High-tech Classroom Management: Effects of an App on Disruptive and On-task Classroom Behaviours for Students with Emotional and Behavioural Disorder
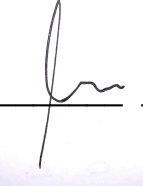
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PhD Thesis, 2020

Acknowledgments

Declaration

This work has not previously been accepted in substance for any degree and is not being concurrently submitted in candidature for any degree.

Signed:_____(Candidate).

Date: _____01.10.2020_____.

Statement

This research thesis is the result of my own investigation, expect where otherwise stated. Other sources are acknowledged by giving explicit references. Some raw data and other evidence are appended.

Signed:_____ (Candidate).

Date:_____01.10.2020_____.

Contents

Abstract

Students with emotional behavioural disorders may exhibit extremely challenging behaviour and/or emotional problems that interfere with their academic achievement and social relationships. Failure at school frequently leads to a succession of poor life outcomes, including increased rates of unemployment or underemployment. Increasing on-task behaviours and decreasing disruptive classroom behaviours is of crucial importance. If successful, this may promote positive experiences and outcomes through effective learning, enhancing quality of learning and, ultimately, greater opportunites in life. Most classroom management programmes involve packaged procedures, including clear instructions, rules and guidelines, use of reinforcement and punitive consequences, and feedback. Although these often yield rapid and positive outcomes, they be at high cost and are time-consuming and complex to apply. Due to limited budgets, many educational settings cannot afford these programmes, leaving students with a poor-quality learning experience. This study evaluates a high-tech approach to classroom management by examining the effects of a mobile application (App) 'iOwnLearning' that faciliates a low-cost dual-component intervention that embeds both a sense of control and predictability into the classroom, as a means of increasing on-task behaviour and decreasing disruptive behaviours for four individuals with emotional and behavioural disorders. The procedure involved two hours of training for teachers in how to upload their lesson plan to the App on their mobile phone and how to broadcast it on screens in the students' classrooms. Students saw an image or cursor on their classroom screen which continued to move throughout and in parallel with the course of the lesson, and indicated specific key markers reached along the way for the different segments and class time remaining. A multiple-baseline design across participants was used. The data suggested that the App can be used effectively as an affordable high-tech tool for classroom management. Although the outcomes were below efficacy levels illustrated in other multi-procedure programmes, the App may be preferable to educational environments based on its accessibility, innovation and motivational qualities. *The mobile Application (**iOwnLearning**) developed and discussed within this research is available from the author.

Introduction

Emotional and Behavioural Disorder

Emotional and Behavioural Disorder (EBD) refers to emotional, behavioural or psychiatric disorders, including attention deficit hyperactivity disorder, depression, and mood or anxiety disorders (Kaufman & Landrum, 2013; Markelz & Taylor, 2016; Morse, Cutler and Fink, 1964). Typically, individuals with EBD are characterised by both internalising behaviours, such as fear and anxiety, and externalising behaviours, such as aggression and vandalism. The former includes symptoms of depression, anxiety, social withdrawal, unhappiness, fear, isolation, phobias and low self-esteem, whereas the latter includes conflicts with others, delinquency, hyperactivity, disruptive behaviour and aggression (Ogundele, 2018; Smith, 2010). In educational environments, students with EBD may exhibit extremely challenging behaviour and/or emotional problems, such as anxiety and anger, that interfere with academic achievement and social relationships (e.g. Smith, Katsiyannis, & Ryan, 2011). They present with a host of poor academic, social, emotional and post-school outcomes, and higher rates of disruptive and off-task classroom behaviours than typically-developing individuals (Steiner et al., 2013). Researchers have also found a tendency toward course failure, lower average grades and absenteeism; the latter was found to be strongly linked to poor academic outcomes, disruptive behaviours and aggression (Bradley et al., 2008; Greenbaum et al., 1996; Lane et al., 2008; Wagner et al., 2005). In turn, disruptive behaviours have a negative impact on teachers' instructional time and impede classroom learning, making it less likely that students will succeed academically (e.g. Ling et al., 2011). Students with EBD are also more likely to experience disciplinary exclusion (U.S. Department of Education, 2016; Smith et al., 2011; U.S. Department of Education, Office for Civil Rights, 2014) and are at greater risk both of being placed in more restrictive settings than students with other disabilities (U.S. Department of Education, 2016) and becoming involved in the criminal justice system (Newman et al., 2009).

Failure at school frequently leads to a succession of poor life outcomes, including increased rates of unemployment or underemployment (Sanford et al., 2011). Longitudinal research reports that more than 50% of students with EBD dropped out of school, and

fewer than 50% of those who remained at school graduated with a diploma (e.g. Wagner et al., 2005). Moreover, 20% were arrested at least once before they left school, and more than 50% were arrested within a few years of leaving school. Among those who dropped out, 70% were arrested (Van Acker, 2004).

In this context, increasing on-task behaviours and decreasing disruptive classroom behaviours for students with EBD is of crucial importance as a proactive strategy. If successful, this may promote positive experiences and outcomes through effective learning (Sutherland et al. 2008), and additionally decrease teacher attrition and high turn-over, ultimately enhancing the quality of learning and – even more importantly – the quality of life of students, their families and educational personnel.

Quality of Life

The importance of quality of life has been increasingly recognised in the field of special education. Over the past twenty years, quality of life has increasingly become a student-centred concept, stimulating researchers to develop new ways to define and measure improvements, with an emphasis on individualisation: students' own needs, preferences, learning habits, ways of communication and learning (Clair et al., 2018; Cohen, 1990; Fraser, 2002; Jonsson et al., 2016). In a study examining differences in quality of life between students with EBD and their non-EBD peers, Sacks and Kern (2008) found that the former were significantly more dissatisfied with their quality of life, and so were their parents and school personnel. Over the years, leading scholars in the area of EBD have developed a range of practices, considerations and systems aimed at increasing on-task learning and decreasing disruptive classroom behaviours with the ultimate goal of enhancing quality of learning and life. For example, In June of 1990, 12 leaders in the EBD field met in Charlottesville, VA to review the basis for criticisms against special education services for students with EBD (e.g., Morse, Cutler, & Fink, 1964), outline the current state of knowledge in school-based interventions, and develop recommendations for policy and practice improvements (The Peacock Hill Working Group, 1991). The outcome of the meeting was an article in Behavioural Disorders that outlined seven key features of successful strategies; systematic data-based interventions, continuous assessment and monitoring of progress, provisions for practice of new skills, treatment matched to problem, multicomponent treatment, programming for transfer and

maintenance and commitment to sustained interventions. Furthermore, in 2004, researchers identified several strategies; teacher praise/reinforcement; opportunities to respond; clear instructional strategies; and positive behavioural supports such as functional assessment-based planning, self-management, social skill instruction, and school-wide positive support planning as research-supported practices for students with EBD (e.g., Lewis et al., 2004; Odom et al., 2005). Nonetheless, other researchers provided contradicting results suggesting much of these strategies suffered from a research-to-practice gap (Carnine, 2000). Carnine explained many educators experts have not embraced the use of rigorous scientific research to identify effective methods. In additional, Carnine suggested this was not the only variable that affected their judgments. In other cases, what prevented education experts from being guided by scientific findings was a misunderstanding of the inerent limits of descriptive or qualitative research. More fundamentaly, Carnine suggested many education experts hold many years experience (some decades), and are so used to teach the way they teach. In essence, many relatively short-term behavioural skill training intervention programs are likely to fail when trying to compete with years of practiced experience. Such experience are often based on punitive approach and ineffective strategies aiming to increase on-task and reduce disruptive classroom behaviours. Inevitably, this is likely to leave many education experts frustrated fuelling teacher attrition and high turnover. At present, there are several empirically-validated behavioural support strategies (e.g. Epstein et al., 2008; Lewis et al., 2017). An effective evidence-based framework that has been applied within educational environments in recent years is school-wide Positive Behaviour Support, a variation of the Positive Behaviour Support framework. Lewis and colleagues (2017) introduced the Multitiered Systems of Support (MMTS) to ensure that students with EBD are more likely to experience success and to ensure that educator experts asked to work with challenging students also experience success. Researchers suggested to focus on three main areas; supporting teacher behaviour, student behaviours and supporting decision making together these base school-wide Positive Behaviour Support.

Positive Behaviour Support

Positive behaviour support (PBS) is a person-centred approach which seeks to enrich the quality of life of individuals who display challenging behaviour by drawing on behavioural interventions and valued outcomes, and by promoting choice, inclusion and

equality in the community (Gore et al., 2013). A review conducted by LaVigna and Willis (2012) found PBS to be an effective approach for individuals with severely challenging behaviour. With the goal of improving quality of life, PBS emphasises the use of proactive interventions and strategies to support such individuals.

School-wide Positive Behavioural Support (SWPBS) (Sugai & Horner, 2006) is implemented by more than 20,000 schools in the United States and internationally (Borgen et al., 2020; Gage et al., 2018). Its primary aim is to address social and behavioural concerns in schools. A substantial body of literature demonstrates the impact of SWPBS on reducing disruptive behaviour and improving appropriate on-task classroom behaviours (e.g. Lewis et al., 2016; Sorlie et al., 2015). SWPBS is also seen as promoting academic achievements and effective classroom management (Evertson & Weinstein, 2006; Korpershoek et al., 2014). By definition, effective classroom management is the process of organising and conducting a classroom in order to enhance learning, on-task behaviours and life quality (Kellough & Kellough, 2011). Henley (2010) identified effective classroom management as an essential teaching skill and suggests that effective teachers minimise disruptive behaviour and enhance on-task classroom behaviours and learning environments that allow for students' intellectual and emotional growth. Wong and Wong (2014) believed that classroom management encompasses all that a teacher does to organise students, space, time and materials so that student learning can take place. McDonald (2010) suggested that classroom management involves teacher actions and instructional techniques to create a learning environment which facilitates and supports active engagement in academic, social and emotional learning. In addition, several empirical studies have documented the effect of SWPBS on students with, or at risk of, EBD (e.g. Doyle et al., 2016). These studies were conducted in a variety of settings, including elementary schools (Cheney et al., 2008; Lane et al., 2008; Willis et al., 2010), secondary schools (Ness et al., 2011), public schools (Lane et al., 2002; Little et al., 2010; Marchant et al., 2007), and alternative education settings (e.g. McDaniel et al., 2016). To date, such research has used single-case designs (Kamps et al., 2011; Lane et al., 2010). Generally, many of the studies conducted – most of which used proactive, effective, multi-component interventions – have provided empirical evidence that SWPBS has a positive impact on social and academic behaviours for students with or at risk of EBD (Lane et al., 2002; Little et al., 2010; Marchant et al., 2007).

Effective, Affordable and Feasible

Despite the evidence for the use of common multi-component classroom interventions, their effectiveness may be limited due to two primary considerations: the high costs involved, and the number of skills that teachers need to master for this endeavour within a short period of time relative to years of acquiring and practising other teaching skills (Bradshaw et al., 2015). In a recent study, Hickey et al. (2017) investigated the efficacy of a universal multi-component classroom management training intervention (summarised in Table 1). Amongst other elements, the intervention included the establishment of rapport, providing clear rules and instructions, giving attention to appropriate and adaptive behaviour, and ignoring disruptive classroom behaviours.

Session 1	Preventing behavioural problems: The proactive teacher
Session 2	The importance of teacher attention, coaching, and praise
Session 3	Motivating children through incentives
Session 4	Decreasing inappropriate behaviour
Session 5	Teaching children to be socially competent: Emotional regulation, social skills and problem solving. Group discussions, videos and role-playing are used to support teacher skill development.
- Coaching and monthly telephone calls are provided by group facilitators to support the implementation of classroom management strategies. - Teachers keep a written diary of their progress. - Barriers to attendance are addressed through the provision of substitution costs to schools. - Participating teachers are provided with refreshments during the sessions.	

Table 1: The five phases of the universal multi-component classroom-management training intervention (Hickey et al., 2017).

In addition to examining the impact of the multi-component classroom intervention on teachers' and pupils' behaviour, Hickey et al. also assessed its affordability and feasibility. They found that, despite the knowledge gained within the field, teachers frequently reported difficulties in coping with disruptive behaviours that arose in the classroom. Furthermore, many lacked knowledge of research-based strategies and practices which can promote positive learning environments (Reinke et al., 2011, 2014; Webster-Stratton et al., 2008). Moreover, the researchers found that this type of intervention was not as effective as they expected for either pupils or teachers:

> The findings from the robust regression analyses of observed child behaviour did not reveal any statistically significant effects of the intervention. *(Hickey et al. 2017, p.190)*

In addition, the intervention proved to be very costly (involving training time, travel and accommodation costs), making it unaffordable and not feasible to implement more widely (see Table 2).

	Total cost of programme	Average cost per teacher	Average cost per client
Non-recurrent initial training cost	€2428.02	€220.73	€11.04
Pre-delivery cost of programme	€6593.22	€599.38	€29.97
Group costs	€5266.30	€478.75	€23.94
Substitution cover	€7904.59	€718.60	€35.93
Total	€22,192.13	€2017.46	€100.87

Table 2: Costs of intervention provided by Hickey et al. (2017) spread across teachers, pupils, and trainers.

Brady et al. (2019) explain that multi-component classroom management programmes may only be effective when they are also affordable, feasible and – more importantly – generalised and maintained. Furthermore, researchers have stressed the significance of monitoring treatment integrity to ensure that the intervention is implemented precisely as planned. It may well be that, to be classed an *effective* intervention, it must also be affordable and feasible; only then may it be implemented and evaluated as contributing positively to behavioural change.

It appears, therefore, that multi-component programmes may have certain limitations in terms of affordability and economic feasibility (Iwata et al., 1976). In addition, due to the lack of component analysis, researchers cannot attribute outcomes to a single variable, thereby adding ambiguity in terms of the relevant contributory factors. Many schools may not be willing or financially capable of implementing lengthy multi-component programmes, particularly with the staggered introduction inherent in some research designs, which requires additional resources, and delays on-site training and teaching (Stolz, 1976). Ethical considerations are, therefore, also important (Barrett et al., 1991; Menendez et al., 2017), because lengthy, complex programmes often delay learning and,

thus, outcomes. Not only does an extended period of teaching involve high costs, but it may also be neither effective nor efficient. For example, training based on simulations is less effective than on-site training (e.g. Salas et al., 2009), and acquiring the skills to enhance on-task learning and reduce disruptive classroom behaviours in the normal teaching environment requires that training be provided in this environment (Ricciardi, 2005). On-site training also provides the opportunity to shape the behaviour of both teachers and students, potentially reducing the time required to acquire skills, and this makes such programmes potentially more affordable, feasible and likely to succeed (Brady et al., 2019).

High-Tech Classroom Management

High-tech classroom management aims to encompass the accessibility, affordability and feasibility of effective classroom management intervention programmes through the utilisation of technology. In recent years, we have witnessed the development and improvements in information technology, the integration of communication networks and the growing use of mobile digital media (consisting mainly of smartphones and tablets) which have permeated various aspects of learning in an affordable manner (Curran et al., 2019). Such mobile devices are intended to assist students' learning, and mobile learning has been developed under a new social development model. Due to the advantages of portability, the ability to access information at any time and inherent affordability, mobile learning tools are being used increasingly for high-school teaching (Wang et al., 2017).

Since 2007, mobile phones using Apple's iOS or Google's Android systems have taken over the mobile market. Today, the number of smartphone users worldwide exceeds three billion and is forecast to increase further by several hundred million in the next few years (Holst, 2019). China, India and the United States have the highest number of smartphone users, with well over 100 million users in each of these countries (Holst, 2019) – for example, 56% of Americans now own a smartphone (Arthur, 2014). Such accessible and commonly used devices are attracting software developers to design third-party mobile applications.

