

# ANALYSIS OF KNEOMEDIA LIMITED KNEOWORLD ESP PILOT STUDY

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# EXECUTIVE SUMMARY

## PURPOSE AND METHOD OF THIS REPORT

The purpose of this pilot study was to identify improvement opportunities for the KNeoWorld ESP platform, and to inform KNeoMedia in the development of their product to adhere to best evidence in educational practice standards. The research presented in this report is based on the pilot study that was designed to answer the following research questions:

1. What are the effects of KNeoWorld ESP gameplay on students' task-engagement, academic achievement, and behavioural concerns?
2. How do students, teachers, parents, and the Monash University research team rate the usefulness of the KNeoWorld ESP platform?

A mixed methods research design was used for this pilot study. The project was conducted in two stages. Stage 1 involved a classroom trial of the KNeoMedia ESP platform at a Special Education School for children who have been removed from their mainstream school placement as a result of severe challenging behaviours and learning challenges. All students enrolled at the school, their teachers, and their parents were invited to participate in the research study. Stage 2 involved an independent evaluation of the version of the platform that was used in the classroom study of Stage 1. A team of five Monash University professors, and one Monash University research consultant evaluated the platform, then subsequently discussed their findings as a group.

## FINDINGS AND CONCLUSIONS

### **Stage 1**

A generally positive experience was noted for the Junior student participants in this study. These students exhibited high rates of time on-task, and displayed highly appropriate social skills during gameplay sessions. Junior students rated their gameplay experiences highly, and expressed a desire to continue to play the game in their classroom environment.

Similarly, a generally positive experience was noted for the Senior student participants in this study. These students exhibited extremely high rates of time on-task, and also displayed highly appropriate social skills during gameplay sessions. Most Senior students rated their gameplay experiences favourably, and expressed a desire to continue to play the game in their classroom environment.

These findings are extremely important given the academic and behavioural challenges the student participants face. Two-thirds of the case study students highlighted in this report have been removed from their mainstream educational setting as a result of Oppositional Defiant Disorder (ODD), in addition to other neurological atypicalities such as ADHD and ASD. That these students have engaged happily and enjoyed a positive classroom learning experience is indicative of the potential value of the KNeo ESP Serious Game as a classroom tool for students with challenging behaviours.

### **Stage 2**

The Monash University research team identified seven minor platform enhancements (Recommendations 1 through 7) for the attention of the KNeoMedia development team. In addition, further recommendations are suggested that will support a cutting-edge evaluation of the enhanced KNeoMedia platform.

## LIMITATIONS

Low response rates from teachers and parents included in this pilot study reduce the confidence readers can place in these findings and limit our ability to draw meaningful conclusions from these stakeholders. Only two teachers participated in the study. The participating teachers agreed to the student participation over the research period but they did not participate in any pedagogical assessment or measurement. It is important to acknowledge that while all parents consented to their child's participation, they did not actively participate in the study. Parents that responded did not get the opportunity to look at the KneoWorld platform extensively. The data from parents thus needs to be viewed with a small degree of caution. Additional research, including larger samples of teachers and parents, is necessary to answer the original research questions from these stakeholder perspectives.

Incomplete pre and post assessment data was provided by Roosevelt Franklin School for the student participants included in this pilot study. Consequently, it was not possible to evaluate skill development in any subject domain for any of the student participants.

## RECOMMENDATIONS FOR PRODUCT IMPROVEMENT AND FUTURE DIRECTIONS

The current KNeoMedia ESP SG offers a strong foundation for additional development. The most robust research standards for single-subject research design, as identified by the US Department of Education, What Works Clearinghouse, have been integrated into this pilot study research. The student participants in this study have all been removed from a mainstream school placement, and many have been identified as having the serious behavioural challenges fitting the description of Oppositional Defiant Disorder (ODD). While students with ODD are frequently denied access to classroom experiences, often set on a pathway to an excluded future at a young age, the students in this study typically exhibited high to extremely high rates of task engagement when using the KNeoMedia ESP platform. Most encouragingly, many of the students were regularly observed enjoying their experiences with this technology, and were noted to engage in highly appropriate conversations with peers that related to the relevant tasks. Recommendations for future development of the product are described in Stage 2 of this report.

