching vocabulary in the home. The 2008 study by Roberts saw a percentage increase in vocabulary mastery from 50% to 80% between two 6-week sessions of spelling instruction.

Limitations of Studies

In this review, two studies had limitations. The first one was home storybook reading strategies (Roberts, 2008), because the teacher did not have control over the entire execution of the intervention. The teacher could not control whether the student did the reading "at home" nor could the teacher control the extent to which parental support was offered when the child was performing the intervention at home. During the study, researchers reported that parental participation actually increased throughout the intervention, but without replication studies it is not clear that that trend would happen every time this intervention is implemented. It may be difficult for teachers to acquire sets of stories that are in the child's native language (ex. Hmong) and in English. The strategy assumes that the parents will be literate or otherwise capable of providing support to their child with regards to literacy. However, in future studies researchers might include some type of accountability form so that the teacher can keep track of whether the parents and children are completing the at-home portion of the strategy together.

A second limitation was found in listening to stories (Brett et al., 1996) because if teachers do not include images, then the strategy is making a huge assumption about students' background knowledge and ability to understand target-words' spoken definition, and that the child can already visualize the word. The intervention requires students to have strong oral-language abilities and working memories as well as the ability to process so much information orally. However, Brett et al. (1996) suggested vocabulary words were not learned incidentally; rather, they were targeted and an explanation was provided. Despite this limitation in listening to stories, the approach may still have worthwhile uses in the classroom. For example, each story was read over a period of 5 school days, making it easy for the teacher to include this strategy in daily lessons.

CONCLUSION

In summary, the reading strategies, storybook reading strategies, memorizing strategies, CCC strategies, and writing strategies are effective for enhancing English vocabulary skills and spelling skills of students who are ESL, EO-speakers, and/or have learning disabilities, but future research must be done with CCC strategies among ESL students who also have LD and are working to improve their vocabulary skills. CCC strategies are self-instructional, so students work at their own pace and teachers may be freed up to support other students or do their own course planning. CCC is an important way for LD students to achieve vocabulary and spelling success. Such a study should take at least one year with students from first to fourth grades and rely on quantitative research. The researchers can use data collection techniques such as dependent measures, interobserver agreements (IOA), and treatment integrity. Most studies examined were reliable sources, however, some studies required a lengthier time of application (such as repeating a study a few times for validity, or, increasing the number of subjects). Regardless, such promising future research will look at using CCC strategies to improve vocabulary skills for students who are ESL and have learning disabilities. At that future point, CCC strategies may be found to be useful in the special education classroom, especially with LD students.

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Review Article

Responsive Mobile Learning (M-Learning) Application Design and Architecture in Fog Computing

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Abstract:

Today, digital transformation is changing the educational and social life rapidly. In contrast, organizations and educational institutions, developers, and end users do not benefit from cloud-based mobile technologies to the desired level. Mobile systems are used extensively for educational purposes in the Internet of Things (IoT) environment, and the number of online students is increasing. The real problem is how user-friendly, aesthetic mobile learning courses can be effectively delivered on different mobile devices in the desired performance and manner. The responsive design developed with fog computing should be able to provide the ability to design and use mobile learning lessons with sufficient performance, automatically adapted to any browser or device. This should ensure that every person of the target audience can benefit from the lessons without worrying about screen size, resolution, speed and even security. In this study, the fog informatics teaching strategies of mobile learning sensitive teaching design are discussed. The fog computing architecture that can be used with responsive mobile learning, utilizing mobile computing to provide seamless and low latency mobile devices, is described. Finally, a fog-based, responsive designed mobile learning education architecture has been compiled with a better understanding of the lessons and a suitable structure for the use of mobile devices in education.

Keywords: Responsive design, mobile learning, fog computing, minimum device set, Internet of Things, cloud computing, Industry 4.0.