Mobile Applications

Third-party mobile applications (Apps) are software programs that expand the utility of smartphones (e.g. Tu et al., 2018). In May 2013, Apple celebrated its 50 billionth App download, with Google trailing only slightly behind with 48 billion (Skillings, 2013). This new App market has resulted in over $9bn being paid to developers for Apple Apps alone (Arthur, 2014). In recent years, increasing numbers of researchers appear to be using high-tech classroom management Apps, in order to make interventions not only effective but – more importantly – affordable and feasible (e.g. Dash, 2019; Wang et. al., 2017; Xiangming & Song, 2018; Schuck et al., 2017). Xiangming and Song (2018) developed a 'RainClassroom' App, which uses Affordance Theory to evaluate new mobile technology tools and students' engagement with them and willingness to participate. Affordance is used in the psychological study of perception to analyse the interaction between features of the environment and the action of the individual. Rain Classroom is a mobile learning tool developed by Tsinghua University in China in 2016. It integrates the information publishing before class, the real-time answering and multi-screen interaction in class and the reviewing after class. It also generates comments in bulletin boards and data analysis of participant performance screen interaction in class and the reviewing after class. Researchers have found that aspects of the RainClassroom App have enhanced the learning experience and had a positive effect on teachers, students and institutions.

Predictability, Control and Choice

The research literature suggests that predictability and control are linked with choice which in turn promotes attentiveness and learning (e.g. Dangwal & Kapur, 2008; Gabriel & Matthews 2011; Glasser, 1998, 2001; Mitra & Dangwal, 2010; Lopes & Oliveira, 2017). Glasser (1998) developed Choice Theory which is beneficial in solving classroom management problems, based on the notion that five basic human needs – survival, belonging, freedom, power and fun – drive both desirable and undesirable behaviour in the classroom. The basic premise of this theory is that teachers cannot control the behaviour of their pupils simply by telling them what to do but can play a critical role in helping students to make choices, thereby leading to positive behavioural changes (Freeman, 2005, Glasser, 2001 Gundlach, Farr, & Cook-Gumperz, 1989). A need for 'freedom' in terms of making choices is vital for pupils and Glasser suggests that it promotes a sense

of independence and autonomy, both of which are essential in creating an increased sense of control. To achieve this sense of freedom, students must be allowed to create, think, make mistakes and have sufficient space and independence, thus giving a sense that they have made choices (Frey & Wilhite, 2005, Harris, Graham & Mason 2003).

In a more recent study, Tasky et al. (2018) also used choice as a variable to enhance on-task behaviour in three adults who had been diagnosed with traumatic brain injury. Although this method resulted in instantly enhanced performance (from an average of 36% baseline to an average of 79% following intervention), it was limited and was not sufficient to maintain performance over time, especially in the absence of a reinforcement schedule. Nonetheless, it was affordable and simple to implement.

Glasser's Choice Theory has influenced teachers' classroom management, creating environments and curricula that cultivate appropriate, on-task behaviour through meeting student needs for a sense of belonging and empowerment (Praveen & Anoop, 2018). In essence, Glasser conducted manipulations of choice in educational environments and found that choice strengthened the sense of control and helped to reduce anxiety and fear, which are known to diminish attentiveness and learning (e.g. Panksepp, 2000). Evidence from neuroscience suggests that, when we feel threatened, the prefrontal cortex, the part of the brain linked with learning, shuts down (e.g. Panksepp, 2000). Individuals who are exposed to uncertainty (the opposite of predictability) are likely to feel threatened, which increases negative emotional reactions such as fear and anxiety (Panksepp, 2000). These are the two primary characteristics of students with EBD (Kaufman & Landrum, 2013; Smith 2010), who tend to present with higher rates of disruptive and off-task classroom behaviours than typically-developing individuals (Steiner et al., 2013). Such students may experience anxiety during lessons in which they cannot clearly predict the lesson structure or the amount of time allocated to each task, or do not understand the topic aims and objectives, and this, in turn, contributes to reduced attentiveness (Panksepp, 2000). In contrast, a sense of control promotes independence, autonomy and the ability to make choices, all of which are linked to enhanced on-task learning and decreased disruptive classroom behaviour (e.g. Brooks & Young 2011; Frey & Wilhite, 2005).

An App for Classroom Management

The general concept for the App was based on the in-flight screen that flight passengers have in front of them, showing the port of departure, their destination and information such as the speed of travel and the estimated time of arrival. The entire flight can be tracked via a digital image of an aircraft and its position on the flight path, providing the passengers with some predictability during a long flight.

Instead of showing a flight path, students saw an image (such as a universal computer cursor, appropriate for all ages, following a path (e.g. a dotted line). This figure continued to move throughout and in parallel with the course of the lesson (e.g. from 8.00am until 8.45am, when the lesson ended), with specific key markers reached along the way. For example, the teacher may have spent the first fifteen minutes presenting the lesson's objectives and explaining the content, so the first marker would be set at this 15-minute point and labelled accordingly. The second segment of the lesson might have been independent work, and this would also appeared on the path, labelled accordingly. A third marker may have indicated a 10-minute group discussion, and so on.

Predictability. Teachers prepared their lesson using the App on their smartphone in exactly the way they planned to run it. The average time envisaged for setting up the App was approximately 90-120 seconds. By simply touching an icon on their smartphone the visual representation of the lesson was broadcast to the classroom flat screen ensuring it was clearly visible to the participants. In this way, both before and during the lesson, the lesson's topic and objectives were visually represented and unambiguous and this allowed students (all other things being equal and controlled for) to predict the path of the lesson, what would be expected of them in terms of on-task behaviours, where the choice points would fall, etc.

Control. The App was designed in such a way that teachers needed to embed two choice points during each lesson. Both the choices and the point at which they became available during the lesson were chosen by the teachers. For example, the second segment of the lesson might have been 'work', and the teachers would allow students to choose between individual or group work. For each choice point, teachers identified and

listed appropriate on-task behaviours, for example, raising a hand for help, engaging in quiet discussion. These on-task behaviours were then represented by appropriate icons which also appeared on the screen at the relevant point.

However the lesson had been prepared, the icons and information appearing on the screen continually provided the students with the information they needed. They saw the plan for the entire lesson, as well as where they were in the lesson (as represented by the cursor moving along the lesson path). As a result, the students were able to see how much time had passed since the lesson started, how much time was left, what activities were still to come etc. This helped the students in scenarios such as the following:

i) If a student lost their focus during the lesson, possibly distracted by someone, or simply thinking about something else, the information on the screen enabled them to focus once more on the relevant segment of the lesson: they knew exactly where they were and what was expected of them at that point.

ii) If a student needed to leave the classroom for any reason, on their return they knew exactly which section of the lesson the class was engaged with and, again, what was expected of them. They could immediately reconnect with the lesson and get back on task.

The App also helped the teacher to follow the specific lesson plan. In the event of unforeseen circumstances or time-keeping issues, the teacher quickly made changes via the App and updated the screen. For example, they could shorten, or adjust, the remaining sections to ensure that the lesson ended precisely on time and, more importantly, that the students were also aware of the new expectations.

The Aim of the Present Study

This study aims to evaluate the use of the App for classroom management in terms of both increasing on-task behaviour and reducing disruptive classroom behaviours in students with EBD using a multiple baseline across subjects design (Carr, 2005; Kazdin, 2010). It should be stressed that the study does not suggest how the teaching itself should be organised or structured; it does not specify particular teaching methods (other than via the structure imposed by the App); it does not specify teaching objectives; it does not

specify which disruptive behaviours or adaptive on-task behaviours were targeted. These were determined individually by the teacher according to the needs of their students, the lesson etc.

Method

Participants

Participants were selected based on teachers' referral of students with high levels of disruptive behaviours and low levels of on-task classroom behaviours during regular classroom instruction. Four main teachers in a small, public Special Education school for students with EBD were each asked to select one of their pupils for inclusion in the study, resulting in the selection of four male participants, aged between 11 and 12 years, one from each of four classes of ten students. All four participants were reported to be in the low-average range of the Intelligence Quotient (IQ) (Resing & Drenth, 2007); Participant 1 (Oscar) had an IQ of 97, Participant 2 (Simon) had an IQ of 93, Participant 3 (Mark) had an IQ of 99, and Participant 4 (Richard) had an IQ of 90. All presented with low on-task learning levels and high levels of disruptive classroom behaviours.

The four main teachers, who also participated in this study, all had the minimum of a first degree, a teaching qualification, and were employed by the Ministry of Education. They were the main teacher responsible for a classroom with approximately ten students for five days per week, and they had been teaching in the school for several years. Teacher 1 (for Participant 1) had ten years of teaching experience and had taught in the school for five years. Teacher 2 (for Participant 2) had 13 years of teaching experience and had taught in the school for seven years. Teacher 3 (for Participant 3) had eight years of experience and had taught in the school for four years. Teacher 4 had six years of teaching experience and had taught in the school for three years. The teachers' participation consisted of teaching their daily lessons with only two additions: (1) a two-minute-long set up of the App (uploading their lesson using the App, and broadcasting it on a screen in the classroom before beginning their typical teaching), and (2) allowing data collection relating to any social contact they might have with their respective participant during the three phases of the study. Teaching assistants collected data on students' on-task and disruptive behaviours during the different phases of this study (one assistant for each participating student), as well as noting teachers' social contact with the respective participants. The four assistants conducted daily 20-minute direct observations for the duration of the study. Parents and other school personnel did not participate in any part of

the study. At the time this research project was conducted, all the student participants had a valid diagnosis of EBD and lived with their families.

Consent and Ethical Approval

Consent was obtained via a range of methods. The researcher provided the four participants, their families, teachers and the Director of Special Education with a letter detailing the procedures and potential outcomes (Appendix 1). This was followed by a formal request for consent (Appendix 2). All the participants, their families and teachers confirmed their consent in writing. The teaching assistants and the Director of Special Education also provided formal written agreement for this study (Appendix 3 – not attached due to confidentiality). Due to the Data Protection Act, all signed consent forms and agreements were confidential. In addition, prior to commencement of the study, a best-interest discussion took place to weigh the benefits against the potential risks for the participants, teachers and their assistants, even though teaching assistants did not technically participate in the study. The best-interest discussion involved the four participants, teachers and assistants, the Director of Special Education and the researcher. All were in agreement that the potential outcome of this study (increased on-task learning and reduced disruptive behaviour) would be beneficial for all participants and thus justified the study and the resources invested in it. The potential risk was deemed to be minimal and outweighed by the potential positive outcome. Nevertheless, it was decided to conduct full risk assessments for each participant. The potential negative social impact on the participants was also discussed. All parties agreed that such risk was low and, moreover, if results were encouraging, that this intervention would very likely be extended to more classes and, potentially, the entire school. A school meeting regarding ethical approval also took place to discuss ethical considerations and data-protection issues which were resolved. It was agreed that all data collected related to the four participants would only be used for this study and kept in a locked cabinet in the office of the Director of Special Education. The names of participants and teachers would not be shared with other parents or students. Furthermore, it was agreed that confidentiality would be maintained throughout, including any dissemination of results. For example, no private details or real names would be divulged, and only initials would be used. It was also agreed by all concerned that, in the event of increased disruptive behaviour that might put any of the participants, other students or school personnel at risk, this study would

immediately cease, and its continuation would be reassessed in a multi-disciplinary meeting. Finally, it was agreed that no video recording would be made of any participants, other students or school personnel.

Setting

The study was conducted in a small regional school for Special Education, which had 106 students aged 6–12, twelve classrooms, and 40 staff members, the latter including teachers, teaching assistants and paraprofessional therapists. All observations were conducted during the normal school day (08.00–13.40) and within the participants' main standard-sized classrooms (measuring approximately 17–25 m^2) in which they studied throughout the school day. Throughout the phases of this study (pre-baseline, baseline, intervention and follow-up) the students remained in their usual seats and classrooms during the same study hours (08.00–13.40), with the same teachers, and functionally identical flat screens fixed on the wall or placed on a table in a position from which they could be seen by the participants. Typically, lessons included the entire class (approximately ten students) and the teaching involved direct instruction in language, reasoning and writing skills, followed by independent work at their desks or group work associated with similar topics. Occasionally, games related to the curriculum were introduced as part of the whole class activity, or videos relating to the topic were shown. Class schedules and lesson content, as planned by the teachers, remained constant across all phases of the study.

Materials

The only material used in the study was the App that had been specifically designed and developed for that purpose. Its design and development, therefore, required the hiring of an expert in this field, a smartphone application programmer. The first step in developing the App was to describe the intended purpose to the programmer: how it would operate, the conditions and criteria for its use. As the App was used both for teachers to upload lessons in segments and to broadcast these to the participants in their classroom, two separate interfaces were designed: one for the teachers and one for the participants. The dual-interface App was developed on the Swift platform using the iOS SDK framework, X-Code, and Cocoa Controls programmers' application tools. The newly-

developed App was subsequently placed in the Apple App Store. The signed agreement with the Apple Store is shown in Appendix 4. The teachers each received a user-name and password from the researcher, enabling them to download the App from the Apple Store directly to their mobile phone free of charge.

The teachers' interface on their smartphones enabled them to upload lessons easily in segments and broadcast them on the screen. The students' interface consisted of only what they could see broadcast on the screen. Example of screenshots from the App are shown in Figure 1.
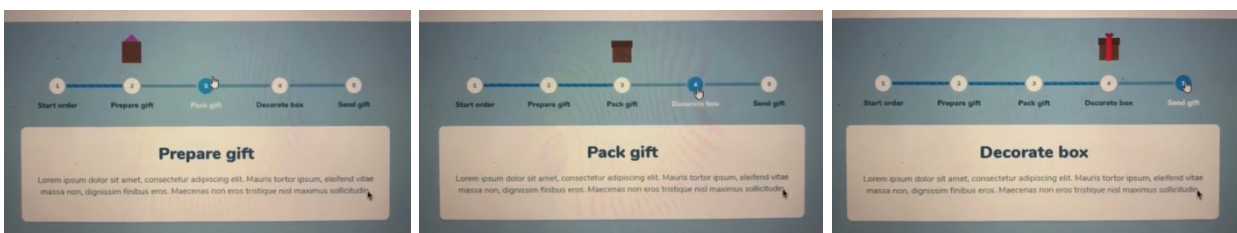

Figure 1: An example of the App Outcome shown on the screen.