## INTRODUCTION

In the second half of 2017, KNeoMedia Limited (KNeoMedia) reported significant success in key international markets, particularly evidenced through significant sales of seat licenses of its serious game (SG) KNeo ESP in New York Public School District 75 (D75). The platform met with strong favourable responses by principals, educators, and students in D75, and KNeoMedia received numerous anecdotal accounts of enhanced concentration, improved on-task engagement, and increased memory and reasoning skills attributed to student use of KNeo ESP.

While KNeoMedia has a strategic vision of wide-scale expansion throughout the United States (US), the United Kingdom (UK), Asia, and Australia, the company remains committed to developing its product to adhere to best-practice standards in education. In their effort to provide a SG that will assist learners with diverse ability levels and individual learning styles to achieve optimal outcomes, KNeoMedia has the intent to inform their future product development based upon the highest level of research integrity.

In April 2018, KNeoMedia engaged Monash University, Australia (Monash), to undertake a robust evaluation of the KNeo ESP SG. Key objectives of this evaluation were to (i) determine the impact of KNeo ESP on levels of task engagement, academic achievement in numeracy and literacy, and behavioural outcomes; and (ii) make recommendations on ways KNeo ESP could be made more effective and acceptable/likeable to students, educators, and families.

Since that time, KNeoMedia has made several major advancements in its business practice. In June 2018, KNeoMedia formed an alliance with the National Association for the Advancement of Colored People (NAACP) in the US. This alliance has strategically positioned KNeoMedia to fast track its sales and roll out of KNeoWorld across the US. In July 2018, KNeoMedia engaged Dubit UK (Dubit) in a technology upgrade of the KNeoWorld platform. Recognised as a global leader in content development, KNeoWorld SG hosting, maintenance, and content enhancement is now conducted by Dubit around the clock.

In response to the evolution of KNeoWorld during the research period, KNeoMedia and Monash agreed that the most appropriate course of action would be to conduct the research using a two-phase approach. The initial pilot phase (Pilot) of the research study, conducted between April and November 2018, will be used to inform the anticipated subsequent multi-site “Best-evidence Intervention” (Evidence) research study in 2019.

The pilot study is comprised of two core research undertakings. Stage 1 involved a mixed methods research design, and has included a trial of the KNeo ESP SG. Stage 2 involved an independent assessment of the KNeo ESP SG by each member of the Monash research team.

Preceding the pilot phase report, a brief review of SG literature is presented. Details of the pilot phase research methodology can then be found in the Methodology section of this report. Following a full description of the research setting and participants, the results are presented. Six individual student case studies are presented in depth. An evaluation of the platform version that was used in the pilot study, conducted by the Monash Research Team in detail, and conclusions and recommendations for future directions are presented.

## LITERATURE REVIEW

The term SG is widely understood to mean (digital) games that are used for purposes other than mere entertainment or fun. Zyda (2005) noted that it is the addition of pedagogy, activities that educate or instruct, that makes a game “serious”. In June 2018, a google search of “serious game\*” returned 74,900,000 results suggesting tremendous interest in this domain. At that same time, a systematic search of “serious game\*” in the academic databases “psycINFO” and “ERIC” that focused specifically on SGs for school-aged students identified 33 literature reviews that have been published in peer-reviewed English language academic journals. Three academic fields, namely inclusive education, technology in education, and learning analytics are represented in the Venn diagram in Figure 1. It is useful to think of the intersection of all three fields that underpin the academic theory of SGs as representing the precise area of relevance for KNeoMedia Ltd.

