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Title: Wordshark: A Computer-Assisted Programme

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Computer-assisted programmes have been described as ‘an educational or instructional technique that is based on a two-way interaction between a student and a computer that is used to promote human learning and understanding’ (UNESCO, 1987, as cited in Chueng and Slavin, 2012, p. 201). With the rise in popularity of social media, mobile devices and tablets, computer-assisted learning has been posited as a more relevant and student-centred approach to learning in the 21st century (Tan and Chua, 2011). In particular, programmes designed to enhance children’s phonological awareness have become widely available worldwide.

Wordshark (Savery and Burton, 1995) has been described by Singleton and Simmons (2001) as, ‘a multisensory, drill and practice computer programme which aims to improve children’s spelling and word recognition skills’ (p.317). Wordshark presents information through sound, text, visual imagery and animation, and is designed to be a freestanding addition to a structured literacy programme for children aged five to 15 years of age (Singleton and Simmons, 2001). It provides children with the opportunity to consolidate their learning of a particular group of suffixes, consonant diagraphs or commonly misspelt words.

In total five versions of the Wordshark software have been developed by Savery and Burton (1995). For the purposes of this academic critique the title ‘Wordshark’ will be used generically to denote all versions of the software. Originally the content of Wordshark was based on the phonic word-lists and cumulative, didactic structure of the Alpha-to-Omega programme, created by Hornsby and Shear (1975). More recently Wordshark has incorporated word-lists from the National Literacy Framework and the Letters and Sounds phonics scheme. The most recent version (Wordshark 5) includes over 60 games, 9,000 pre-recorded words, the option to add personalised word-lists and printable resources.

In 2001 Singleton and Simmons suggested that Wordshark was used in approximately 10-20% of UK schools. However, as it is sold through various distributors and is popular for home use, more exact and up-to-date figures are unavailable. Nonetheless, Wordshark is considered as one of the leading drill-and-practice computer programmes for developing phonic skills nationwide (Singleton and Simmons, 2001).

Limited published research currently exists which directly evidences Wordshark's efficacy in terms of outcomes for learning. In order to support a fuller understanding of the programme, this critique will explore the proposed mechanisms which are claimed to underpin the programme's effectiveness.

Research and Theory

Substantial empirical evidence supports the view that a child's acquisition of fluent word decoding is dependent upon the quality of their phonological representations (Harm and Seidenberg, 1999). Rose (2006) suggests that, 'high quality, systematic phonics offers the best and most direct route to becoming skilled readers'. Wordshark is based on the assumption that phonological awareness is a major cognitive prerequisite for the acquisition of the mappings between graphemes and phonemes, which themselves provide the foundation of reading acquisition (Ramus, 2001). Research has suggested that, in order to achieve the accurate phonemic decoding skills necessary to acquire automatic word recognition, explicit, synthetic phonics instruction is required (Ehri, Nunes, Stahl and Willows, 2001).

Wordshark adopts a drill-and-practice approach to learning and there is evidence that this can support the development of children's phonological decoding skills (Hannaford, 1983). The creators, Savery and Burton (1995), suggest that children should use Wordshark approximately three or four times per week, lasting for around ten to fifteen minutes per session. Evidence suggests that children with phonologically based reading disabilities

require more frequent and intensive instruction in order to develop the same fluency and automaticity as skilful readers (Wolf and Bowers, 1996).

There is a large body of evidence to support the view that systematic, synthetic, phonics instruction is more effective than non-systematic, analytic phonics instruction in the teaching of encoding and decoding skills required for reading (Ehri et. al., 2001; Torgerson, Brooks and Hall, 2006). However, there is less consistent evidence that the former instructional method is better than the latter in improving children's comprehension (De Graaff, Bosman, Hasselman, & Verhoeven, 2009). Systematically learning letter-sound relationships, through programmes such as Wordshark is, therefore, not enough to develop reading skills in isolation. It has been argued that children must know how to apply knowledge to the reading of text in order to contextualise language (Poulson & Avramidis, 2003). Whole-book reading should therefore be advised alongside systematic phonic programmes, such as Wordshark, to provide children with a more authentic learning experience.