The programmer relied on the researcher to provide the specifications and criteria for both interfaces. For the teachers' interface, it was critical for the App to be genuinely user-friendly, requiring only a few clicks to upload entire lessons, and a single click to broadcast a lesson at any location within the school, and all in less than two minutes. An illustration of the processes involved are shown in Figure 2. It was also important to design the App in such a way as to ensure that (a) it was energy efficient and did not drain the mobile phone battery, and (b) it had error- and bug-detection capabilities, so that potential viruses would not slow or freeze the mobile phones, which would inevitably have discouraged the teachers from using the application.
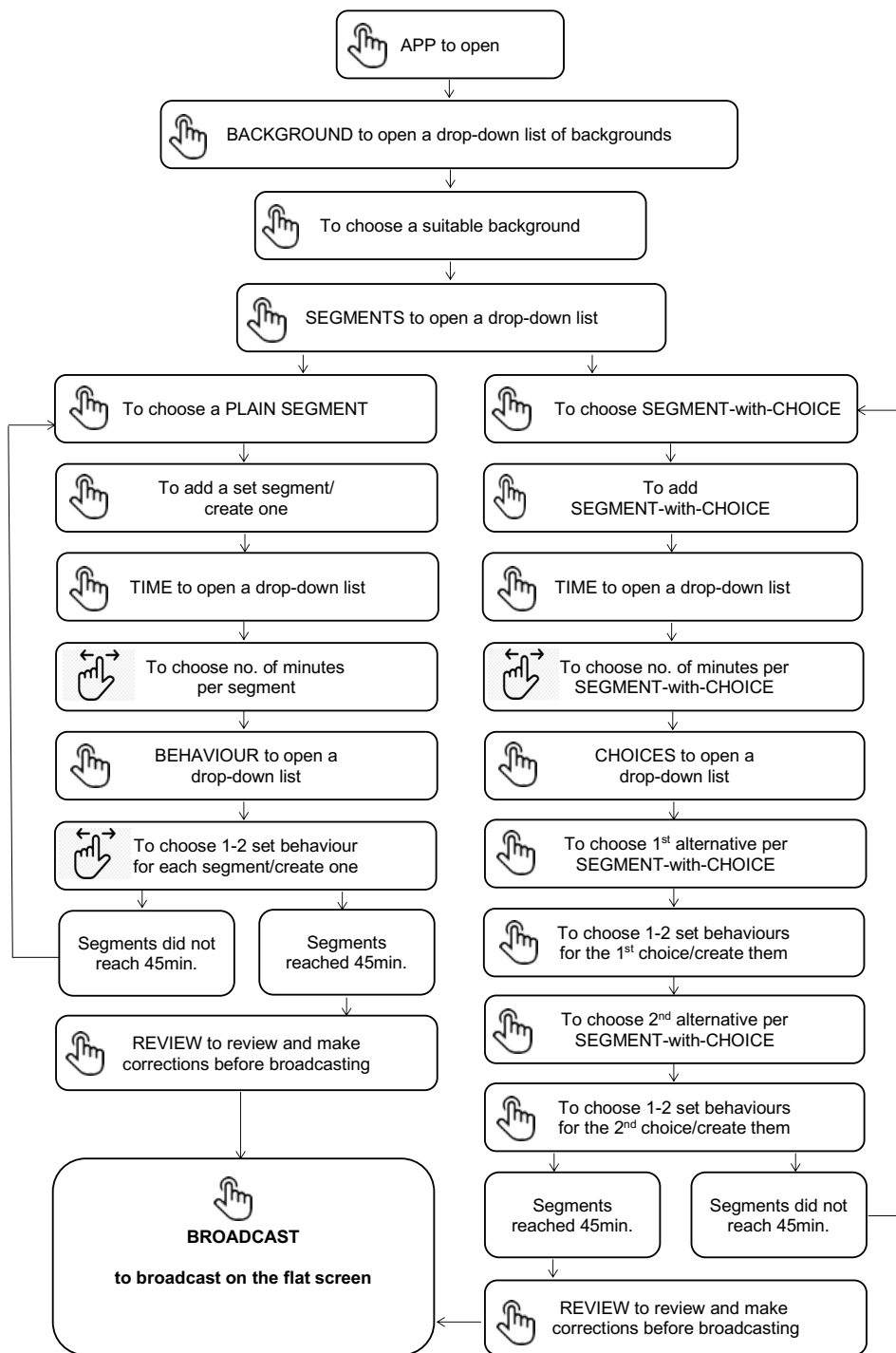
Figure 2: Illustrates the procedures of the App use.

The use of a Google Chrome Cast component with the App was vital, as the participating teachers' right to privacy was of great concern to the researcher. In order to maintain privacy and confidentiality in terms of their personal data (such as e-mails, social media messages, pop-up notifications etc.), an alternative to the free mirroring capabilities that are built in to most mobile phones had to be considered. With mirroring, users share all the data on their mobile phone indiscriminately. In this case, however, all other data displayed on the teacher's main screen (regardless of whether it was locked or unlocked) would be seen by everyone viewing the flat screen in the classroom. Since the teachers needed to share only the content of the App, they could not use the free mirroring feature. By using the Google Chrome Cast component, private and discreet broadcasting was possible, thereby ensuring the teachers' privacy and increasing the probability of their use of the App.

The participants' interface with the App was what they saw on the screen which had been chosen by the teachers: various segments representing the lesson structure; the number of minutes for each segment (whereby the maximum total for all segments could not exceed 45 minutes – the length of a typical lesson); two choices per lesson (that is, two segments in which the participants could choose from two alternatives); one or two target behaviours for each lesson segment (or for each alternative if applicable), and a clear visualisation of the progress of the lesson which would show on the screen throughout the lesson. The illustration of the entire lesson changed at regular intervals, showing different screens at different times. For the first five minutes of each lesson, the flat screen showed the entire layout of the lesson with its segments and alternative choices, their timing and the expected target behaviours. Then, the screen zoomed in to focus on the current segment or alternative, with its timing and targets. After two minutes, it would zoom out, to illustrate the entire layout of the lesson for 30 seconds. This cycle continued until five minutes before the end of the lesson. Then the screen showed the current and follow-up segments with all their components. The timing intervals of the layout illustrations are shown in Figure 3.
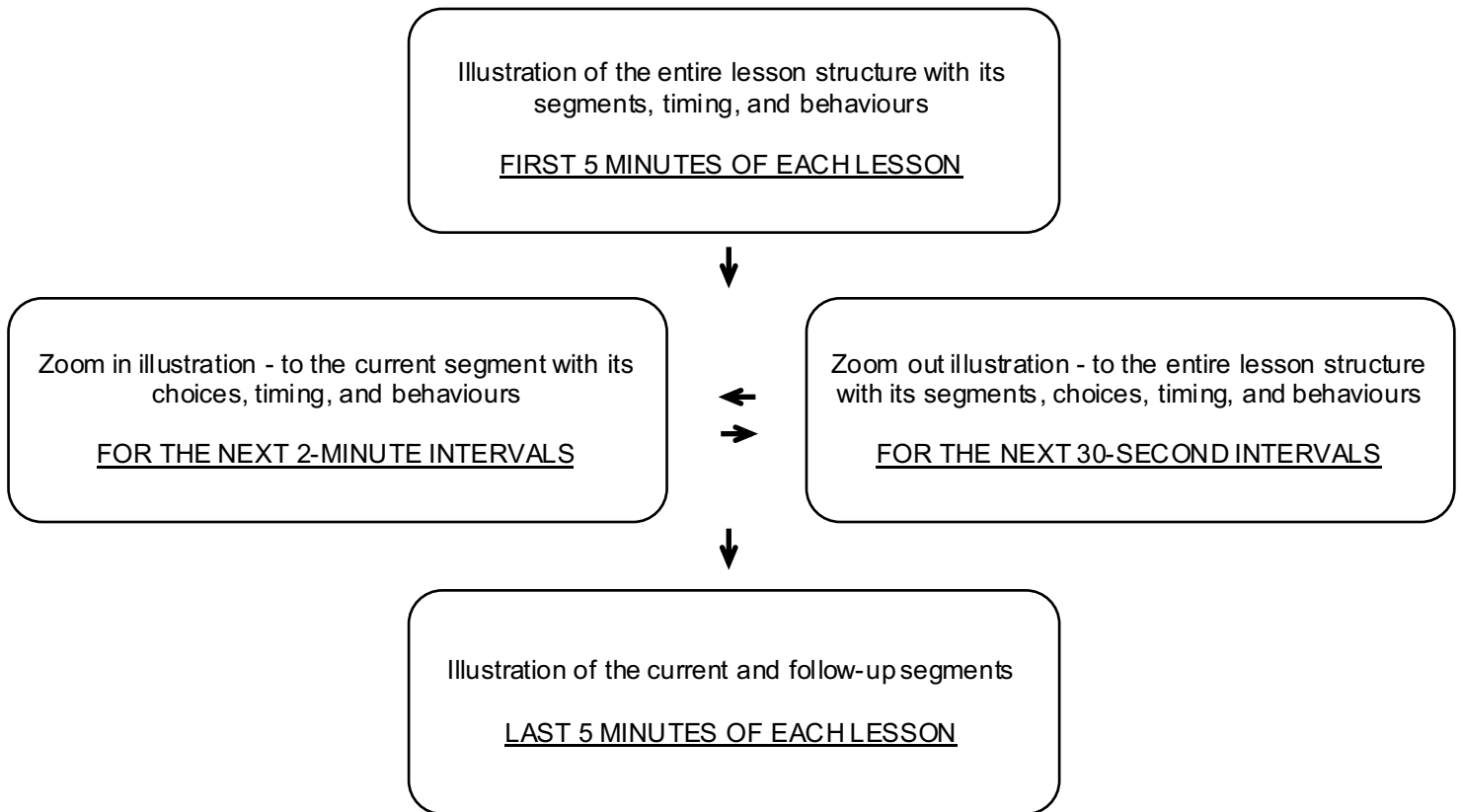
Illustration of the entire lesson structure with its segments, timing, and behaviours

FIRST 5 MINUTES OF EACH LESSON

Zoom in illustration - to the current segment with its choices, timing, and behaviours

FOR THE NEXT 2-MINUTE INTERVALS

Zoom out illustration - to the entire lesson structure with its segments, choices, timing, and behaviours

FOR THE NEXT 30-SECOND INTERVALS

Illustration of the current and follow-up segments

LAST 5 MINUTES OF EACH LESSON

Figure 3: The layout of the flat screen content.

Teacher Training

Teacher training was conducted for a total of 120 minutes in seven steps, as illustrated in Figure 4. For the first step (five minutes), the teachers were introduced to the App and its components on the researcher's mobile phone. Examples of screenshots of the Apps are illustrated in Figure 5. The researcher explained each component and the criteria illustrated in Figure 2, and then answered the teachers' questions. Examples of the first step of teacher training are illustrated in Figure 6.
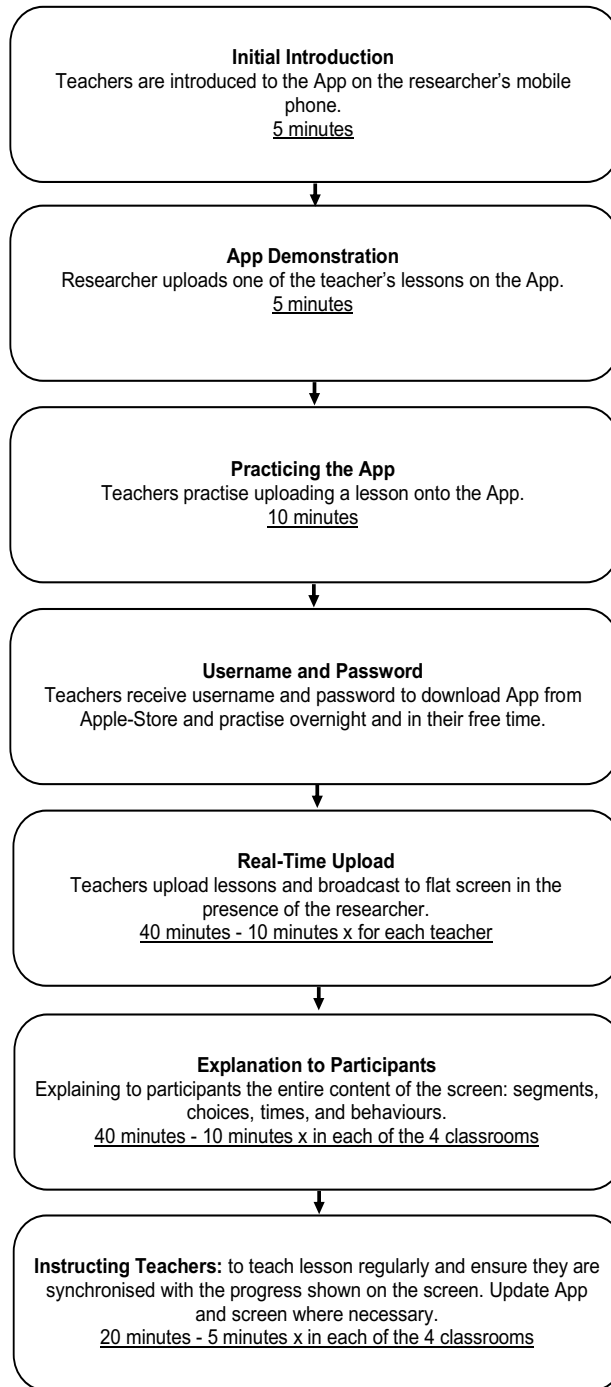
Initial Introduction
Teachers are introduced to the App on the researcher's mobile phone.
<u>5 minutes</u>

↓

App Demonstration
Researcher uploads one of the teacher's lessons on the App.
<u>5 minutes</u>

↓

Practicing the App
Teachers practise uploading a lesson onto the App.
<u>10 minutes</u>

↓

Username and Password
Teachers receive username and password to download App from Apple-Store and practise overnight and in their free time.

↓

Real-Time Upload
Teachers upload lessons and broadcast to flat screen in the presence of the researcher.
<u>40 minutes - 10 minutes x for each teacher</u>

↓

Explanation to Participants
Explaining to participants the entire content of the screen: segments, choices, times, and behaviours.
<u>40 minutes - 10 minutes x in each of the 4 classrooms</u>

↓

Instructing Teachers: to teach lesson regularly and ensure they are synchronised with the progress shown on the screen. Update App and screen where necessary.
<u>20 minutes - 5 minutes x in each of the 4 classrooms</u>