Citation:

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INTRODUCTION

Designing for teaching and learning in education has gained popularity in the digital era. For developing responsive mobile learning (m-learning) materials, it is essential to take into consideration that e-learning materials need to be redeveloped for responsive m-learning. Target users and design strategies are important to build for a successful m-learning initiative. Users respond diversely to m-learning because of m-learning nature and the content. As Millennials (people who have grown up in the modern technological era) are in the m-learning environment, m-learning developers need to think these tech-savvy learners when developing m-learning. Mobile learning is ubiquitous in a way of consuming content mostly socially in an informal way. This is why the majority of mobile applications are on-demand content and performance support for education (Gaved, & Peasgood, 2017).

In m-learning, most of the courses are run on platforms like Android or iOS. The applications as SMS and WAP are nearly about to be outdated. Few types of research are about cross-platforms namely responsive but are not supportive of mobile learning enough. Thus the development of responsive m-learning has a great significance (Adkins, 2013).

The Internet has affected schools, and digital learning has become an important implementation in school systems. But the use of the Internet of Things (IoT) in education is numerous, and the implications are tremendous. The connection of devices to the Internet is the transformation of many applications to daily life, and education is on the agenda. So, mobile technology and the IoT help teachers to create mobile lesson plans which are accessible from any device in fog computing (Meola, 2016).

The purpose of this study is to offer a responsive mobile learning application design and make it work on different mobile devices in fog computing. Upon completing this purpose the following questions will be answered with this study:

- What are the responsive design steps for mobile learning?
- How does fog computing effect mobile learning?
- What is the responsive m-learning architecture?

The responsive m-learning design process

Responsive design for m-learning courses is suitable for any course in order to access to from any mobile device or browser. Design elements such as text blocks, images, and videos can be displayed without any problem. Responsive design can offer a wide range of benefits for the m-learning course, as follows:

- Provides an accessible mobile learning experience
- Increased audience reach
- Reduces costs
- Improves accessibility
- Easily maintain.

The classical application design process is linear. When a step ends, the next step begins. The progression of the steps is only in one direction but when problems occur, solutions are not performed gracefully. One of the problems of the classical application design is creating only for the standard desktop browsers. Once the responsive design implemented, the application can be used properly on desktop computers, mobile devices, and tablets (Heppard 2012). The responsive design process is shown in Figure 1.

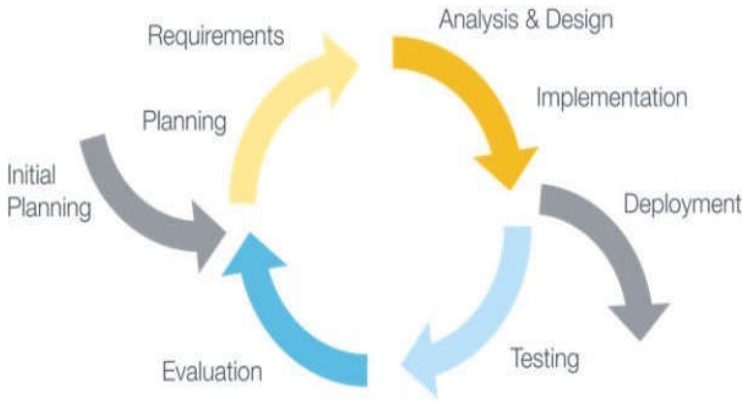


Figure1. The responsive design process, (Heppard, 2012)

Responsive design process with 5 steps:

Step1-Plan: Components should be designed for different views and the screen should not be considered as a single page. Pages are designed as a whole of sliders, content, forms, and other components. Frames should represent different screen sizes and must be fluid. A single column can be scaled to two columns from three columns and even to one column for the smallest screens of mobile smartphones.

The user experience must also be modified to interact with the small screens by touching the mouse. Frames should be provided as prototype tools rather than plans, and they should be subjected to some development and testing that are fully functional throughout the screening spectrum. If the design starts before the first test, then unknown development problems may arise. Regardless, the final vision of the project should be maintained, so communication lines between departments should be kept open.