Wordshark also markets itself as a multi-sensory programme. Different sensory channels are engaged when children actively manipulate letter and word-components by hearing, seeing, constructing, deconstructing, playing and repeating constructs (Montali and Lewandowski, 1996). Digitised speech feedback is one strategy employed by the programme which enables children to make immediate associations between graphemes and phonemes (Foster, Erickson, Foster and Brinkman, 1994). Jiménez et. al (2007) explained that:

> The computer can also orthographically segment and 'speak' the word at syllable and sub-syllable levels and the simultaneous highlighting of the orthographic segment and the presentation of its corresponding speech sound provides a powerful means of

emphasising the relations between groups of letters and their sounds during reading. (p. 53).

The idea that 'learning experienced through all the senses' is helpful in reinforcing the teaching of phonics has a long history in pedagogy. Some believe this has its roots in the multisensory Orton-Gillingham (O-G) approach to reading (Vickery, Reynolds and Cochran, 1987). However, in 2010 a US Department of Education agency produced a report entitled 'Orton-Gillingham based strategies'. It concluded that it could not find any studies, meeting rigorous evidence standards, to support the efficacy of the O-G, multisensory components in structured reading instruction. Despite the lack of evidence supporting the effectiveness of multisensory techniques, including the use of animation and computer graphics, it is clear that these would have appeal to children living in a technological age. For demotivated children, in particular, this could help promote engagement in literacy.

Wordshark has been described as a motivational resource by the teachers who use the programme, according to qualitative research conducted by Singleton and Simmons (2001). According to the Self-Determination theory (Ryan and Deci, 2000) humans have three innate psychological needs which form the basis for self-motivation: competence, autonomy and relatedness. Children who struggle with reading and literacy may have experienced failure at school which has affected their perceived levels of competence and self-efficacy (Bandura, 1993). As Wordshark can be tailored to a child's individual pace of learning it has the potential to create frequent opportunities to achieve success. At the end of each activity there are also reward 'games of chance' where extra points can be played for, and this can help to build esteem and heighten feelings of confidence.

In terms of developing a 'sense of autonomy' the programme provides children with immediate feedback, choice and control over their learning. However, it should be noted that

the software does not provide children with 'a sense of relatedness'. Relatedness has been described as the universal want to interact and be connected to others (Baumeister & Leary, 1995). Wordshark is designed for individual use and so there are no opportunities for collaborative learning with peers or adults. In addition, computers do not provide children with personalised, social-emotional feedback which can help children self-regulate and persist for longer at a task (Webster-Stratton, Reid, & Stool-Miller, 2008).

Empirical Evidence and Evaluation

It is difficult to assess Wordshark in relation to outcomes for children, as there has only been one published evaluation of the programme since its origins in 1995. This was produced by Singleton and Simmons (2001) who issued a 20-item questionnaire to primary and secondary schools in the UK who had purchased Wordshark. A total of 403 schools participated in the study. The study found that 96% of teachers felt that their students were more motivated using Wordshark, to practice their encoding and decoding skills, than participating in other classroom work. In addition, over 93% of respondents claimed that children made improvements in their reading and spelling after using Wordshark.

The results from the study should, however, be interpreted with caution. The report relied on the subjective opinions of teaching staff derived from questionnaire measures and were not supported by objective, empirical findings. It could also be suggested that the findings lacked validity. The study found that 80% of primary schools and 87% of secondary schools, 'occasionally used Wordshark with a pupil working independently'. It would, therefore, have been beneficial for the study to collect data from the young people who use the programme, to account for times when teachers are not directly supervising their students. Nevertheless, Singleton and Simmons' (2001) data suggests that Wordshark is popular with

students and teachers alike, and is perceived by educational professionals as a motivational tool.

As a result of poor methodological rigour, Singleton and Simmon's (2001) evaluation has not been included in any of the large, published meta-analyses which have reviewed the effectiveness of computer-assisted technologies on reading since the 1980s (Archer et al., 2014; Becker, 1992; Campuzano, Dynarski, Agodini and Rall 2009; Cheung and Slavin, 2012; Kulik, 2003). Many of these meta-analyses have revealed inconsistent findings and this has been attributed to methodological inadequacies in the research. Often computer-assisted programmes are considered 'supplementary' reading tools which accompany one-to-one tuition, small group interventions or other teaching strategies, known to be effective without technology (Cheung and Slavin, 2012). It is therefore difficult to isolate the unique contribution of the software.

The consensus of major meta-analytical studies suggests that computer technology generally produces small to moderate effects on reading. Effect sizes (ES) ranged from +0.02 - +0.04 (Campuzano et al., 2009) to +0.43 (Kulik, 2003). Cheung and Slavin's (2012) recent review of the research suggested that the higher the methodological quality of the study, the lower the effect size. On the basis of these results some have called into question the effectiveness of literacy based technological applications (Campuzano et al., 2009).