Figure 4: The seven steps of the 120 minutes' intervention.
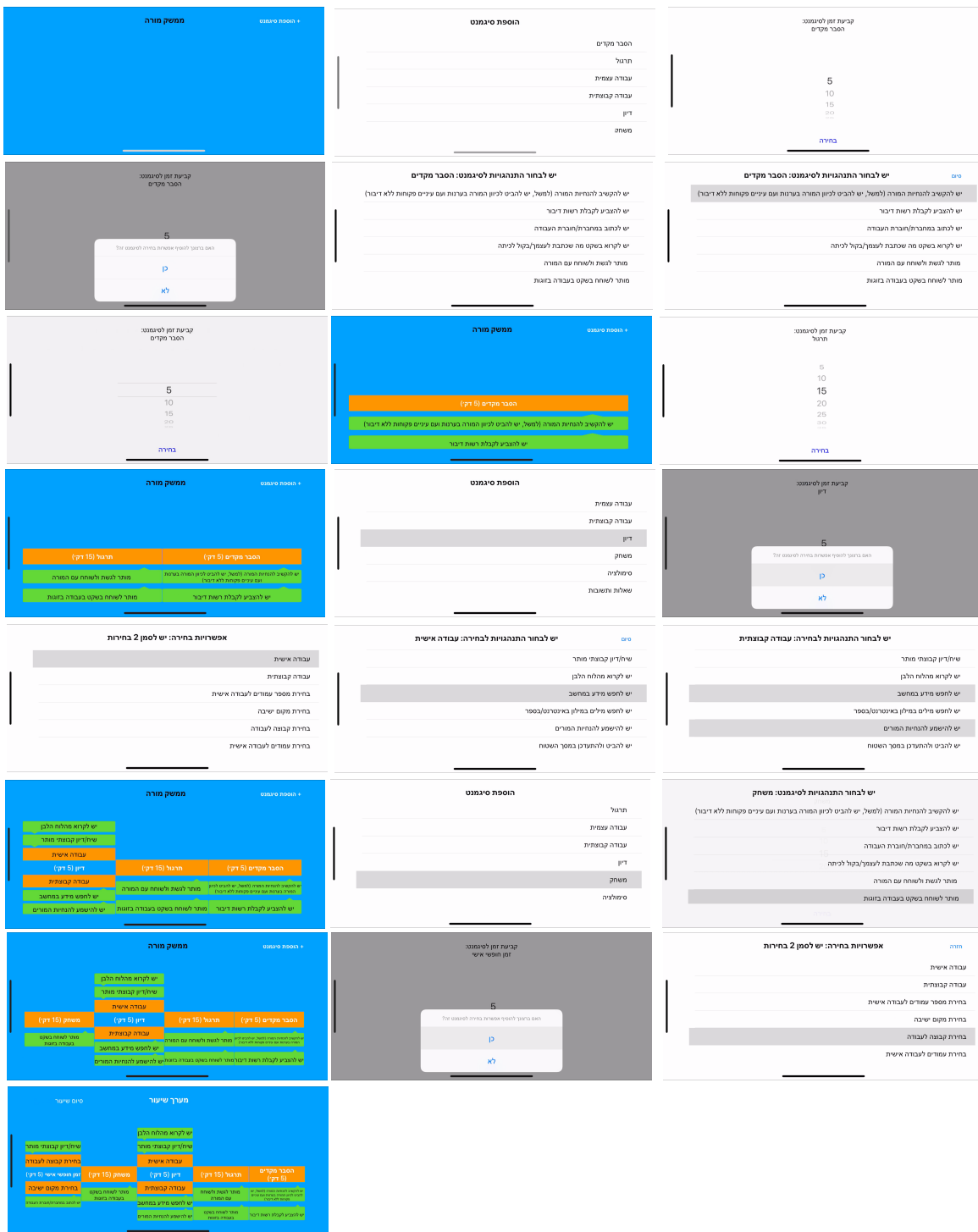
Figure 5: Example of screenshots of the App.
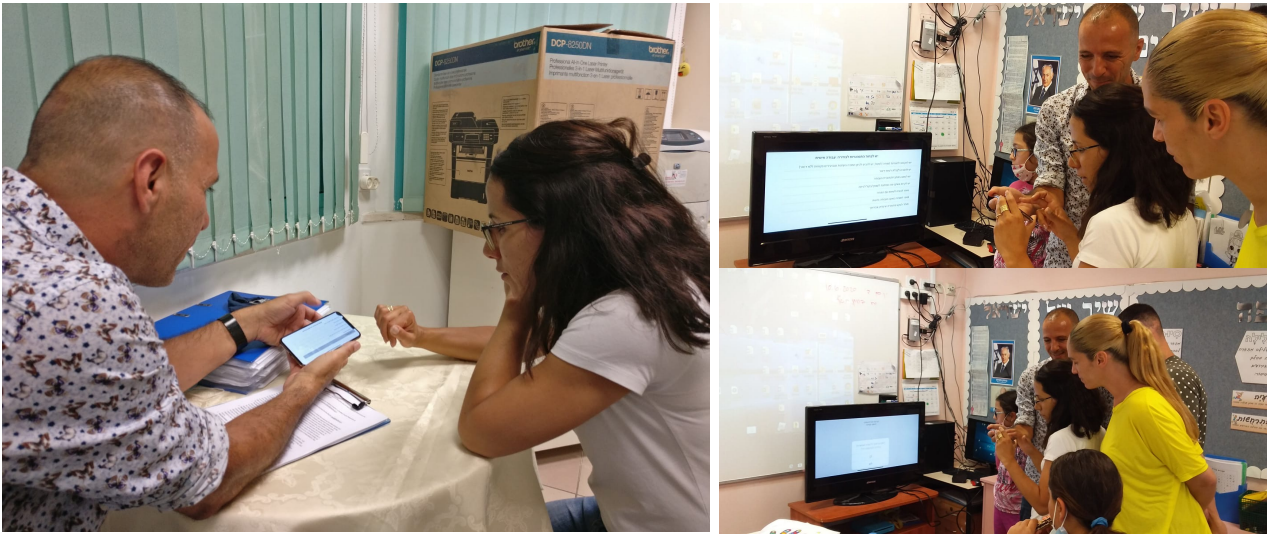
Figure 6: Examples of Teacher Training First Step - Introduction of the App to the Teachers.

Step two involved the researcher demonstrating how to upload a teacher's lesson using the App, again allowing for questions. This also took approximately five minutes, and at this point each of the teachers practised uploading a lesson using the researcher's smartphone, while the other three watched. In step three the researcher provided positive or corrective feedback where necessary and answered any questions for, approximately, another ten minutes. In step 4, the teachers each received a username and password, enabling them to download the App onto their own smartphone and practise in their own time. Step 5 occurred on the following morning at 07.20am (40 minutes before lessons began, with each teacher receiving ten minutes of the researcher's attention. The researcher monitored the teachers as they uploaded their lessons onto the App on their respective mobile phones, and broadcast to the screen in their respective classrooms. At this point, the researcher also inspected the content display on each flat screen. An example of a screenshot from the flat screen is shown in Figure 7. In step 6, a few minutes before a standard lesson began, the participants were shown the overall lesson plan on the screen, including the segments and choices, the time for each segment and the expected behaviours. Participants were also shown the progression of the lesson as it appeared on the screen (see Figure 7), and questions were answered. This step lasted ten minutes per classroom. In the final step (7), the teachers were instructed to begin teaching the lesson they had planned and uploaded onto the App and to ensure they were running to time and synchronised with the progression of the screen content. Where necessary, they were instructed to adjust the content on the App, which would update to the screen automatically. The lesson commenced as soon as the teacher clicked 'Run' to

begin the clock progression on the screen. This final step took five minutes per classroom.

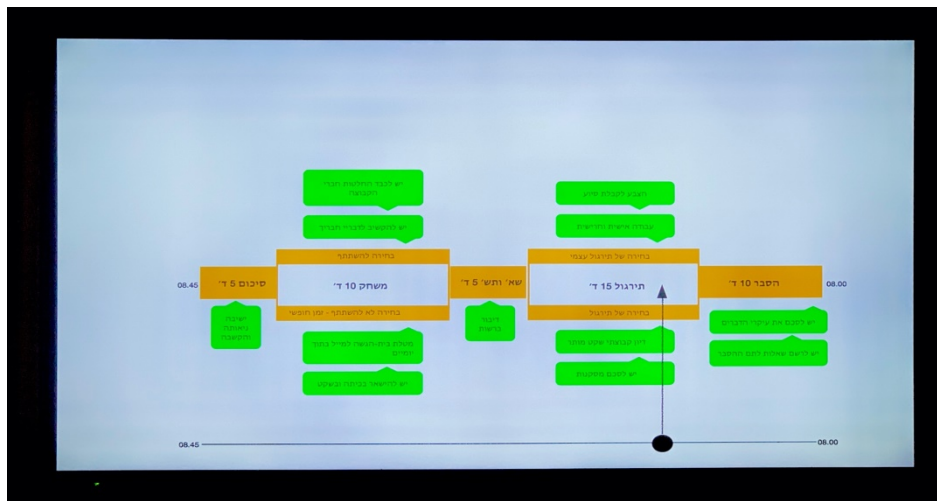Examples of the teacher training in step 7 is illustrated in Figure 8.

Figure 7: An example of a screenshot, showing the lesson segments, choices, time, behaviours, and an indication of the progress of the lesson.

Figure 8: Examples of the Step 7 in Teacher Training – In-Class Final Instructions to Teachers, Participants and Assistants.

Experimental Design and Dependent Variables

A multiple baseline experimental design across participants was used for this study (Carr, 2005). Recent longitudinal research has found it to be the most common and reliable single-subject experimental design (Brady et al., 2019). The target behaviours were various on-task and disruptive classroom behaviours. These were selected because they were those typically identified as targets for change with students with EBD (Bramlett et al., 2002) and they have been consistently used in the literature as behaviour indicators that are highly relevant in the educational environment (e.g. Beck et al., 2009; Damon et al., 2008; Gilbertson et al., 2008; Sutherland et al., 2000). Specifically, on-task behaviours were based on previous research conducted by Moore et al. (2001, 2013). Disruptive behaviours were identified from previous work by Dufrene et al. (2014) and Hall et al. (1968). Furthermore, in order to promote the cooperation of all those involved, and for social validity, on-task and disruptive classroom behaviours were operationally defined by the participants and teachers themselves, reflecting their own educational environment. All identified on-task and disruptive behaviours are listed in Table 3.

On-task behaviours	
1	Listen to teacher instructions (the participants oriented toward the teacher with eyes open and not talking).
2	Raising hand (left or right).
3	Writing on their notebook or booklet.
4	Reading written work (own quiet reading or loud to the class).
5	Talking to the teacher.
6	Discussing set work with a neighbour.
7	Having the teacher check work.
8	Talking to a group in a group discussion task.
9	Reading from the whiteboard.
10	Researching on the computer.
11	Looking up words in the computer/hard copy dictionary.
12	Complying with other verbal instructions given by the teacher/assistants.
13	Look up the 60" flat screen.
Disruptive behaviours	
1	Noncompliance.
2	Yelling.
3	Out of seat behaviours included students sitting on their feet, standing up, lying down, and moving locations and seat without permission.
5	Making inappropriate noises included any vocal noise when the teacher had not indicated that the student may speak.
6	Getting out of seat.
7	Swinging on the chair.
8	Talking none relatedly to other students.
9	Making inappropriate contact with other students and objects included tapping other students, playing with other students' hair, pushing other students with hands or feet, and touching materials not related to the current activity (e.g. nearby chairs, jewellery, shoelaces).

Table 3: The operational definitions for on-task and disruptive classroom behaviours.

Data Recording System

Direct observations were conducted in the participants' main classrooms five times each week commencing at a randomised time between 08.05 and 08.25. Although the lesson began at 08.00, it was decided to not begin collecting data until at least 5 minutes into the lesson because the class may not have been ready exactly at 08.00. The length of the observation was only 20 minutes (of the 45 minute lesson) to acknowledge that the assistants had other roles and responsiblities to perform and so the data collection period needed to be realistic and achievable, able to be sustained for several weeks (without

adding undue pressure on the staff and other students) and meet social validity criteria. To try and ensure that the 20-minute data collection period provided a good representation of the entire 45-minute lesson the start times were randomly selected using slips of paper labelled '08.05', '08.10', '08.15', '08.20', '08.25' that were in a box and selected at random by the teaching assistants who pulled out one of the slips before the class commenced. Teaching assistants then began their observation according to the time on the slip that they randomly picked each morning.

Four teaching assistants conducted their observations in their respective participants' classrooms. They were not informed of the study aim or any hypotheses. All assistants had at least two years' experience in data collection and the implementation of behavioural interventions, in particular in disruptive and on-task classroom behaviours. Additionally, to increase inter-rater reliability, all the data collectors received specific training in partial-interval data-recording using simulations and mock observations. The data collectors completed their training once 90% inter-rater agreement (IOA) had been reached in the mock observations. To protect against observer drift, the researcher reviewed the operational definitions of behaviour types with the data collectors on a weekly basis. A partial interval recording data collection form is attached in Appendix 5. Occurrences of on-task, disruptive and teacher-pupil social contact classroom behaviours were assessed using partial interval recording with ten-second intervals. If the participant exhibited any of the on-task or disruptive behaviours (as illustrated in Table 3) at any time within a ten-second interval, the interval was scored as an occurrence in the correct column. On-task and disruptive behaviours were not considered mutually exclusive during any given interval; this allowed on-task and disruptive behaviours to be recorded simultaneously in the same interval, irrespective of which of the behaviours occurred first. The percentage of intervals with on-task or disruptive behaviours was calculated by adding up the scored intervals for each, dividing by the total number of possible intervals, minus any missed observations, and multiplying by 100.

In addition, to reduce the undesired effect of the influence of external variables, data relating to teachers' social contact with the participant was also recorded. Social contact with the participants during the various phases of the study could influence the occurrence of disruptive and on-task behaviours. Recording these data may, therefore, assist in posthoc interpretation of the participants' target behaviour data and further enable

the assessment of behaviour change in participants and the potential of a transactional relationship caused by social contact by teachers. Social contact was broadly defined as any contact initiated by teachers towards their participants, whether physical, for example, a stroke or a pat on their shoulder, or verbal, for example, 'well done', 'good work' or perhaps 'behave yourself', 'be quiet', or any other punitive contact. However, social contact was recorded as either social contact that appeared to have the function of providing positive reinforcement to 'increase behaviour' ($social^+$) or social contact that appeared to be functionally punitive in nature to 'decrease behaviour' ($social^-$).

Inter-Observer Agreement

The researcher and at least one additional data collector independently observed 33-39% of all lessons for each participant (at least 40 out of 120 intervals for each twenty-minute observation). Agreement was recorded when both observers recorded an occurrence or non-occurrence within a given interval. IOA scores for on-task, disruptive, and teacher social contact behaviours were then calculated on an interval-by-interval basis by dividing agreements by the total number of agreements plus disagreements, multiplied by 100 (Kazdin, 2011). The mean IOA scores combined across all sessions for on-task, disruptive classroom, and social contact behaviours was 89.8% (range = 82.5% - 95%). For O, the mean IOA scores for on-task and disruptive behaviour were 92.5% and 95% respectively, and for $social^+$ and $social^-$ behaviour, 87.5% and 90%. S's IOA scores were 82.5% for on-task and 90% for disruptive behaviours, and 92.5% for $social^+$ and 85% for $social^-$ contact. M's scores were 82.5% and 90% (on-task and disruptive behaviours), and 95% and 92.5% ($social^+$ and $social^-$) R's scores were 87.5% and 92.5% (on-task and disruptive), 95% and 87.5% ($social^+$ and $social^-$). An example of an IOA form completed for participant M and his teacher is shown in Appendix 6.

Risk Assessment

For the health and safety of the participants, school personnel and other students, and in order to identify potentially aggressive behaviours and those which might cause destruction of property, a risk assessment was completed for each participant and signed. The risk assessment form is illustrated in Table 4.

Activity: In-class typical lesson with the option of looking at a flat screen during the lesson, showing its progress with the relevant segments, the time allocated for each segment, choices, and expected behaviours.
Environment: School/typical classroom
Benefit of Activity: Increasing on-task and reducing disruptive classroom behaviours in order to increase engagement with the lesson, effective learning, personal achievement, pleasure, joy, quality of learning and – ultimately – quality of life.

Assessed by: Participant, family, school personnel, and researcher.
People consulted: Participant, family, and school personnel.
Assessment date:_____.
Approved by: Family and school personnel.
Review date: Periodically (six-monthly).

Hazards	Risks	Harm	Likelihood	Rating	Precautions	Additional action required
Ripping the flat screen off the wall and throwing it at the walls/others	Participant, teacher, others	4	1	4	Secure screen tightly on the wall with heavy-duty screws	**Check screen once a month**
Throwing items at the screen	Teacher	1	1	1		
Rosk Assessment is approved by: Name:_____. Relation:_____. Signature:_____.						

Key
Harm

1	2	3	4	5
Insignificant	Minor	Moderate	Major	Severe

Likelihood

1	2	3	4	5
Very Unlikely	Unlikely	Equally likely and unlikely	Likely	Very Likely

Table 4: The risk assessment form completed prior to commencement of the study.

Social Validity

To promote a stable, low-cost and sustainable programme, and to gain commitment from those involved in the study (the participants, teachers, teacher assistants), observations took place during the participants' usual study hours (08.00-13.40). Furthermore, the App was developed to be easy to use, enabling the teachers to upload and broadcast lesson plans from anywhere onto the screen in the classroom. The teachers could edit the lesson, make changes, choose from a variety of backgrounds (e.g. those most age-appropriate for the class), create segments and denote behaviours which were not predetermined. For the purpose of this study, the researcher modified a feedback questionnaire previously developed by Reimer, Wacker, Cooper and DeRaad (1992). The ten-item questionnaire is illustrated in Table 5. It scores the experience and level of satisfaction with the App of

participants, teachers, teacher assistants and parents on a 1–5 rating scale, with higher values indicating strong agreement. The questionnaires were completed anonymously, with a return rate of 100%.