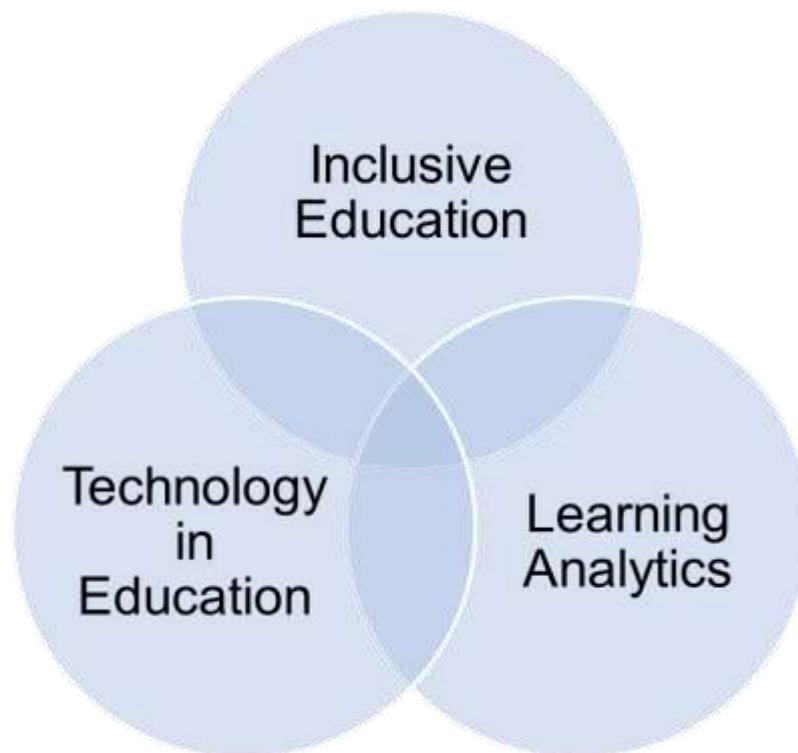
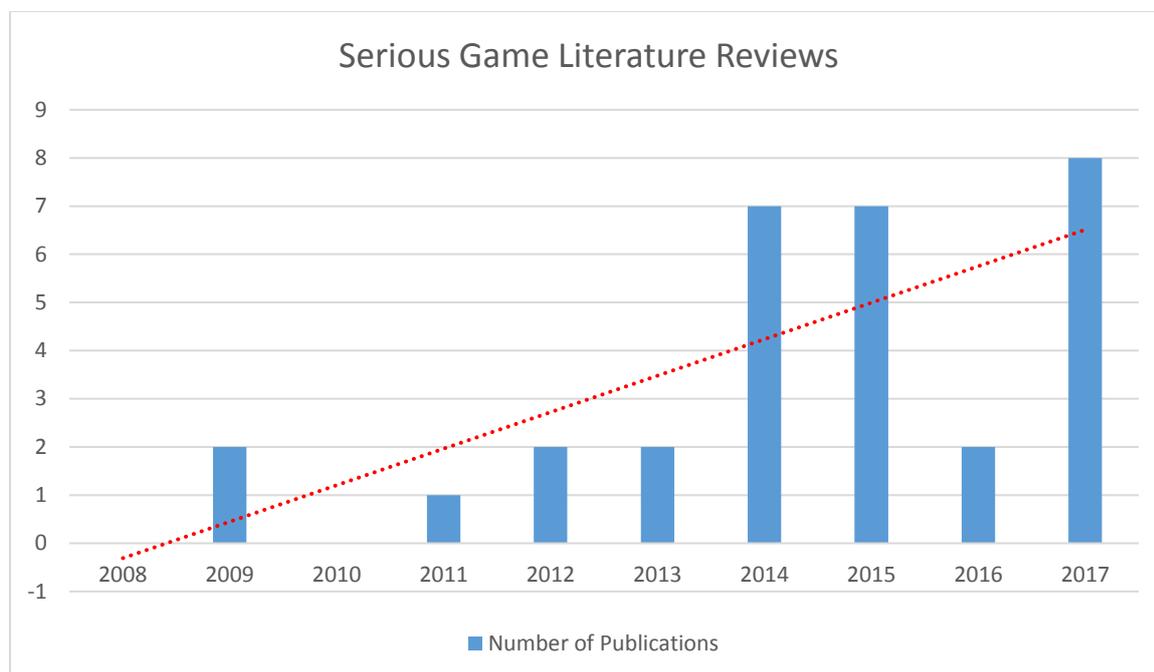


Figure 1: Academic theory underpinning Serious Games

Growth in SG literature reviews reporting on research activity in SGs for school students over the last ten years is illustrated in Figure 2.