Step2-Design: The design should contain the necessary resources and layouts and components of different sizes to better use project time. Perfect pixel designs must be allowed for responsive Web design. These designs are difficult to run on desktop scanners, but when they are considered flexible in a floving screen, the designs needed can be managed.

By using HTML, it is possible to develop fluid layout in all media. The creation of exceptions for each browser width is very time-consuming but instead focuses on the integrity of the user experience. Experience design is as important as the appearance of the site in all screen sizes.

Step3-Build: Agile and responsive processing should live on a flexible screen in the design process. Components must be planned, prototyped and tested by process developers. The codes need to be optimized to ensure that they are the smallest unit for the components. Components can be tested by simply adding and subtracting them from the original unplanned layouts, which gives them peace of mind. Continuous collaboration among the developer, designer, and strategist will solve the inevitable change problems. With different team members, problems are defined and resolved before in the process.

Step4-Test: In a responsive process, you need to test in multiple browsers and screen size, so any problem can arise early. Problems with mobile media that do not match the frames can be found in a number of different platforms as well as in design. A work project prototype can be ready, which allows users to review earlier and become win-win for all parties.

Step5-Rinse, Lather, Repeat: In the responsive approach, the same amount of progress is achieved and, advantageously, there is live code at every step for the user's presentation. This helps to continue the next stages with the discoveries made in earlier stages and foresees the changes before the deadline (Heppard, 2012).

Responsive design parameters

In order to run applications and content with different platforms across multiple devices, it is required to move from a fixed-size screen to a flexible and scrolling format. It is important to think about each page layout and "visual hooks." Each content page is a blank canvas on which to design learning concepts. So, to increase the visual skills for the new multi-device world, it is imperative to use space, color, images, and other visual elements to tie related stories together. There are some points to do:

- At first designing for the minimum device size is important.
- Understand how user feel when the text, images, and interactions showed on a small device.
- Be cautious that audio has listened and video is watched on client devices.
- Make a connection with related concepts on different length pages.
- In order to reinforce related concepts use similar images, visual headings, and color.
- Make use of follow-up resources.
- In order to convey information focus screen content and provide follow-up checklists, flowcharts, consolidate other media. (Quigley, 2015).

Minimum Device Set: Mobile learning is characterized by using mobile devices which have smaller screens than normal desktop ones. Content is squeezed down for smaller screens without multiple versions of m-learning content. Technically, mobile responsive content will adjust itself how to be displayed depending on the size of the screen. M-learning content can be delivered on devices and media having different layout features as in Figure 2.

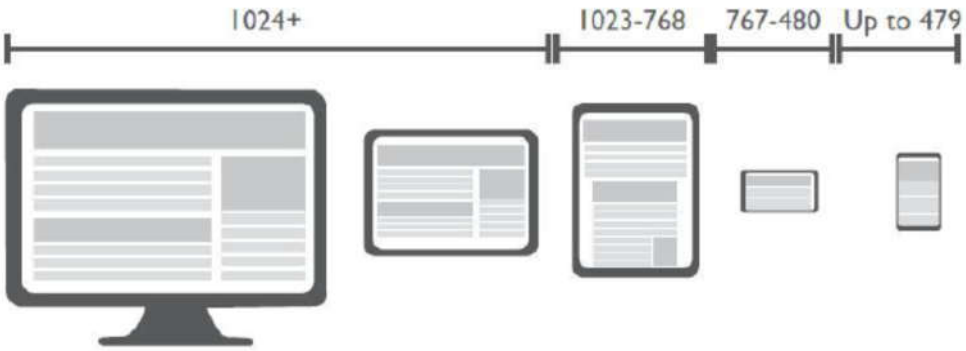


Figure 2. The content layout on different media, (Musti, Kashyap, 2013)

It is important to distinguish between applications designed for the features of a particular mobile device and the contents that will work on various devices. Therefore, it should be avoided to reduce the screen, because the cognitive load on the student is larger. It should be noted that a particular application may require specific design skills. When developing responsive design content, unnecessary content that does not serve the purposes should be removed. E-learning content needs to fit into a variety of screen sizes or scroll through pages when accessing content on a small device (Quigley, 2015).