#	Item	1	2	3	4	5
1	I find this App to be an acceptable way of increasing on-task and decreasing disruptive classroom behaviours.					
2	I would be willing for this App to be used again, to increase other appropriate and reduce other inappropriate classroom behaviours.					
3	I believe it would be acceptable to use this App without the consent of the participants.					
4	I like the App used in this study.					
5	I believe this App is likely to be effective in other educational environments and with others teachers, to increase on-task and decrease disruptive classroom behaviours.					
6	I experienced discomfort using this App.					
7	I believe this App is likely to result in permanent improvement in my teaching skills.					
8	I believe this App does not require many resources, and thus is affordable.					
9	Overall, I had a positive reaction to this method.					
10	Everyone overall satisfaction from this App procedure.					

Table 5: The feedback questionnaire

Intervention Phases

Pre-baseline: This was not a phase of the study, and simply involved one session for each of the participants, in their classroom and with their main teacher and assistant. The principal purpose of the session was to ascertain the optimal classroom layout with regard to the seating arrangement for both the teacher and the participant in order to ensure that the screen was visible to the participant and not obstructed by the teacher's usual teaching location or by the assistant. The first lesson (occurring from 08.00 to 08.45) was observed, enabling the researcher to inspect the layout of the classroom, choose an appropriate observing position that did not obstruct others in the room, demonstrate the partial interval data collection process to each of the four teaching assistants, provide feedback and, finally, make some mock observations in order to desensitise the participants to the observers' presence. The settings (classrooms) for each participant were unaltered, and the participants used their regular learning materials. During this preliminary phase, the researcher asked the teachers to deliver their lessons in their usual manner, using standard classroom materials. Likewise, the participants were asked to study in their usual manner.

Baseline: All data collectors (teaching assistants) were provided with an instruction sheet with all behaviour definitions (Appendix 7) and data collection commenced on the same day. The settings were unaltered from pre-baseline. Participants and teachers were instructed to attend and teach in the usual way and the experimenter answered general questions. Baseline recording for on-task and disruptive classroom behaviours for all participants as well as social contact behaviours for all teachers began at one of four randomised times between 08.05 and 08.25 (as previously described), lasted 20 minutes and used a 10-second partial-interval recording system. The observation sheets were kept in a folder for each participant and all documents were stored in the office of the Director of Special Education, ready for the next morning. Teacher social contacts (as previously described) were also recorded with the participant's target on-task and disruptive behaviours.

Intervention: The intervention (i.e. the introduction of the use of the App) was applied first to Oscar, as his baseline data appeared the most steady and stable. On the morning of the intervention, the teacher uploaded an entire lesson onto the App on her mobile phone and broadcast it to the screen in Oscar's classroom prior to the beginning of the lesson. At 08.00, the researcher instructed the teacher to teach her lesson as planned and following the content on the screen. Oscar was also instructed to attend as usual and to look at the screen periodically to be reminded of the lesson progress, segments, choices and appropriate behaviours. At 08.00 the teacher clicked 'Play' and the lesson, which was already broadcast onto the screen, started to progress. The teaching assistant had already determined when data collection was to begin (using the methods previously described) and began collecting data at that time. This exact intervention procedure was replicated for each participant and the order in which the participants' intervention phases began can be seen in the results section and were determined on the basis of baseline stability.

Follow-Up: The follow-up phase was identical to the intervention phase except that data were only collected very intermittently to see if the intervention was still having an effect with minimal input from the researcher.

Treatment Fidelity

To ensure the integrity of the implementation of the intervention, each teaching assistant monitored 25% of the intervention lessons in her respective classroom with her respective participant. A check-list for the sessions using the App was developed and shown in Table 6. Each lesson had to be a maximum of 45 minutes long; two segments had to include two alternatives; each segment had to specify one or two on-task behaviours; the display had to show an image of a triangle moving along a dotted line (to simulate the progression of the lesson over its various segments); and the teacher had to be synchronised with the App content displayed on the flat screen. Treatment fidelity was 100%. Example of a completed treatment fidelity rating form is shown in Appendix 8.

Lesson #	Total of 45-min. lesson	Two choices – segments with two alternatives	1-2 behaviours in each segment	Lesson progress simulated on screen	Teaching and screen content synchronized	Score: #v/5 x 100
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
Rater initials: _____		Date: _____		Participant: _____		

Table 6: The treatment fidelity rating form.

Results

On-Task and Disruptive Classroom Behaviours

Figure 9 shows the on-task and disruptive classroom behaviours of the four participants during baseline, intervention and follow-up phases. All four participants made gains in on-task behaviours and had some reductions in disruptive behaviours following the introduction of the App. The most striking effects in terms of both increases to on-task behaviour and reductions in disruptive behaviour were seen for Richard, with gains/losses occurring at a more modest but steady pace for the other participants.

Comparison of the mean (M) levels during baseline and intervention observations for the participants shows an increase of 30% for on-task behaviour (baseline M = 16%, range = 0%–27%; intervention M = 46%, range = 19%–86%) and a decrease of 33% for disruptive classroom behaviours (baseline M = 85%, range = 71%–100%; intervention M = 52%, range = 11%–83%).

The data for Oscar in Figure 9 suggests a steady, stable and modest intervention effect for on-task and disruptive classroom behaviours. The difference between the mean levels during baseline and intervention was +19% for on-task behaviour (baseline M = 15%, intervention M = 34%) and -16% for disruptive classroom behaviours (baseline M = 87%, intervention M = 71%). The steadily increasing trend in on-task behaviours seems to correspond with the declining trend in disruptive classroom behaviours. O continued to increase his on-task behaviours (M = 64%) and show decreases in his disruptive classroom behaviours (M = 43%) during the final follow-up phase.

Similarly, Simon's data also suggest a moderate yet consistent effect of the intervention on both on-task and disruptive classroom behaviours. The difference between the mean levels during baseline and intervention was +15% for on-task behaviour (baseline M = 24%, intervention M = 39%) and -21% for disruptive classroom behaviours (baseline M = 83%, intervention M = 62%). Similar to Oscar's data, there was low variability for both on-task and disruptive classroom behaviours during the intervention. The follow-up phase for both dependent variables suggested that S continued to increase

his on-task behaviours consistently (*M* = 74% during follow-up) and decrease his disruptive classroom behaviours (*M* = 30% during follow-up).

Mark's data depict a more variable effect for both on-task and disruptive behaviours. The difference between the mean levels during the baseline and intervention was +36% for on-task behaviours (baseline *M* = 17%, intervention *M* = 53%) and for disruptive classroom behaviours, the difference was -38% (baseline *M* = 77%, intervention *M* = 39%). The clear and sharp upward trend in on-task behaviours corresponds to a downward trend in disruptive classroom behaviours. The follow-up data suggest that Mark continued to increase his on-task behaviours (*M* = 91% during follow-up) and diminished his disruptive classroom behaviours (*M* = 20% during follow-up).

The on-task and disruptive classroom behaviour results for Richard in Figure 9 show relatively immediate and consistent intervention effects for both behaviours. The difference between the mean levels of on-task behaviours during baseline and during intervention was +51% (baseline *M* = 5.8%) and for disruptive classroom behaviours -60% (baseline *M* = 94%) with no overlap for either dependent variables. The sharp increase in on-task behaviours appears to correspond to an equally sharp decrease in disruptive classroom behaviours. This effect was maintained during follow-up with the on-task level at 82% and disruptive classroom behaviour at 13%.
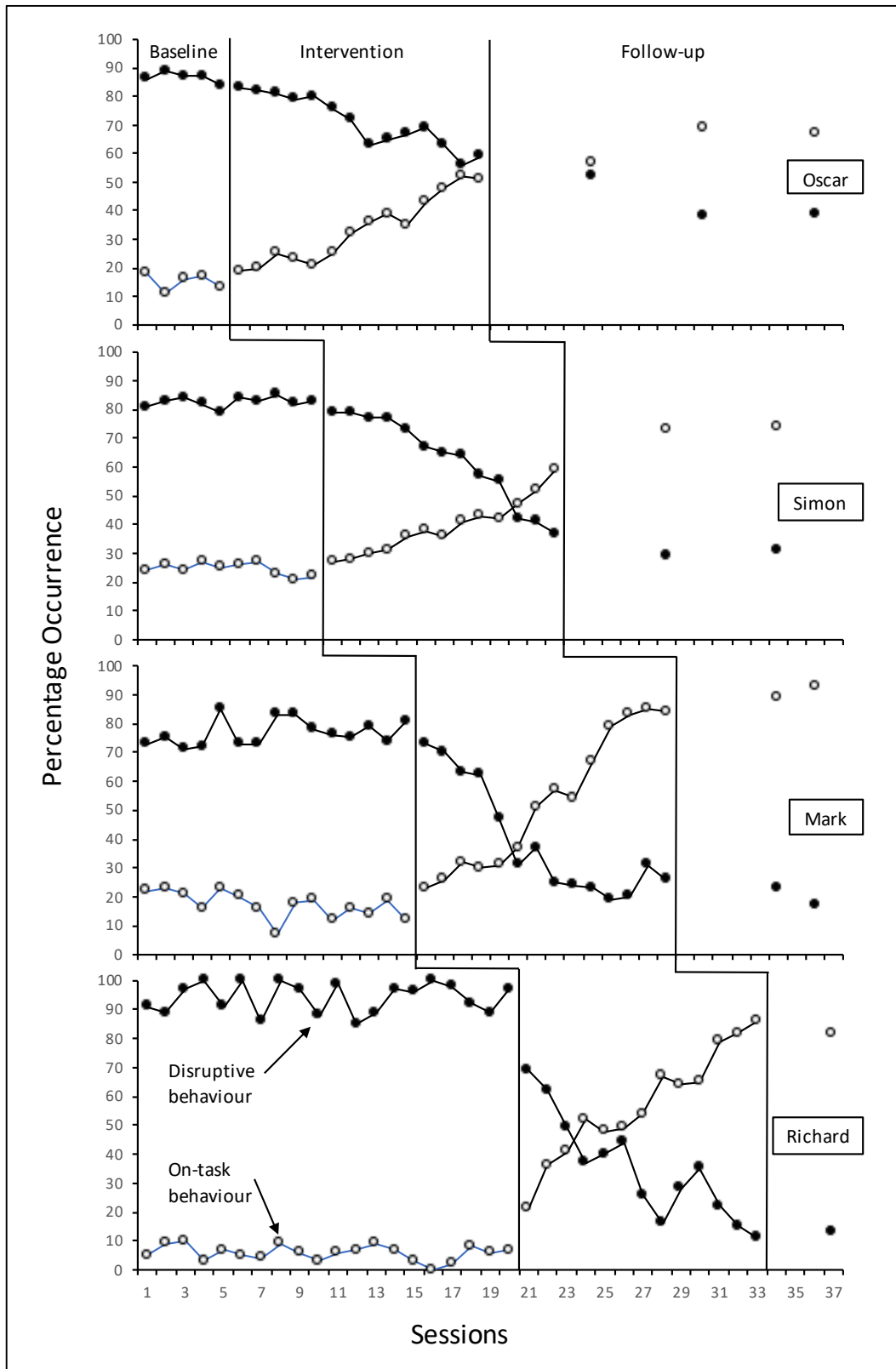
Figure 9: Percentage of 10-s intervals of On-Task and Disruptive classroom behaviours during 20-min classroom observations across all phases.

Teachers' Social Contact

Teachers' social contact, per session, is shown in Figure 10. The mean level of $social^+$ contact for all four teachers was 2.7% during baseline and 4.7% during intervention. $Social^-$ contact was 71% at baseline and 40% during the intervention, a mean decrease of 31%. Mean levels during follow-up were 4.5% for $social^+$ and 20.3% for $social^-$ contact.

Assessed individually, the mean level of Oscar's teacher $social^+$ contact was 2% during baseline and 4.4% during intervention. $Social^-$ contact was 80.6% during baseline and 60.5% during intervention. Mean levels during follow-up were 4.3% for $social^+$ and 33.6% for $social^-$. Simon's teacher's mean level of social contact during baseline observations was 2.9% for $social^+$ and 63% for $social^-$. These figures changed during the intervention to 4.9% for $social^+$ and 48% for $social^-$. Mean levels during follow-up were 5% for $social^+$ and 32.5% for $social^-$ contacts. Mark's teacher's mean level of $social^+$ contact was 2.8% during baseline and 5.5% during intervention. $Social^-$ dropped from a mean level of 69% to 29.5% during the intervention. Mean levels during follow-up were 6% for $social^+$ and 10.5% for $social^-$. Richard's teacher showed the biggest change in social contact (57%) from 79.5% for $social^-$ to 23% during the intervention. Richard's teacher's $social^+$ contact was similar to the other teachers, at 2.9% during baseline observations and 4.7% during the intervention. Mean levels during follow-up were 3% for $social^+$ and 4.5% for $social^-$ contact.
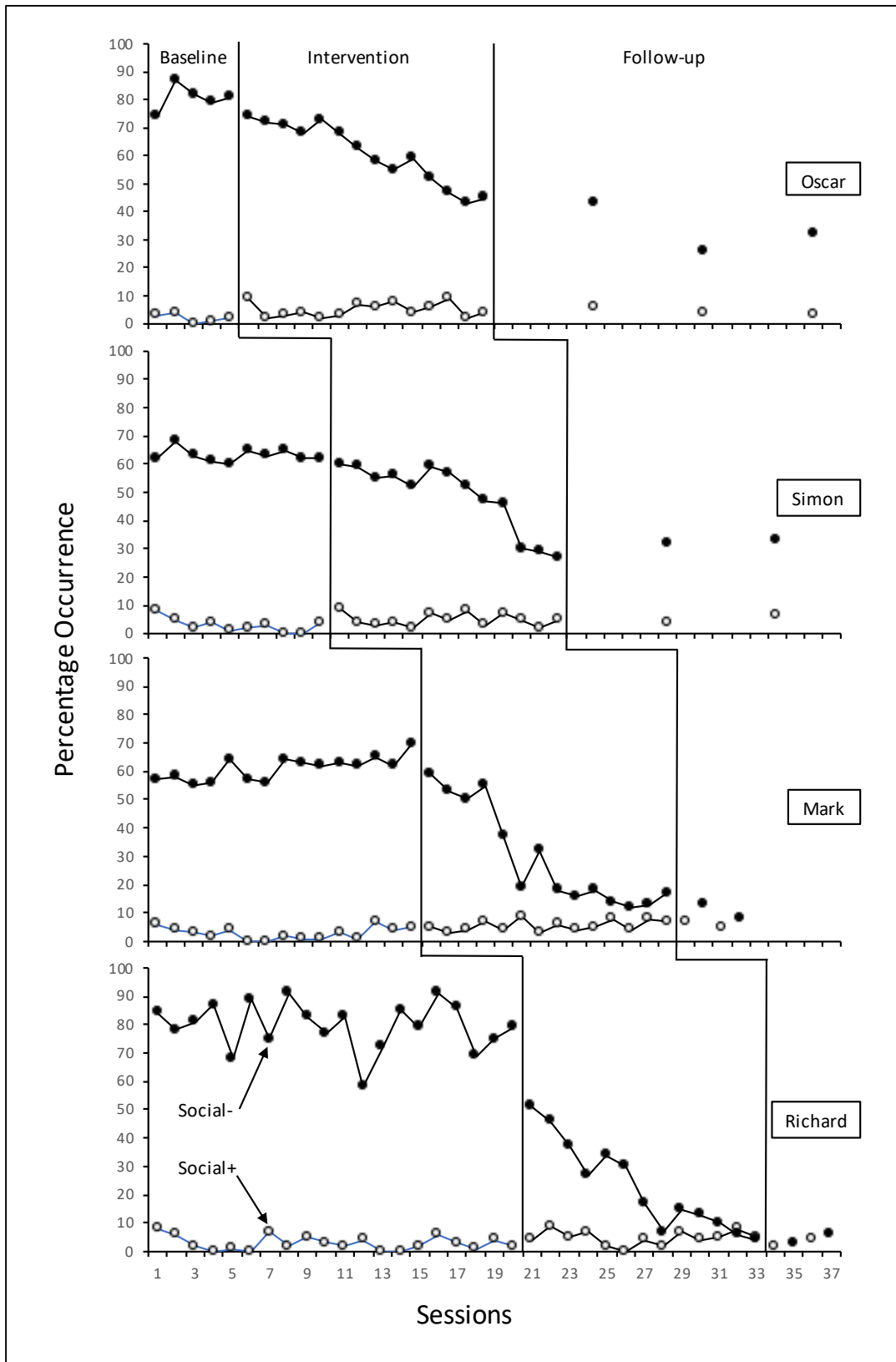
Figure 10: Percentage of 10-s intervals of Teacher Social Contact during 20-min classroom observations across all phases.