**Figure 2: Serious Game literature review publications, 2008–2018**

A thematic analysis of these published reviews found that most research activity focused on the application of SG to mental health (seven reviews). The second most frequently examined theme was SG efficacy (six reviews). The application of SGs for users with ASD represented the third most frequently researched theme (three reviews). The most recent of these three reviews (Grossard et al., 2017) reported on studies published prior to April 2014.

Sharma, Moore, and Carr (in review) conducted an updated systematic review of empirical research into the use of SGs for students with ASD. Their review is based upon 17 studies reflecting 340 student participants, aged between 4–18 years. Two hundred and seventy-eight of the students were described as high functioning, 27 as low functioning, and insufficient detail to determine cognitive ability was provided for the remaining 35 students. Thirteen of the 17 studies were published between 2014 and 2018. Analysis of these 17 studies found that social skill development was the most frequent target behaviour in the SGs. More specifically, these skills included: social communication (8); emotion recognition (3); facial expression (3); and empathy (1). Skills associated with academic achievement were the second most frequent target behaviour in the SGs and included: Mathematics (2); Reading (2); Geography (1); and History (1).

## SINGLE CASE DESIGN (SCD) RESEARCH

Over three decades ago, Murphy and Bryan (1980) reported that both parents and professionals were increasingly demanding evidence regarding the effectiveness of services used to support developmentally disabled individuals, noting that the continued use of services whose alleged effectiveness is based upon conjecture and anecdotal evidence was rapidly becoming unacceptable (Carr, 2015). At that time, Murphy and Bryan suggested that the use of single case design (SCD) methodologies such as multiple-baseline and multiple-probe designs may provide a method to address concerns of accountability and evaluating intervention effectiveness (Carr, 2015).

Evidence-Based Practice (EBP) involves the identification, dissemination, and adoption of diagnostic and intervention practices that are backed by scientific research (Carr, 2015). Initially developed within the medical profession, EBP has spread across other health related disciplines including psychiatry, social work, physical and occupational therapy, and education (Kratowill, 2007). In 2005, the APA Presidential Task Force on Evidence-Based Practice (EBP) developed a policy statement in which it defined evidence-based practice in psychology (EBPP), and discussed issues relating to the adoption of EBP in the field of psychology (Carr, 2015).

A literature review of research assessment guidelines specifically addressing research in the field of education, was conducted (Carr 2015). Carr noted that early document versions produced by Chambless and Hollon (1998)

drew upon the foundation work provided by the Division 12 (Clinical Psychology) Task Force on Promotion and Dissemination of Psychological Procedures (1995) and the APA Task Force on Psychological Intervention Guidelines (1995), and by Horner et al. (2005) who expanded this earlier work to determine “acceptable rigour” defined upon the basis of replicable precision (see Carr, 2015 for details). The standards that have been developed for the US Department of Education, What Works Clearinghouse (WWC) (Kratochwill et al, 2010) are the most comprehensive to date (Carr, Moore, & Anderson, 2014).

For single case design studies the WWC standards require a minimum of three data points per phase to “meet standards with reservations” or five data points per phase to “meet standards”. Inter-observer agreement assessments are required for each case on each outcome variable, collected on at least 20% of sessions across all intervention phases (Kratichowill et al., 2010).