Online learners do not want to wait for long load times when accessing e-learning content, regardless of the device or scanner they use. Therefore, it is necessary to compress the content of e-learning to reduce loading times and to concentrate on content-based areas. This means that excessive white space, which does not add any value to e-learning, eliminates unnecessary graphics and boundaries (Pappas, 2015).

Layouts: With flexibility, reconfigured, edited, and selected content can be suited for all devices and browsers with different screen sizes and resolutions. Multi-platform layouts must have a simple design and have some boundary values. It provides standard layouts in general: desktop, portrait iPad tablet and smartphones covering the largest, medium and smallest screen sizes. The breakpoints change in the standard layouts dynamically and readjust to fit screen sizes between breakpoints (Varma, 2014)

Fonts: In general, the font size of 16 and 18pt is ideal, but the headers should be slightly larger. Large text may not work well for smaller screen sizes even though it is suitable for a large screen. Also, a good contrast between the background and fonts can be adjusted to fit the screen size. The use of a fancy font instead of a vector icon is not good because the fonts are not blurred or brought together on the screen of existing devices. Serif fonts are more difficult to read on digital devices, so sans serif writing is recommended. When using Sans-serif fonts, it is advisable to avoid italics because reading tends to become pixellated. Therefore, it may be better to choose a Web-safe font (Varma, 2014).

Navigation: The navigation should be simple because it is a trap in complex navigation responsive design. Ideally, a particular device should not be focused. Instead, a suitable course flow is required for all devices. In navigation, it is necessary to avoid using

clickable images that distribute the page, and it is always necessary to use the text buttons that indicate the right direction to the learner.

Preview: Before uploading the application, you need to make sure of the viewing courses on all platforms. In all aspects of the e-learning course, it is necessary to ensure that the components are well adjusted from the images to the placement of the text on the screen. If nothing appears, you may need to make the necessary adjustments before you go back and preview it again. Previewing the following parameters is important. Application performance on different devices.

- Correct rendering on different devices
- User friendliness from the perspective of developers (ADL Mobile Learning Handbook, 2016).

Pictures and Animations: Most of the e-learning lessons include bitmap images, vector graphics, and various complex animations. Bitmap image formats can be photos or vector graphics exported as JPG or PNG. The following options are available to resize JPGs and PNGs to fit different image sizes. (Irish Institute for Education and Development - IITD, 2017).

- Scaling - To resize the structure according to the screen size.
- Cropping - Sometimes, when the images are scaled to a very small size, the details are invisible and their meaning is lost. In these cases, it is an effective alternative to clipping around a focal area that is meant to mean the image.
- Combination - Combine both approaches can be combined for dynamic cropping and then scale the images depending on the size of the device. For this purpose, images can be dynamically scaled and clipped using CSS (IITD, 2017).

Fog computing

Fog computing offers network services, storage space, computational services to the cloud servers and the end user devices. Fog computing plays major role in supporting, implementing the Internet of Things (IoT). Fog computing actually minimizes the latency, which enhance the Quality of Service (QoS). The main reason for the raise of fog computing is for the applications which are having the latency issues. When the Internet of Things is implemented billions of devices will be added into the network. The cloud computing will not be able to provide mobility support, location awareness and low latency. Fog computing promises to overcome all the problems mentioned above.