Campuzano et al. (2009) conducted an experimental study in which teachers were randomly assigned into two groups: one used a range of computer software products to supplement the core reading and numeracy curriculum and one did not. A range of quantitative data, including test scores, was collected to assess the effectiveness of the software products on increasing student's academic achievement over two years. In the first year 16 software products were assessed in 132 schools and students were tested twice a year

using the Stanford Achievement Test reading battery. Observational data and data from school records was also collected. In the second year the experiment was repeated with the same teachers, but a new cohort of pupils. This was in order to assess whether teaching experience impacted on test scores. The study found that student test scores were not statistically significant from zero between classrooms in either the first or second year of the study. Only one software product was found to have a positive, statistically significant effect on test results.

Campuzano et al.'s study (2009) has many implications for the use of software products in schools. Replacing whole-class teaching with computer-assisted technologies has not yet been found to produce meaningful improvements on students' reading test scores. This may be because computer programmes cannot mirror the rich environment for learning which classrooms provide. This includes opportunities for collaborative, peer work and quality communicational dialogue between teacher and student (Stone, 1989). Campuzano et al.'s (2009) findings have been corroborated by a large meta-analysis conducted by Cheung and Slavin (2012). They also did not find any meaningful effects in reading scores for K-12 (reception age) students when class-teaching was supplemented with software programmes (ES= +0.11).

It should, however, be noted that these studies evaluated the effectiveness of a narrow range of software products which 'replaced' classroom teaching. There has not been a meta-analysis, known to this study, which has solely explored the effectiveness of software products used 'in addition' to classroom teaching. There are currently too few randomised studies to warrant firm conclusions and more controlled, empirical research is required (Cheung and Slavin, 2012).

Implications for Educational Psychologists and Wider Application

Educational Psychologists (EPs) are in a position to provide training to schools about the efficacy of Wordshark and other computer-assisted literacy interventions. They should help schools develop criteria which can be referred to when purchasing computer-assisted literacy programmes. Schools should be advised to explore the pedagogical rationale of software products and the empirical evidence in support of these programmes.

There are many alternative uses of such 'pedagogically sound' software programmes which EPs can propose. Research suggests that children 'at risk' of reading difficulties should receive both effective classroom instruction *and* intensive, systematic interventions (Torgesen, Wagner, and Rashotte, 1997). As Wordshark follows well-established, synthetic phonological programmes it could have value in supporting children whose phonological awareness and letter knowledge skills have not become automatic through whole-class instruction alone. The programme could, therefore, be used as part of an additional after-school literacy session, such as a homework club, or as a home-based intervention.

There is emerging evidence to suggest that home-based computer interventions can produce positive results for children 'at risk' of reading difficulties. Zijlstra, Koomen, Regtvoort, and van der Leij (2014) found that 87% of non-professional tutors (parents and volunteers) were able to provide children with sufficiently high levels of support using individualised computer-supported reading interventions. The results from this mixed-methods study suggests that long-term, home-based interventions can support 'at risk' children and be a cost-effective way to prevent reading failure. Further research is required to corroborate these findings as there were only 32 participants in this study. However, these are encouraging findings which suggest that programmes, such as Wordshark, could produce positive outcomes when used in the home. It should be cautioned that this would require parents to collaborate with schools to ensure that their children are working at the correct levels and that classroom learning is being reinforced.

Summary

In summary, there is little doubt that the use of educational technology will continue to grow in the future. It is the EP's role to provide training to schools about the use of these technologies before they reallocate or invest in new resources. EPs should emphasise that current research warns against computer-assisted technologies replacing or supplementing whole-class teaching. There is, however, potential for 'pedagogically sound' software, such as Wordshark, to be used as an additional learning tool. This would be particularly beneficial for children 'at risk' of reading difficulties who require more systematic and intensive support.

EPs should also disseminate research which suggests that systematic, computer-assisted, phonic programmes should be used in conjunction with more realistic and naturalistic approaches to reading, such as engagement with whole-books (Poulson & Avramidis, 2003). Social-emotional support should also be provided to children who engage in computer-assisted learning in order to boost levels of motivation and task perseverance (Caprara, Barbaranelli, Pastorelli, Bandura, and Zimbardo, 2000). Looking forward, more randomised, controlled studies are required to determine whether empirical data supports the suggestions made in this report.

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