## BEST PRACTICE IN SERIOUS GAMES FOR STUDENTS IN SPECIAL EDUCATION SETTINGS

Sharma and colleagues (in review) noted that SCD methodology is particularly appropriate for research involving students with disabilities or additional learning support needs. With this in mind, the 17 empirical studies included in the SG systematic literature review were examined in relation to the WWC SCD research framework. To date no studies were identified that meet the guidelines set-forth by the WWC for “meets standards” or “meets standards with reservation”. Sharma and colleagues (in review) reported that at the time of writing, little is known about the efficacy of SGs for use by students in special education settings. Further, Sharma and colleagues have proposed a research agenda for researchers in this field, highlighting the need for research to evaluate the efficacy of SGs for the student through embedded pre-post testing, to incorporate pedagogical instruction that utilises both audio and visual modes to teach new material, together with prompts and rewards for achievement that harness motivational principles, and the need for research designs to include both generalisation and follow-up data measurements.

## PURPOSE OF THE STUDY

After reviewing the academic literature on SGs, the aim of the Monash research team was to identify improvement opportunities for the KNeoWorld ESP platform, to inform KNeoMedia in the development of their product to adhere to best evidence in educational practice standards. Further, KNeoMedia had reported receiving numerous anecdotal accounts of high rates of task engagement by students using their SG in the classroom. An additional specific purpose of the pilot research study was to apply rigorous research methodology. The pilot research study was designed to answer the following research questions:

1. What are the effects of KNeoWorld ESP gameplay on students’ task-engagement, academic achievement, and behavioural concerns?
2. How do students, teachers, parents, and the Monash Research Team rate the usefulness of the KNeoWorld ESP platform?

# METHODOLOGY

## MIXED METHODS DESIGN

A mixed methods research design received approval from the Monash University Human Research Ethics Committee on 2 August 2018. This pilot study research project “Evaluation of the KNeo ESP application”, Project ID: 14232, was led by the Chief Investigator: Professor Umesh Sharma.

Mixed methods research uses both quantitative and qualitative approaches in a single study to develop a rich data set that encompasses a broad perspective to answer research questions. In doing so, researchers aim to minimise the risks of personal bias in data analysis, reporting, and conclusions. Participant voices may emerge through the qualitative data, adding depth to the story that may emerge through quantitative findings.

The pilot project comprised two core research undertakings. Stage1 involved a mixed methods research design, and included a trial of the KNeo ESP SG. Stage 2 involved an independent assessment of the KNeo ESP SG by each member of the Monash research team.

The mixed methods research design used for Stage 1 included collection of observational data during a KNeo ESP SG platform trial by student participants. The observational study adopted the SCD WWC research guidelines, to ensure findings that adhere to the most robust research standards for the examination of educational research conducted within a special education classroom setting. Daily self-assessment data was collected at the end of each game session for each participating student. Student interviews were conducted at the end of the trial period. Questionnaires were also completed by classroom teachers, and the parents of participating students.

Stage 2 involved the independent assessment of the KNeo ESP SG, using an evaluation table that was developed collectively by the Monash research team, based upon the findings of the literature review.

## STAGE 1 — ROOSEVELT FRANKLIN SCHOOL (A PSEUDONYM)

### SETTING AND PARTICIPANTS

Participants were recruited from Roosevelt Franklin School (a pseudonym), a special education school located in a suburb of a large multi-cultural city in Australia. An information session was held at the school during which the researchers explained the purpose and procedures of the research project to parents and teachers. A written explanatory statement was distributed to all stakeholders, along with teacher and parent consent forms, and child assent forms. Twenty-two children were enrolled in the school at the commencement of the study.

Three staff teachers, and one student teacher completed the teacher consent form. Eighteen families returned parental consent and child assent forms. Nineteen children received consent to participate in the SG play sessions. Two of these children did not receive consent to be filmed, and were omitted from video recording during gameplay sessions. Two families did not give consent for the child to participate in the study. Three families did not return parent consent or child assent forms.