Communication devices have changed the way of communication and mobile phones have begun to extend the mobility. Tablets, smartphones, and netbooks have emerged to use the Internet of Things (IoT). IoT describes objects in the physical world and allows for any connectivity. IoT describes objects, devices, sensors, and items to connect and to be accessed (Pinola,2016). The fog is connected to the Internet of Things (IoT) devices that make up the fog nodes (Azimi et al., 2016). The following technology and market trends are drivers for IoT:

- IP-based networking: The Internet provides global connec¬tivity for users and any devices.
- Connectivity: Broadband Internet connectivity benefits for users in anywhere globally.
- Smaller and faster computing: It results in faster computing and smaller device sizes.
- Cloud computing: Cloud services allow for fast and easy access to data and content.
- Data analytics: Analytics enhances services and performance.
- Fog computing: It expands the computing facilities and services to the edge of the network by supporting end users, geographical distribution and mobility.
- Bring Your Own Device (BYOD): A policy for employees to use their own personal mobile or other computer-based devices in the workplace to access privileged organization resources (Garba, Armarego, Murray, Kenworthy, 2016).

The Internet of Things, large data streams from their devices, generate large amounts of information that can be processed and used to create useful services for end users. Fog Information architecture recommends that IoT devices first analyze a local point and send it to central servers, unlike the architecture that allows the data to be sent and processed to a cloud server (Ducange et al. 2017). For product and engineering teams designing IoT systems, the core challenge lies in taking IoT use cases and turning them into a connected system – with full integration, the right IoT communication protocols, security, and a user-friendly look and feel. For industrial manufacturing, IoT product design is also known as Industry 4.0 design. There are four universal design principles shaping IoT design today:

Interoperability: At the most fundamental level, a connected system requires sensors, machines, equipment, and sites, to communicate and exchange data. Interoperability is the underlying principle throughout all Industry 4.0 design processes.

Information transparency: The rapid growth of connected devices means continuous bridging between the physical and digital worlds. In this context, information transparency means that physical processes should be recorded and stored virtually, creating a Digital Twin.

Technical assistance: A driving benefit of IoT, technical assistance refers to the ability of connected systems to provide and display data that helps people to make better operational decisions and solve issues faster. In addition, IoT-enabled things should assist people in laborious tasks to improve productivity and safety.

Decentralized decisions: The final principle of Industry 4.0 design is for the connected system to go beyond assisting and exchanging data, to be able to make decisions and execute requirements according to its defined logic (Seebo, 2019).

Based on time and location information, the fog architecture completes and interacts with nodes instead of completely replacing the cloud. In fact, the fog compiles cloud computing information, and both share the same resources and most of the same mechanisms. The need to accurately analyze the data to be obtained at the right place, in the network and at the time, has increased with the use of intelligent sensors, devices, and IoT.

The following innovative features are typical features of architectures (Numhauser and Jonathan, 2013).

- The game focuses on a very low and predictable delay for augmented reality that requires video conferencing, fast response and small vibration
- The geographic distribution and availability of fog nodes are less distributed than scattered but non-intuitive sensors by central cloud servers
- Place and content awareness is useful for applications where information about the place plays an important role
- Exploitation of rapid mobility
- Use in large-scale distributed control systems
- Flow and real-time for continuous monitoring and early prevention
- Heterogeneity of the fog
- Interoperability between different areas
- Processing of data at the place where the data is generated
- Low bandwidth workability
- Security and privacy (Abdelshkour, 2015).

METHODOLOGICAL APPROACH

In order to conceptualization the fog-based learning structure as the interaction between cloud and fog it is required to communicate through internal Application Interfaces (APIs). The cloud division is responsible for time-based backup and large storage operations, and data mining techniques that require a lot of time (Pecori, 2018). A data storage that is located at the center of the fog computing structure can be accessed by both device layer and fog layer (Cha, 2018). The fog computing structure provides some advantages as follows:

- Reduced network load: In the fog computing structure, the amount of data flowing into a network is reduced because computation is conducted at a network edge near IoT devices.
- Mobility support as a default function: The Mobility according to reliability is a fundamental requirement to many IoT applications. The device resources like smart phones and laptops may provide physical or virtual mobility to support a mobile IoT application.
- Context awareness: In the fog computing structure, resources provide context awareness relating to data created by a sensor. The device resources play roles in combining data at a sensor, using position or application context.
- No single defective point: As calculation is completed in a distributed way in fog computing, the model does not have a single defective point. Several snapshots of an application can be allocated at a cloud to improve reliability.