Social Validity

The results from the feedback questionnaire from each of the participants, teachers, teacher assistants and parents (n=16) are shown in Table 7. The 10-item feedback questionnaire used a 1–5 rating scale, with higher values indicating strong agreement. The responses provide an overall encouraging evaluation of the App used in the study in terms of favourability, affordability and general social validity. Their combined responses indicated that the use of the App was acceptable and appealing with minimal risks involved in terms of using it. The overall satisfaction score was 95.25%.

All school personnel and, specifically, the special education team (e.g. teachers and assistants) were favourably impressed by the high-tech intervention and its effects on the behaviour of their students and staff. They commented on the ease and simplicity of uploading lesson plans and broadcasting them to students in their classes. They reported encouraging behavioural changes in their students and believed that the intervention (i.e. the use of the App) was responsible for these. They found the intervention to be accessible, easy-to-use and cost-effective. Each teacher reported an increase in on-task behaviours (including active participation), in-class engagement, improved attendance, reduced stress (e.g. from not knowing what to do), reduced confusion, greater awareness (e.g. now knowing what to do), and better academic outcomes. Moreover, all of the general education teachers anecdotally reported that control and predictability within the classroom are as fundamental for learning as for teaching, but also admitted that they had not known how to enhance control and predictability within their classroom and lessons. They did not expect this positive impact on their students' behaviour – although it was a slow gradual process, there was a consistent and steady improvement. Staff were also interested in introducing the App across the entire school for the following academic year.

Item #	I find this App to be an acceptable way of increasing on-task and decreasing disruptive classroom behaviours.	I would be willing for this App to be used again, to increase other appropriate and reduce others' inappropriate classroom behaviours.	I believe it would be acceptable to use this App without the consent of the participants.	I like the App used in this study.	I believe this App is likely to be effective in other educational environments and with other teachers, to increase on-task and decrease disruptive classroom behaviours.	I experienced discomfort using this App.	I believe this App is likely to result in permanent improvement in my teaching skills.	I believe this App does not require many resources, and thus is affordable.	Overall, I had a positive reaction to this App.	Everyone overall satisfaction from the entire App procedure
O	100	100	100	100	80	100	80	100	100	100
S	100	80	100	100	100	80	100	100	100	100
M	100	100	100	100	100	100	100	80	100	100
R	80	100	100	100	80	100	100	100	100	100
O's Teacher	100	100	100	100	100	100	100	100	100	100
S's Teacher	100	100	80	100	80	100	80	80	100	100
M's Teacher	100	100	80	100	100	100	100	100	100	100
R's Teacher	100	100	80	100	80	100	100	100	100	100
O's Tea. Assist.	100	100	80	100	100	100	100	100	100	100
S's Tea. Assist.	100	100	80	100	40	100	80	40	100	100
M's Tea. Assist.	100	100	80	100	100	100	100	100	100	100
R's Tea. Assist.	100	100	80	100	60	100	100	100	100	100
O's Parents	100	100	60	100	100	100	80	100	100	100
S's Parents	100	100	100	100	60	100	100	40	100	100
M's Parents	100	100	80	100	100	100	100	100	100	100
R's Parents	100	100	60	100	100	100	100	100	100	100

Table 7: Participants', teachers', teacher assistants' and parents' responses to the App intervention.

All students commented that the addition of the screen with vital and relevant information was both fun and important; it made them feel less stressed, more informed and more relaxed. They indicated that they wished it was available during all lessons with all teachers. Some commented that this intervention was particularly important with certain teachers (e.g. those who were less than transparent about their lesson's aims and objectives). All students stated that greater knowledge of the path and progress of the lesson and what specific on-task behaviours were expected, along with an element of choice, were important factors in reducing uncertainty, which would have previously resulted in unnecessary stress and distress, leading to outbursts of problem behaviour with some of their teachers.

Discussion

The main goal of this study was to evaluate the effects of a mobile App that was intended to provide an affordable, user-friendly and accessible, dual-component, high-tech, classroom-management intervention, which aimed to increase on-task behaviour and reduce disruptive classroom behaviours in four students with EBD. The results suggest, both experimentally and anecdotally, that the dual-element App, uniquely and specifically developed for this study, was reasonably successful.

The data collected at baseline for each participant's on-task and disruptive behaviours were used to set specific outcome criteria for posthoc analysis of success (Scheithauer et al., 2020; Kelly & Shogren, 2014). For Oscar, Mark, and Richard, their on-task behaviour outcome criterion was set at 65%. For Simon, his on-task learning behaviour outcome criteria was 75%. Criterion for the outcome for disruptive classroom behaviours was set at 30% for all four participants. For on-task behaviours, Mark achieved the target criterion in the last five of 14 intervention sessions (with 67%, 79%, 83%, 85% and 84% respectively). Richard achieved the target criterion five of his 13 intervention sessions (sessions 8, 67%, 10, 65%, 11, 79%, 12, 82% and 13, 86%) but with an ascending trend. Whilst not reaching their set targets, the remaining two participants also achieved relatively high on-task scores with ascending trends. Oscar reached 52% in the 13th and 51% in the 14th intervention session and Simon reached 52% in the 12th and 59% in the 13th session. For disruptive classroom behaviours, both Mark and Richard achieved the set target in six of their intervention sessions. Participants O and S, although not reaching their targets also demonstrated relatively high performance with descending trends: Oscar's disruptive classroom behaviour decreased from 83% to 56% during the intervention sessions and Simon's decreased from 79% to 37%.

The results are unlikely to be attributable to practice effects or time factors because the multiple baseline design effectively demonstrated that behavioural change was achieved only once the App was in use. Despite some modest performance achievements, the results are nonetheless clinically significant with increases in on-task behaviour and decreases in disruptive behaviour in all cases. Furthermore, the unique intervention appeared to be popular and willingly accepted by participants (students and teachers), teacher assistants, school personnel, the head of special education and parents, thus

enhancing its social validity. For example, two parents requested to have the App installed on their mobile phones so that they could use it at home for their children's evening routines (e.g. a homework session from 18.00-18.30 with a choice of where to do this; meal time from 18.30-19.00 with a choice of dessert, etc.) At home, the App content was broadcast on to a smart screen in the living room or the child's room.

In many instances, teachers anecdotally reported productive discussions with other students regarding alternative choices teachers could use during their lessons using the App (e.g. presenting their own work via Zoom – such as due to Covid-19, listening to their music when independent work was completed, specific background pictures on the screen to indicate that the lesson was approaching its end), thus making the use of the App a socially constructive as well as educationally fun activity for everyone. Reportedly, such student discussions often productively extended to students' learning habits, educational interests, needs, capabilities and desires. Some school personnel requested that the App be installed on their mobile phone as they were delighted with the positive responses of students. For example, two teachers were astounded to witness two of their challenging students quickly re-engaging in the lesson once they returned from a 10-minute drinking/toilet break. Apparently, such 'returns' had previously involved considerable disruptive classroom behaviour, often resulting in the students being sent to report to the head teacher or, worse, to the Special Education Director.

Additionally, the use of high-tech classroom management in a single mobile App might have contributed to accessible and fun learning as well as improved teaching. Participating teachers adopted a range of methods to learn how to improve their teaching habits, for example, adhering to their own choice of segment-timing, becoming more aware of students' needs and desires by adding two relevant choices for each lesson, and making students aware of changes in segment times by swiftly and simply adjusting the time, essentially becoming more punctual and efficient and, thus, enhancing teaching and learning efficacy. It appears, therefore, that teacher behaviour (constructive teaching and support) was likely reinforced by positive changes in students' attending and, ultimately, learning and enhanced performance. In other words, students developing appropriate learning-behaviour patterns, achieving higher grades, decreasing their disruptive classroom behaviours and increasing appropriate classroom social interactions (e.g. expressing opinions with permission and making socially acceptable arguments) may likely

lead to the increased probability of teachers employing a similar teaching approach, in a much-desired positive cycle of teaching and learning. If so, the high-tech classroom-management App could have been effective in making relevant stimuli and instructions more salient, leading to greater student progress, increased learning opportunities and less disruptive behaviour. This may be encouraging news for many schools and educational environments with limited funds. Rather then employ personnel with specialist skills in classroom management, one could provide a relatively effective programme that promotes predictable learning, offers a sense of control, efficient teaching, with tangible outcomes in terms of on-task and disruptive behaviours that would, hopefully, be maintained and generalised.

Intrinsically, the App (with its dual interface for teachers and students) was designed in such a way as to offer students a degree of predictability and choice (within set parameters), and so some control over the teaching environment potentially enhancing both teaching and learning. The intervention was discreet because it occurred during the time when teaching was already happening, and in the same place and time at which it occurred naturally, and in a place familiar to the students and teachers. Furthermore, it was simple and motivating because it involved using mobile phones (a frequent activity for many people) and unambiguous information presented on screens for the students. It also enabled teachers to continue to teach in the same way (because the App itself was about process not content) but with additional control over their own timings and choices. Essentially, the App did not intimidate its users as it did not dictate what or how to teach but simply required teachers to upload it in segments and broadcast it to their students minutes ahead of real time and, most importantly, during the lesson as it progressed. The student interface was also friendly and positive. It added more control and predictability, providing more information about the lesson before it began and, most importantly, as the lesson was progressing and, thus, reducing stress and uncertainty during the time students needed to be completely at ease – ready for learning and enjoying learning. Lastly, the enhanced motivation of using the App ensured a level of commitment and consistency with tangible outcomes for both students and teachers, with the students' behaviour being automatically reinforced by greater success and the teachers' behaviour also being reinforced by student success. Indeed, the core of the programme was based on methods widely shown in the literature to be effective with individuals with EBD (for example, Brady et al. 2019; Bradshaw et al., 2015; Borgen et al., 2020; Clair et al., 2018;

Gage et al., 2018; Hickey et al. 2017; Praveen & Anoop, 2018, etc.). Any person can and in fact does have the desire and right to learn, progress and experience an enriched, independent lifestyle, respected by others, with control over their own environment, and to achieve success regardless of their level of EBD or, indeed, the wider range of labelling which society carefully chooses for its members. The use of the App as an intervention described in this study does not discriminate between individuals' capabilities, disorders or disabilities but complements individuals' characteristics, desires and needs. For example, the 'Other' option in the teacher interface of the App enables teachers to develop lessons as they wish and does not restrict them in any way. The App was designed to be installed on a teacher's own mobile phone to save them having to carry around an alternative device to use to upload their lessons. For students, once it was broadcast on the screen, the App not only enabled them to see the end of the lesson approaching but declared it boldly, as the lesson presented on the screen acted as a non-written, 45-minute binding covenant between teacher and students. This may potentially have enhanced learning by reducing the behavioural difficulties associated with stress, uncertainty, fear and anxiety (e.g. Panksepp, 2000), commonly found to be associated with hindering learning.

The literature on behaviour analysis is rich with research aiming to find new ways to enhance quality of life for children, adults and students at all ages, including through empowering students with choice and a degree of control (Kellough & Kellough, 2011; Praveen & Anoop, 2018; Tasky et al., 2018). The results in our study complement this worthy objective by offering teachers a relatively effective and easy-to-use high-tech App to increase on-task behaviour and reduce disruptive classroom behaviour, ultimately enhancing the quality of life of students with EBD, teachers and significant others.

Many related investigations have designed multi-element behavioural training programmes, some of which were highly effective, resulting in notable behavioural changes, yet which often required excessive resources and many training hours for multiple highly skilled personnel. For example, in a study aiming to examine the impact of the Self Determination Learning Model of Instruction on the on-task and off-task behaviours of students with EBD in general education classrooms, researchers taught self-determination skills in three phases, each of which required approximately 10 sessions each lasting 1½ hours, i.e. a mean average of 45 teaching hours for highly skilled personnel (Kelly and Shorgen, 2014). It reported encouraging results with a mean average

increase of 65% for on-task behaviours and a reduction of 53% for off-task behaviours. However, providers with limited funds may not be able to use such resource intensive interventions, thus leaving their students subject to poor teaching, poor achievement and a learning experience which essentially leads to an impoverished quality of learning and life. Additionally, the lack of component analyses in multi-element investigations has prevented the identification of the relevant controlling variable(s), naturally weakening credibility and potentially increasing costs (cf. Hickey et al., 2017; Kissel et al., 1983; Wood et al., 2007). Although, in many ways, the current study extends these and other studies, it differs in that it requires fewer resources: approximately 120 minutes of teachers' time to learn how to operate the App (Figure 2, p.22) plus, of course, the (one-off) cost of developing the App. Perhaps future research should consider discussing such figures, so that a realistic overview of economical programmes can be achieved.

Study Limitations and Further Research Suggestions

The current study proposed a dual-component, classroom-management behavioural training programme in the form of a mobile App providing predictability and a sense of control. The content of the App is broadcast to the screen in the students' classroom where they can see the layout of the lesson, but is planned and the choices made by teachers. Several sub-components embedded within the App might have had uncontrolled effects in terms of the participants' behaviour change: for example, the animation showing the progress of the lesson, the personalisation of the App (e.g. choice of background, colour etc.), the specifics of the two choices embedded within the App, the location and use of the screen, the visual representation of elapsed time running on the screen, and also the behaviour of the teacher whose fluency in lesson delivery would have been influenced by the moving animation on the screen, the time allocated to specific segments and choice elements etc. These may well have contributed to the target behaviour outcomes because no form of control over these sub-components was designed and so their individual effects upon the behaviour change are unclear (Ward-Horner & Sturmey, 2010). Similar results could have been achieved without, for example, personalising the App or the layout of the screen content, or designing it as exceptionally user-friendly, Thus, costs could, potentially, have been further reduced, making the App even more viable as a cost-effective and efficient intervention. This is one of the major limitations of this study and, thus, it might be useful for future studies to consider a

component analysis in order to under the level of control exerted by specific variables in an attempt to gain effective classroom management programmes at low costs.