A response rate of 19 out of 22 students (86.4%) was recorded, and a participation rate of 17 of 22 students (77.3%) was achieved. One child, for whom participation was confirmed, attended the school on a half-day schedule and was not present for the SG play sessions which were conducted at 2:30pm on Mondays, Tuesdays, and Thursdays. Accordingly, a total of 16 children participated in the regular gameplay sessions during the KNeo ESP trial.

All gameplay sessions took place in the open plan Senior students' classroom. Students with consent to be filmed were seated in view of video camera recorders. Students without consent to be filmed were seated in the adjacent room out of view of the video cameras. The moveable wall partition between the two rooms was left open to enable the children out of view of the camera to feel included with the main group. Students participated in the game session during the last half hour period of the day, which ran from 2:30pm until 3:00pm. After a full day of academic and social activities, the students were arguably at their most tired and as such may have a diminished capacity for concentration, and/or a higher proclivity to engage in escape-maintained or other challenging behaviours. This period usually was used as a free play session, in which the students participated in various board games or card games. Accordingly, this period represented a particularly meaningful time to examine task-engagement and social interactions while using the KNeo ESP SG. Game play sessions were scheduled on Mondays, Tuesdays, and Thursdays so as not to clash with class field excursions or other non-routine school activities that may have impacted the gameplay session through higher rates of over-stimulation or fatigue.

Information about any existing psychological diagnoses was collected for all students that provided consent to participate the SG trial sessions. This information was provided by the records held on file at Roosevelt Franklin School, and is provided in Table 1. All names are pseudonyms.

Apart from the following Conclusion, the balance of this Report, is not provided as it contains commercially confidential reasons to protect the commercial interests of the company and its Shareholders

Name	Diagnosis	Class
Harley	ADHD, ASD	Junior
Mario	ASD, ADHD, ODD	Junior
Filipe	ASD, Generalised Anxiety Disorder	Junior
Bevan	ADHD, ODD, Sensory Processing Disorder, possible Fetal Alcohol Syndrome Disorder	Junior
Jalal	Separation Anxiety	Junior
Mike	ODD, ASD, ADHD	Junior
Todd	ADHD, ASD, Epilepsy	Junior
Octave	ASD, Epilepsy	Junior
Dominic	No documentation on file	Junior
Trevor	ADHD, ODD, Anxiety, HF ASD	Senior
Kofi	ODD, ADHD, Anxiety, Depression, provisional ASD, Absent seizures	Senior
Hunter	ASD	Senior
Billy	ODD, ADHD	Senior
Ivan	ODD	Senior
Craig	No diagnosis	Senior
Ollie	Not provided	Senior
Jarian*	ASD	Junior

Note: \* Attended on a half-day schedule and was unable to participate in gameplay sessions.

**Table 1: Participant Existing Psychological Diagnosis Data**

#### ***Inter-observer assessments***

Inter-observer assessments (IOAs) were calculated for each of the six case study students. Two researchers attended every KNeo ESP gameplay session, and completed the observational task sheets for the students during gameplay sessions. Classroom gameplay session videos taken by two cameras were uploaded by each of the researchers to a common Monash University research team drive, on a daily basis.

Prior to video coding for the identified case study students, the two researchers met to establish the data recording protocol. It was determined that observational data would be coded using interval sampling, starting at 5:00 into the gameplay session and ending at 15:00. Each researcher independently coded each observational variable on the coding sheet for each of the case study students for the corresponding time intervals. It was necessary to refer to each of the two camera angles to adequately identify student behaviours from a front facing angle for each student.

Upon completion of this trial coding, the two researchers met to compare results. To ensure the highest degree of reliability of video coding, the two researchers then independently coded all sessions for the first week (to serve as baseline data) for each of the six case study students. Baseline IOAs for each of the case study students were: Harley (100%); Mario (91.7%); Filipe (100%); Billy (100%); Ivan (100%); and Kofi (100%). Following this satisfactory IOA score, each of the researchers were assigned a set of one-third of the intervention sessions to code independently. The other third of the intervention sessions was coded independently by both observers. IOAs were subsequently calculated for this data: Harley (100%); Mario (83.3%); Filipe (83.3%); Billy (100%); Ivan (100%); Kofi (100%). Again, the IOA scores were satisfactory (exceeding 80% IOA for a sample representing 20% of all sessions within each intervention phase).