Fog Computing-enabled Content-Centric Networks

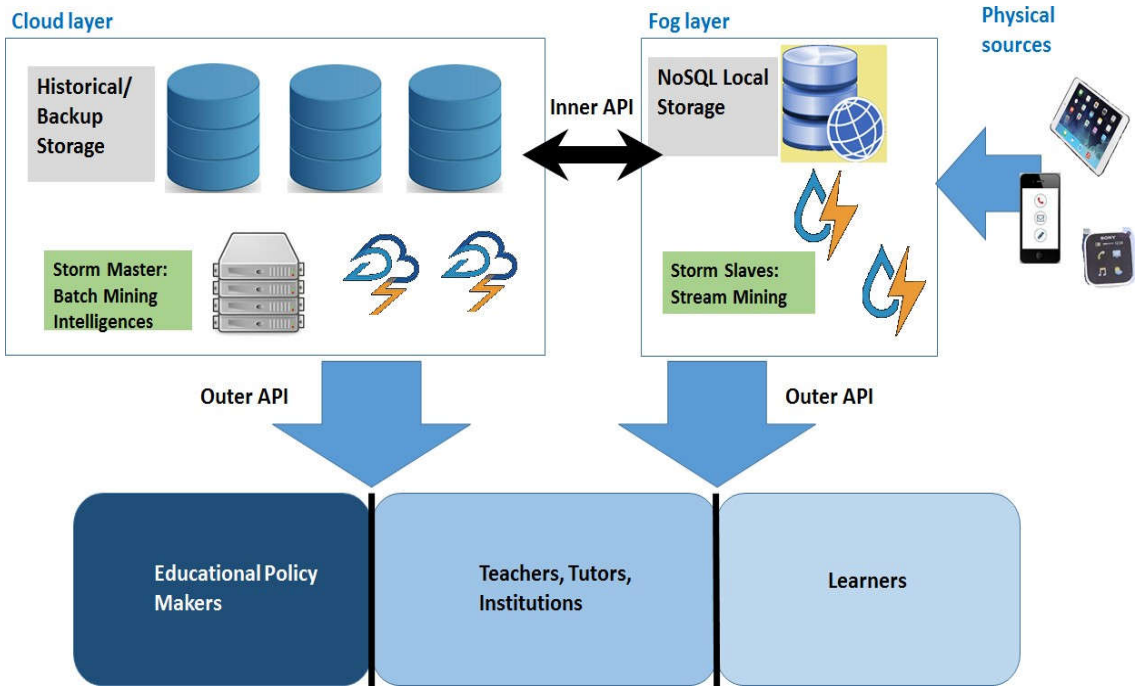
Fog-enabled mobile network (FMN) and content- centric mobile network (CCMN) can be used for both the service quality and resource utilization of the mobile networks.

Content centricity, naming the data and caching popular content at network edges can reduce duplicate content transmission in the mobile network, speed up the incident response and improve the utilization of network resources. It is beneficial to extend the fog computings principles to manage the caching resources (Wang, 2017).

The fog section consists of lightly NoSQL data storages and various internal network operations (local area network or sensors and tools). They can be used to calculate various features to make them useful and to make short-term forecasts to always interface with other users, such as teachers, teachers, and students, through external application interfaces (Pecori, 2018).

External Application Interfaces can operate according to a subscriber/notification paradigm that allows nodes for acting as mediators. This shows that some stakeholders are subscribing to some data streams or estimators and get information when possible with some notifications. On the other hand, the internal Application Interfaces operate according to a push/pull model in which the requests and commands are directed to the cloud when the data streams depend not only on the fog layer but also on the data stream. Moreover, while the internal Application Interfaces guide both control and data information, external stakeholders often carry mainly educational content to offer to stakeholders how to tune their educational activities as shown in Figure 3 (Pecori, 2018).