In their study, Hickey et al. (2017) investigated a multi-component classroom-management intervention programme, providing teachers with a series of specific skills, establishing more positive relationships with pupils, developing clear classroom rules, using predictable schedules, providing praise and attention for pro-social behaviour, using encouragement and incentives, ignoring negative behaviour, using timeout and limit-setting as minimally non-aversive discipline strategies, and facilitating child-directed play and cooperative learning opportunities. Hickey et al. used two highly skilled, trained and fully accredited professionals as facilitators. Training was delivered one day per month for five consecutive months and took the form of instructions, modelling, phone calls and more. The results of their study were divided into teacher outcomes and pupil outcomes. Overall intervention attendance was high, at 96%. Teacher outcomes were significantly high in some areas, such as using less harsh and restrictive classroom-management strategies and more positive classroom-management strategies, and giving pupils additional time to comply with instructions and questions. In other areas the change was limited, for example, to the use of classroom-management strategies, praise, indirect commands and direct commands. Future studies should seriously consider the controlled evaluation of functionality-related sub-components, such as providing video footage of the instructions and footage samples of how and when such instructions or praise should be delivered. Factor analyses could be conducted to assess the contribution of each individual component, potentially saving costs and ultimately benefiting many students who experience poor learning achievements, ineffective education and an impoverished quality of life.

Direct comparison between the Hickey et al. (2017) study and the present study is not possible, primarily due to the participants' age and background but also because of the type of intervention, length and costs. Hickey et al. experimented with participants who were 5 years old on average, with no diagnosis of any mental illness or learning difficulty. Moreover, the trainers were highly skilled and training extended over several months. The actual training programme was well known and implemented worldwide, and the cost of their multi-component packaged intervention rose to over €20,000, all of which could have influenced the results. This contrasts with the participants and other factors in the present

study. Participants were 11.5 years old on average and the intervention facilitators were the teachers themselves: essentially non-specialists with no specific background in any type of behavioural intervention programmes. The length of training in the current study was only two hours in total and costs were approximately one-tenth of the costs in Hickey et al.'s study. The intervention programme used in Hickey et al.'s study was comprehensive, detailed and prestigious, as opposed to the high-tech but low-cost and simple implementation of the present study. Perhaps future studies could also attempt to control for the facilitators' background knowledge and skills, the type of intervention, its ease of implementation, length and costs, to ascertain the impact upon behavioural change and, possibly, to reduce costs further to ensure that classroom management training is viable for a wider range of school personnel, staff and facilitators in general.

A major training element of the study involved technology: making use of smartphones, screens and an App. The use of technology is contemporaneous with the current era, which has changed dramatically and quickly over recent years and for which, therefore, little research exists. Nonetheless, recent research has suggested that high-tech methods of teaching new skills are effective, economical and simple to apply and often result in positive outcomes (e.g. Curran et al., 2019; Dash, 2019; Tu et al., 2018). In fact, the current study makes extensive use of App development technology to make learning, as well as teaching, effective, accessibly, easy and, most importantly, motivating and fun. Furthermore, the choices embedded within the lessons were based on Glasser's Choice Theory (1998) and Tasky et al.'s (2018) classroom-management evaluation (for students with traumatic brain injuries), which aimed to take advantage of pupils' preferences, existing skills, and the aim and objectives of the subject areas being taught. This may have differentially impacted on the results based on the function of the pupils' disruptive behaviour (which was not assessed). For example, pupils who throughout their school years had exhibited disruptive behaviour with an escape function, where exhibiting such behaviour had the effect of their removal from an unwanted lesson or environment, were now intermittently provided with choices other than engage versus disengage. For such individuals, escape may no longer have been necessary because of the reduction and predictability of demands commonly related to disruptive classroom behaviour (Brown, Bellamy, Perlmutter, Sackowits & Sontag, 1972). This may have had little or no impact on pupil disruptive behaviour that was maintained by attention from others. Future research

should conduct functional analyses of pupil problem behaviour and assess the impact on and across problem behaviour serving different functions.

For ease of implementation purposes, teachers and students were encouraged to use ordinary teaching materials where possible, use the existing screens that were already fixed in their classroom, stick to the same subjects and topics with their respective aims and objectives, and for the same hours and with the same classes. The benefits and disadvantages of such decisions (and others) had to be evaluated prior to the start of the study. For example, by not using the App to teach an entirely new subject or subject area, and not using newly qualified teachers to use the App, unnecessary initial changes in routine with the additional uncertainty and unpredictability that they may have introduced (which would have likely been related to disruptive behaviours were reduced (cf. Saunders & Spardlin, 1991). New teachers and new subjects could have been introduced at a later stage contingent on the successful application of the App, but would have impacted on the overall response effort involved in implementation. This might have contributed to what was clearly perceived to be a popular and fun learning programme for both students and teachers. For teachers, using lessons they have already prepared and taught made uploading the lessons using the App quick and easy, with low response effort and, thus, with a higher probability of being reinforcing for the teacher. The teachers' motivation during the class may have been an unintended outcome of the ease of implementation and although the data on teachers' $social^{+}$ contact remained largely unchanged, there was a clear decreasing trend for all teachers in terms of the $social^{-}$ contact exhibited towards the pupil participants. It would be important for additional research to compare the possible differential effects of manipulatiung the response effort involved in the use of the App.

In other studies, researchers demonstrated high levels of performance using multi-element classroom-management programmes. Clair, Bahr, Quach and LeDuc (2018) examined the coupling of behaviour-specific praise, teacher performance feedback and contingency-specifying stimuli as the primary strategies of a classroom-management intervention package. Each of these techniques has been researched in its own right, although they have not been tested in one multi-component treatment package. The researchers hired two highly skilled consultants who delivered classroom intervention programmes aimed at increasing on-task learning and decreasing inappropriate verbal and motor behaviours. This Positive Plus intervention programme was a relatively costly

and complex multi-element training programme requiring approximately 6.5 hrs per day for 31 days, totalling 201 training hours. The results across all four students showed an average increase from a baseline of 54.98% to 72.95% during the intervention. A greater increase was evident from the second baseline: 38.43% to 73.27%. The average performance increase was 26.41%, whereas the average percentage increase in the present investigation was slightly higher at +30% for on-task behaviours and -33% for disruptive classroom behaviours. Given the huge differences between Clair et al.'s (2018) study and the current study in terms of overall cost and response effort, and that the procedures used in the present investigation appear to have had greater positive effects all around – student outcomes, teacher behaviour, measures of social validity for all stakeholders – future research in terms of the use of such an App would benefit from an evaluation of the effects of additional training time, and the involvement of more skilled and experienced teachers to see if the tentative outcomes achieved could be enhanced significantly. This would also allow schools to evaluate the cost-effectiveness of such an investment relative to the outcomes achieved.

The data-recording sheet used in this investigation enabled objective and controlled evaluation. For example, each of the on-task or disruptive classroom behaviours measured was simply and clearly defined, leaving little room for personal interpretation or bias. Nonetheless, it was fairly limited in its scope and did not allow for the observer to record other potentially significant variables that were more subjective in nature. For example, there were anecdotal reports of increased 'enthusiasm' and 'curiosity' from some of the other students in relation to the use of the App and the visual displays on the screen during the lessons. Additionally, such increased activity within the classroom may have led to some observer drift due to increased opportunities for distraction, and reactivity from the teachers who were unsure whether to respond to such activity or ignore it. Moreover, at times, when the researcher was present during data collection (for example, for inter-observer data collection), both the teachers and teaching assistants looked at the researcher, as if to ask whether such activity (mainly around exploring and learning the screen and App layout) should have been recorded or noted. Perhaps allowing additional time for students and teachers to become accustomed to the new features and screen would have eliminated some of these distractions and resulted in different outcomes in terms of the data collected. Another limitation of the data-recording system was that it only able to record a single instance of student on-task or disruptive behaviour, rather than

multiple occurrences across different topographies. In other words, any increased frequency of topographical responses that occurred during the lesson was not captured, thus reducing the sensitivity of the study to detect improvements in performance.

Visual analysis of the data recorded for three of the four participants reveals what appears to be a very gradual behaviour change from baseline to intervention phases for both on-task and disruptive classroom behaviours (see Figure 9) and may perhaps hint at weak experimental effects. Engel and Schutt (2008) identified five limitations of using visual interpretations for single-subject design findings, the second of which relates to the immediacy of the behaviour change. That is, when the change is not evident immediately after the intervention is presented, this may negatively influence the experimental effects. In a study examining how a school-wide bullying prevention programme affected the bullying behaviour of particular students, Ross and Horner (2009) studied two students who had regularly engaged in bullying. During the baseline phase, they observed the students for 10-minute periods each day during the lunch break and counted the number of aggressive behaviours they exhibited toward their peers. After two weeks, they implemented the programme at the first school, after two more weeks they implemented it at a second school, and after another two weeks they implemented it at a third school. They found that the number of aggressive behaviours exhibited by each student dropped shortly after the programme was implemented at his or her school, but the behaviour change was not evident immediately. If the researchers had only studied one school, or if they had introduced the treatment at the same time at all three schools, then it would have been unclear whether the reduction in aggressive behaviours was due to the bullying programme or some other environmental variables not considered, such as some incident that happened at about the same time the intervention was introduced. With their multiple-baseline design, however, this kind of coincidence would have to happen three separate times, a very unlikely occurrence, to explain their results. Similarly, the present study examines four individuals in four separate classes with four different teachers, classes and lessons, thus increasing the likelihood that the results, albeit showing only gradual changes at times, are related to the application of the intervention. Moreover, the intervention introduced in this study is to some extent unique and innovative, introducing a fundamental change within the educational environment, and as with other innovations and changes globally, the initial responses are to some extent unknown, variable and even sporadic. Rotter (1954, 1966) explains human behaviour in response to innovations and

change, or indeed to unfamiliar stimuli. The psychological construct of the locus of control predicts that an individual's behaviour is guided by the perception that a certain behaviour will lead to an expected reinforcement. Lever, Pinol and Urlade (2005) explain that, from the individual's viewpoint, the locus of control is the motivating force that leads the individual to behave in a particular manner. The outcome of the selected actions will be determined either as a consequence of the behaviour (internal) or as a result of circumstances unrelated to the behaviour (environmental/external). The locus of control concept has been widely discussed and leveraged within the education arena. It is based on internal versus external control, referring to the degree to which an individual believes that a desired outcome can be achieved through their own behaviour or personal characteristics. If the desired outcome occurs, this serves as a reinforcement of the belief in internal efficacy. Carr, Hard and Trahant (1996) also explain change by defining it as making something different from its initial position, involving confrontation with the unknown and loss of the familiar. Carr et al. claim that it implies a significant disruption in established patterns of behaviour and/or expectation and could lead to discontinuity, destruction and the replacement of familiar social structures and relationships. It could alter set patterns of behaviour and define work procedures, job skills and relationships with others. All these changes may present individuals with new situations, new problems and challenges, ambiguity and uncertainty. Given that the intervention presented in this study was relatively novel for the participants, it may be that participants initial responses were delayed whilst trying to ascertain those behaviours to be displayed in order to gain access to reinforcement. Admittedly, this was explained to the students verbally prior to the implementation of the intervention, but existing research suggests that an instruction alone may not readily lead to a change in behaviour relative to a history of reinforcement/punishment. Since students' learning history in respect of this intervention was limited (because the intervention was unique and new), participants may have required additional time to understand the contingencies.

The use of high-tech classroom-management systems has several advantages in terms of future research. Mobile Apps may be designed and customized for different teachers and students to allow a range of teaching providers in a multitude of educational settings to provide learners with predictability and a sense of control in order to increase on-task behaviours and reduce disruptive behaviours. These, in turn, could lead to similar outcomes in terms of achievement and the experience of success, whilst being fun and

involving active and positive participation, and this ought to have an inevitable influence on the way that teaching and learning are perceived. Apps could be designed and evaluated for use in different settings, both with and without the mediation of a teacher's input. This may well define and set precedents for future educational contexts by emphasizing that teaching and learning should be both functional and meaningful and, perhaps even more importantly, that learning should be a joyous and and fun experience that empowers achievement and ultimately influences quality of life. There are multiple components and parameters that should be evaluated for the use of hi-tech systems to optimize their efficiency and cost effectiveness.

The purpose of the design and use of the App was not to guide teachers or trainers in terms of what to teach or to dictate or suggest how to teach, as do the majority of the multi-component classroom-management intervention programmes. Instead, the App quite simply guides its users to communicate what and how they plan to teach before the lesson begins and, most importantly, during the course of the lesson. It also encourages its users to embed choice elements which, in turn, transfers a degree of control from the teachers to the students. The fact that the intervention does not dictate to teachers what and how to teach or suggest new ways of teaching – such as providing clear instructions, guidelines for the use of reinforcement, schedules, rules etc. – may have the effect of reducing inherent resistance to 'rules and guidelines' (Carr, Hard & Trahant, 1996). It simply offers clarity in terms of what is going to be learnt and how, so that learners can become familiar with these objectives before the lesson begins and, most importantly, during the lesson. Future research might wish to evaluate whether such Apps might be more or less effective for some content areas rather than others. For example, would the use of a hi-tech system lead to similar gains for teaching subject areas that are heavily reliant on learning of facts (e.g. the sciences) and it would for subject areas that encourage creative thinking (e.g. the arts). Given that the App used in this study was deliberately content-free, future research might also wish to evaluate the impact of making the use of the App more prescriptive in certain circumstances.

In summary, the overall aim of this study was to evaluate the use of hi-tech classroom management system (in the form of an App) in terms of whether it would lead to an increase in on-task behaviours and reduction disruptive classroom behaviours in four students with EBD. The premise for the successful use of the App was drawn from

behavioural, cognitive and social learning theory constructs and concepts. The performance levels achieved, to some degree, fell below other related studies which had focused on low-tech strategies albeit with multi-component procedures. Yet, given the ease of use, affordability, limited expenditure in terms of training requirements, and its uniqueness and use of modern and powerful innovative technology, the results were extremely promising. The small number of particiapnts and some of the limitations previously described require future studies to assess the efficacy and efficiency of the intervention in a range of teaching situations, and across different individuals and settings. The relatively low-cost programme, combined with the relatively rapid behaviour change observed in participants, may be appealing to educational personnel seeking new and innovative technology to adopt for this day and age, where learners seek more control and more predictability and are no longer willing to accept an impoverished learning environment where teachers control and dictate within the classroom. High-tech classroom management systems such as the one presented in this study might well appeal in many educational environments. If teachers with experience of over 15 years, whose teaching skills have been shaped and deeply rooted over the years, would be willing to learn to use such hi-tech systems, and use them to improve the teaching experience, enhance the learning experience and increase the quality and motivation of the experience for all, then high-tech classroom-management intervention programmes could/would be disseminated extensively. Such interventions are the future whether we like it or not, and they may be more effective than traditional teaching and teaching methods and have a significant impact on many learners worldwide, in a variety of age-groups, settings and subject areas, ultimately enhancing the quality of learning and life experience for many.

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Appendices

Appendix 1: A letter detailing the procedures and potential outcomes of the study.

<u>Information About Research - Participants</u>

<u>Project title</u>:
High-tech Classroom Management: Effects of Apps on Disruptive and On-task Classroom Behaviours for Students with Emotional and Behavioural Disorder.

<u>Researcher</u>:
Gabriel Cohen, BCBA. Head of the Applied Behaviour Analysis program, a Verified Course Sequence in Oranim academic college for education, Israel. (<u>gabriel.cohen@oranim.ac.i</u>).

<u>Supervisor</u>:
Neil Martin, PhD, BCBA-D. Director of International Development for the BACB (<u>neil@BACB.com</u>).

<u>Description</u>:
I am requesting your participation in a study that examines the effectiveness of a mobile phone application (App) on reducing disruptive and increasing on-task classroom behaviours. During the project, you will be exposed to lessons similar to those you're already used to; sitting on your same seat in the same classroom with the same teacher, learning the same material you would expect to learn on any typical day and so on. The only one difference is that during time this project will take place, you will notice a 60" flat screen placed on the wall in front of you, next to teacher while board,. On that screen, you will be able to see the structure of the lesson showing lesson segments, time allocated to each segment, two choices for you to make during each lesson and appropriate classroom behaviours your teacher is expecting you to present with during the lesson. Lastly, you will be able to follow the progression of the lesson, its path and when it ends. During lessons you would be able to look at the screen as and when you want to. It will be entirely up to you. You will notice that during lessons the structure may differ according to how the teachers planned their lessons.

The project will include three phases:
1. **Pre-Baseline** - during this phase I will visit your classroom and observe parts of lessons, I will simply watch you learning. You would simply do what you normally do in a typical lesson. I will probably enter your class a few times and do nothing but observe for a few minutes each time then leave without saying anything to anyone. I probably won't even smile, so sorry about it. This is to ascertain your learning behaviours during lessons.
2. **Baseline** - during this phase and before you begin learning I will provide you with an instruction sheet explaining what on-task behaviours your teacher is expecting you to demonstrate during the lesson and what behaviours are forbidden during lessons. For clarity, I will define each behaviour and ask you to demonstrate to ensure it is clear. We will have 10 minutes to read this together and I will answer your questions should you have any. Over several days, I will visit your class and observe you learning and take some notes. I expect you to behave according to what you read in the instruction sheet. I will probably enter your

class a few times and observe for several minutes each time then leave without saying anything to anyone. I probably won't even smile, so sorry about it.

3. **Intervention** - during this last phase, and before any lesson begins, I will introduce you to the 60" flat screen in your classroom. It will be On and we will go through the components showing you the segments, times, choices, behaviours and the path of the lesson. We will look at it for 10 minutes and I will answer questions. For clarity, I will define each behaviour and ask you to demonstrate to ensure it is clear. Then, over several days, I will visit your classroom observe you learning and take some notes as I did during the previous phase. As previously, I will probably enter your class a few times and observe for several minutes each time then leave without saying anything to anyone. Again, I probably won't even smile, so sorry about it.

I would like to confirm and assure you that the results of this study will be strictly confidential. All data will be kept secure and locked away from anyone else. No names or any identifying details will be shared or retained with the exception of the researcher and the supervisors assessing this study. No other persons will be allowed to see or discuss any of the individual responses. Your responses will be combined with others and reported in a research report/a journal article. Video and photos may be taken and be treated with confidentiality and may be used for learning purposes only. Your participation is voluntary and you may withdraw your participation at any time with no consequences whatsoever.

Should you have any questions please ask now or contact the researcher Gabriel Cohen by phone +972549267773 or by mail gabriel.cohen@oranim.ac.il) or Dr. Martin by mail neil@bacb.com.

Yours sincerely,

Name:_____

Date:_____

Appendix 2: A formal request for consent.

Formal Written Agreement

I am the Director of Special Education of this school
_____, have read carefully the Information Form, fully understand the nature of this study, freely and voluntary give my agreement for this study to take place within our school, pupils and teachers. I am also happy to be involved in this study. Furthermore, the potential outcome and risks of this study were discussed in a best interest meeting. We have found no potential risk with conducting this study but in contrast found great potential benefits for the entire school, pupils and teachers.

Please circle Yes or No for the following two questions:

1. I hereby give my written agreement for this study and to be involved as and when needed.

Yes / No

2. I am happy to have my photo taken.

Yes / No

Full name:_____.

Date:_____.

Signature:_____

Appendix 3: Teaching assistants and Director of Special Educaitons' Formal written agreements for this study.

- **Not attached due to confidentiality -**

Appendix 4: A signed agreement for App-Store with Apple.

18:04 🔒 developer.apple.com

Gabriel Cohen | Sign Out

Thank You

We are processing your order and will send you an activation email when it's ready. Please note that it may take up to two (2) business days to process your order.

Order Details
May 11, 2020

Item

Apple Developer Program
1 year membership

US$ 99

Your order will be charged in U.S. dollars   **Order Total:** US$ 99

Payment Information

Address Line 1:
   39 Mevo Ha Kfar

City/Town: **Har Adar**

State, Province, or Region:
   Israel region

Country: **Israel**

Billing Phone:

18:04 🔒 developer.apple.com

Member Information

Name: **Gabriel Cohen**

Email: **gabriel@gabrielcohen.co.il**

Enrollment ID:
   MR94UUHSLJ

Frequently Asked Questions

What payment methods can I use?

You can pay for your items with a Visa, Mastercard, Discover, or American Express.

Can I use a credit card other than my own to complete my purchase?

The payment information you provide must match exactly with your enrollment information. If this information does not match, your enrollment will be delayed and you may be asked to provide a copy of a government issued identification.

When can I access my items?

Once your payment has been processed, you will receive an email from Apple Developer Program Support on how to activate and access your items. It may take up to two (2) business days to process your order.

Shop the Apple Online Store (1-800-MY-APPLE), visit an Apple Retail Store

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Appendix 5: Data collection form

Participant Initial:_____. Observer initial:_____. Obs#:_____. Lesson:_____.

Lesson difficulty level:_____. Date:_____. Time:_____.

Phase: Baseline:_____. Intervention:_____. Probe:_____.

Secondary Observer (40 interval only):_____.

Interval time	On-Task	Disrpt. Behav.	Teacher. Social Contact		Interval Time	On-Task	Disrpt. Behav.	Teacher. Social Contact	
			Incrs. Behv.	Decrs. Behav.				Inc. Behav.	Dec. Behav.
1 - x.x.00-x.x.10					32 - x.x.20-x.x.30				
2 - x.x.10-x.x.20					33 - x.x.30-x.x.40				
3 - x.x.20-x.x.30					34 - x.x.40-x.x.50				
4 - x.x.30-x.x.40					35 - x.x.50-x.x.00				
5 - x.x.40-x.x.50					36 - x.x.00-x.x.10				
6 - x.x.50-x.x.00					37 - x.x.10-x.x.20				
7 - x.x.00-x.x.10					38 - x.x.20-x.x.30				
8 - x.x.10-x.x.20					39 - x.x.30-x.x.40				
9 - x.x.20-x.x.30					40 - x.x.40-x.x.50				
10 - x.x.30-x.x.40					41 - x.x.50-x.x.00				
11 - x.x.40-x.x.50					42 - x.x.00-x.x.10				
12 - x.x.50-x.x.00					43 - x.x.10-x.x.20				
13 - x.x.00-x.x.10					44 - x.x.20-x.x.30				
14 - x.x.10-x.x.20					45 - x.x.30-x.x.40				
15 - x.x.20-x.x.30					46 - x.x.40-x.x.50				
16 - x.x.30-x.x.40					47 - x.x.50-x.x.00				
17 - x.x.40-x.x.50					48 - x.x.00-x.x.10				
18 - x.x.50-x.x.00					49 - x.x.10-x.x.20				
19 - x.x.00-x.x.10					50 - x.x.20-x.x.30				
20 - x.x.10-x.x.20					51 - x.x.30-x.x.40				
21 - x.x.20-x.x.30					52 - x.x.40-x.x.50				
22 - x.x.30-x.x.40					53 - x.x.50-x.x.00				
23 - x.x.40-x.x.50					54 - x.x.00-x.x.10				
24 - x.x.50-x.x.00					55 - x.x.10-x.x.20				
25 - x.x.00-x.x.10					56 - x.x.20-x.x.30				
26 - x.x.10-x.x.20					57 - x.x.30-x.x.40				
27 - x.x.20-x.x.30					58 - x.x.40-x.x.50				
28 - x.x.30-x.x.40					59 - x.x.50-x.x.00				
29 - x.x.40-x.x.50					60 - x.x.00-x.x.10				
30 - x.x.50-x.x.00					61 - x.x.10-x.x.20				
31 - x.x.00-x.x.10					62 - x.x.20-x.x.30				

Interval time	On-Task	Disrpt. Behav.	Teacher. Social Contact		Interval Time	On-Task	Disrpt. Behav.	Teacher. Social Contact	
			Inc. Behav.	Dec. Behav.				Inc. Behav.	Dec. Behav.
63 - x.x.30-x.x.40					92 - x.x.30-x.x.40				
64 - x.x.40-x.x.50					93 - x.x.40-x.x.50				
65 - x.x.50-x.x.00					94 - x.x.50-x.x.00				
66 - x.x.00-x.x.10					95 - x.x.00-x.x.10				
67 - x.x.10-x.x.20					96 - x.x.10-x.x.20				
68 - x.x.20-x.x.30					97 - x.x.20-x.x.30				
69 - x.x.30-x.x.40					98 - x.x.30-x.x.40				
70 - x.x.40-x.x.50					99 - x.x.40-x.x.50				
71 - x.x.50-x.x.00					100 - x.x.50-x.x.00				
72 - x.x.00-x.x.10					101 - x.x.00-x.x.10				
73 - x.x.10-x.x.20					102 - x.x.10-x.x.20				
74 - x.x.20-x.x.30					103 - x.x.20-x.x.30				
75 - x.x.30-x.x.40					104 - x.x.30-x.x.40				
76 - x.x.40-x.x.50					105 - x.x.40-x.x.50				
77 - x.x.50-x.x.00					106 - x.x.50-x.x.00				
78 - x.x.00-x.x.10					107 - x.x.00-x.x.10				
79 - x.x.10-x.x.20					108 - x.x.10-x.x.20				
80 - x.x.20-x.x.30					109 - x.x.20-x.x.30				
81 - x.x.30-x.x.40					110 - x.x.30-x.x.40				
82 - x.x.40-x.x.50					111 - x.x.40-x.x.50				
83 - x.x.50-x.x.00					112 - x.x.50-x.x.00				
84 - x.x.00-x.x.10					113 - x.x.00-x.x.10				
85 - x.x.10-x.x.20					114 - x.x.20-x.x.30				
86 - x.x.20-x.x.30					115 - x.x.30-x.x.40				
87 - x.x.30-x.x.40					116 - x.x.40-x.x.50				
88 - x.x.40-x.x.50					117 - x.x.50-x.x.00				
89 - x.x.50-x.x.00					118 - x.x.00-x.x.10				
90 - x.x.00-x.x.10					119 - x.x.10-x.x.20				
91 - x.x.20-x.x.30					120 - x.x.20-x.x.30				
63 - x.x.30-x.x.40					92 - x.x.30-x.x.40				
64 - x.x.40-x.x.50					93 - x.x.40-x.x.50				
Score:					Score:				

* % On-task/Disruptive/S. contact exhibited = no. of B's / (no. of available intervals (120) – missed M intervals) x 100. If participants exhibit any one of the behaviours associated with being on-task at any time within a 10-s intervals, the interval will be marked as on-task. If participant demonstrate disruptive behaviour at any time within the same 10-s interval, the interval will be marked as disruptive. On-task and disruptive behaviours will not be considered mutually exclusive during a given interval, which will allow on-task and disruptive behaviours to be coded in the same interval regardless of which behaviour occurred first. Social contact will be scored when teacher made any contact (verbal of physical) with the participant specifically; any social contact with intention to Increase Behavior will be scored in the appropriate column. Any social contact with intention to Decrease participant Behaviour will be marked accordingly.

Observer signature:_____

Appendix 6: Example of a completed inter-observer agreement form.

Inter-Observer Agreement for the 10s Partial Interval Data Collection System
(Agreement is scored when both data collectors record an occurrence or non-occurrence during a given interval. A disagreement is scored when a discrepancy occurs.)

#	Tick for agreement in recording On-Task Behav.	Tick for agreement in recording Disruptiv. behav.	Tick for agreement in recording Teacher Social Contact.	
			Increase Behaviour	Decrease Behaviour
1	✓	✓	✓	✓
2	✓	✓	✓	✓
3	✓	✗	✓	✓
4	✓	✓	✓	✗
5	✓	✓	✓	✓
6	✗	✓	✓	✓
7	✓	✓	✓	✓
8	✗	✓	✓	✓
9	✓	✓	✓	✗
10	✓	✓	✓	✓
11	✓	✓	✓	✓
12	✓	✓	✓	✓
13	✓	✓	✓	✓
14	✓	✓	✓	✓
15	✓	✓	✓	✓
16	✓	✓	✓	✓
17	✗	✓	✓	✓
18	✓	✓	✓	✓
19	✓	✓	✓	✓
20	✓	✓	✗	✓
21	✓	✓	✓	✓
22	✓	✓	✓	✓
23	✓	✓	✓	✓
24	✓	✓	✓	✓
25	✓	✗	✓	✓
26	✗	✓	✓	✓
27	✓	✓	✓	✗
28	✓	✓	✓	✓
29	✓	✓	✓	✓
30	✓	✗	✓	✓
31	✓	✓	✓	✓
32	✓	✓	✓	✓
33	✓	✓	✓	✓
34	✓	✓	✓	✓
35	✗	✗	✓	✓
36	✓	✓	✓	✓
37	✗	✓	✓	✓
38	✓	✓	✗	✓
39	✓	✓	✓	✓
40	✗	✓	✓	✓
%	82.5	90	95	92.5
	Date: 12\8\20	Signature:		

M + M teacher

Appendix 7: Instruction sheet with all behaviour definitions.

Before your lesson begins, please read the following guidelines and familiarise yourself with the behaviours you are expected to present during your lessons:

	On-task behaviours – to exhibit
1	Listening to the teacher's instructions (the participants oriented toward the teacher with eyes open and not talking).
2	Raising your hand (left or right).
3	Writing in your notebook or booklet.
4	Reading written work (reading silently to yourself or aloud to the class).
5	Talking to the teacher.
6	Discussing set work with a neighbour.
7	Having the teacher check your work.
8	Talking to a group in a group discussion task.
9	Reading from the white board.
10	Researching information on the computer.
11	Looking up words on the computer or in a hard copy dictionary.
12	Complying with other verbal instructions given by the teacher or assistant.
13	Looking up at the flat screen.
	Disruptive behaviours – NOT to exhibit
1	Non-compliance.
2	Shouting.
3	Out of seat behaviours, including sitting on your feet, standing up, lying down, or moving your location and seat without permission.
5	Making inappropriate noises, including any vocal noise, when the teacher has not indicated that you may speak.
6	Getting out of your seat.
7	Rocking on your chair.
8	Talking to other students about unrelated topics.
9	Making inappropriate contact with other students and objects, including tapping other students, playing with other students' hair, pushing other students with your hands or feet, and touching materials not related to the current activity (e.g., nearby chairs, jewelry, or shoelaces).

Good luck, and thank you for your cooperation.

Appendix 8: Example of a completed treatment fidelity rating form.

The Treatment Fidelity Rating Form

Lesson #	Total of 45 min lesson	Two choices-segments with two alternatives	1-2 behaviours in each segment	Lesson progress is simulated on the screen	Teacher teaching and screen content are synchronised	Score: #v/5*100
1	✓	✓	✓	✓	✓	100
2	✓	✓	✓	✓	✓	100
3	✓	✓	✓	✓	✓	100
4	✓	✓	✓	✓	✓	100
5	✓	✓	✓	✓	✓	100
6	✓	✓	✓	✓	✓	100
7	✓	✓	✓	✓	✓	100
8	✓	✓	✓	✓	✓	100
9	✓	✓	✓	✓	✓	100
10	✓	✓	✓	✓	✓	100

Rater Initials: аK .   Date: 29|7|20 .   Participant: O .

Signature: .а.к .

Score: 100 .

Date: 29|7|20 .