Figure 3. A general overview of the fog-based m-learning structure, (Pecori, 2018)



There is a change in presenting online work assignments through student portals where data is stored in the cloud. While implementing common office applications, messaging services, and virtual desktops, schools support web-based services for students and parents, as well as support more specialized training applications. Below are three ways fog information can affect classes (Collier, 2018).

Setting Up Network Traffic: In fog computing, microdata centers provide on-site technology that can be scaled up and down with the requirements of the school. For example, after school, system capacity may have a traffic increase due to students accessing both employees and LMS (Learning Management Systems). During this time, the infrastructure has to be scaled to overcome traffic and the performance does not fall, but everyone has to count down if they exist. These difficulties continue to be higher in academic disciplines, even in higher education (Collier, 2018).

In order to work efficiently, the connection and network communication should be the number one priority. However, these schools can be a challenge for many distributed organizations, especially those spread over various campuses. Delays can be eliminated for a continuous and better user experience by bringing data in place locally. Also, some campuses may not have IT staff. The benefit of the fog computer is that trained IT professionals can perform remote management of tasks. The most important way to do most of these tasks alone is not only because of the cost of going to these sites but also to minimize downtime due to delayed response times due to travel (Collier, 2018).

Improving User Experience: Technology in the classroom has become a new norm because educators are looking for new ways to use computers and online resources in education. Schools with more than one campus are touching the fog computer as a sustainable solution to support educational institutions due to their ease of use and impact on user experience. More specifically, educational institutions work similarly to remote location and branch office organizations with similar IT needs. The fog calculation is a localized calculation that can be deployed quickly and easily, away from the primary data center where performance and reliability are required.

The fog calculation decentralizes the computing resources and brings them closer to the data source. When schools use for calculation, they prioritize the link and network at various campuses to eliminate slow speeds, which significantly increases the experience of students and teachers (Collier, 2018).

Using Digital Tools: Educational institutions provide students with external access to digital libraries and online application portals throughout the day. The fog computer system offers agility to operate efficiently and effectively from the main site and multiple devices. Fog computing technology improves training operations and provides a platform with agility against slowing or stopping them (Collier, 2018).

DISCUSSION

Today it is possible to achieve a high level of teaching and learning by using mobile learning environments, responsive design process, and tools that will make training easier and effective. Mobile courses with responsive design provide opportunities for teachers and students to engage in exciting and innovative learning experiences. The use of responsive m-learning in fog-based computing enables students to engage the courses in both real-time and at asynchronous learning events. Mobile technologies are more widely available at a reasonable cost, and without infrastructure problems using IoT in fog computing environment which performs computing functions on network edges as a front-end

distributed computing archetype for education. The huge benefit of m-learning is that tomorrow's students will be digital natives using IoT (Elsaadany and Soliman, 2017). The responsive design process must also take into consideration the constraints involved in all phases of the training design and implementation. It is a fact that there is no one-size-fits-all approach to the design of m-learning, because each course is unique, and each design process requires responsiveness. The architecture that can be used with responsive m-learning with seamless and low latency mobile devices can be fog-based architecture. Fog computing expands the responsive m-learning application facilities and services to the edge of the network users and mobility in fog. Fog-based responsive m-learning architecture can be used by teachers and students via the use of different mobile devices effectively with desired outcomes.

CONCLUSION

In this article, we present the data flow and fog based e-learning framework for learning purposes in the literature. In addition, suggestions were made to demonstrate the applicability and usefulness of the identified architecture. The proposed advantages can be presented as accurate determination of students' performances in real time, places and times of study, development and participation of students. However, the integration of technologies, user acceptability and innovation in the fog computer, the use of sensors, tools and smart objects in general will be maintained without slowing down. In addition, students' grades and performances can be examined, personalization and measurement and analysis can be done. Evaluating response times and data transfer rates in fog computing, the use of social relations between students and their own devices can be made for further researches that strengthens and enriches the architecture offered.

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