## SINGLE SUBJECT STUDIES

Challenging behaviour of students in special education settings is often exhibited throughout the day. While different schools adopt various support strategies in their attempts to remediate challenging behaviour, Roosevelt Franklin School follow a practice of removing children from the classroom at the classroom teachers' discretion. For some children attending Roosevelt Franklin School, this may mean that they are collected by a parent prior to the end of the school day. As a consequence, children in this situation may not attend the full day of classes on any given day as a result of their behavioural challenges.

At the request of Roosevelt Franklin School, the SG sessions were conducted in the last period of the day on Monday, Tuesday, and Thursday. This class period was typically a free play period, and prior to the introduction of the KNeo ESP SG, involved traditional gameplay with various board games and card games. Social skill deficits are a primary area of concern in special education settings, and are often the underlying cause of a child being unable to retain a mainstream classroom placement even in the event of adequate academic performance.

Six case studies have been identified on the basis of the most complete data sets (regular participation in KNeo ESP gameplay sessions, consent for student interview, regular completion of daily self-assessments, adequate inter-observer assessments of measures of appropriate classroom task engagement and peer-interaction are presented. These case study students represent the most complete understanding of student's behaviour and experiences when using the KNeo ESP platform in the classroom.

Collection of baseline measures in SCD research involves a careful consideration of ethical implications. Caution is urged in collecting baseline data when a student may engage in behaviours that may cause injury to peers, teachers, or themselves, or may involve elopement or property damage (Carr, Anderson, Moore, & Evans, 2014). All 16 Roosevelt Franklin School student participants in this study have been diagnosed with severe behavioural challenges that have resulted in their removal from their mainstream classroom. Some 45% of the 16 student participants were described in assessment reports provided to Monash by Roosevelt Franklin School as presenting with Oppositional Defiant Disorder (ODD). Cooper, Heron, and Heward (2007) advise that behavioural researchers ensure that the dignity, health, and safety of the intervention participants are protected at all times. Given the pilot study nature of this current research project, and the behavioural history of the student participants, baseline data measurements were only collected during the game training sessions conducted in the first week of the study.

Apart from the following Conclusion, the balance of this Analysis is not provided as it contains commercially confidential information and is censored for the reason of protecting the commercial interests of the Company and its Shareholders

## CONCLUSION

### **Phase 1**

A generally positive experience was noted for the Junior student participants in this study. These students exhibited high rates of time on-task, and displayed highly appropriate social skills during gameplay sessions. Junior students rated their gameplay experiences highly, and expressed a desire to continue to play the game in their classroom environment.

Similarly, a generally positive experience was noted for the Senior student participants in this study. These students exhibited extremely high rates of time on-task, and also displayed highly appropriate social skills during gameplay sessions. Most Senior students rated their gameplay experiences favourably, and expressed a desire to continue to play the game in their classroom environment.

These findings are important given the academic and behavioural challenges the student participants' face. Two thirds of the case study students highlighted in this report have been removed from their mainstream educational setting as a result of Oppositional Defiant Disorder (ODD), in addition to other neurological atypicalities such as ADHD and ASD. That these students have engaged happily and enjoyed a positive classroom learning experience is indicative of the potential value of the KNeo ESP Serious Game as a classroom tool for students with challenging behaviours.

### **Phase 2**

The Monash Research Team identified seven minor platform enhancements (Recommendations 1 through 7) for the attention of the KNeoMedia Development Team. These include the removal of erroneous code, the inclusion of realistic images, embedded skill assessment, audio and visual prompting, consistent use of feedback, embedded capacity to personalise the game experience, and the provision of more comprehensive information for instructors. In addition, further recommendations are suggested that will support a future cutting edge evaluation of the enhanced KNeoMedia platform.

## LIMITATIONS

Low response rates from teachers and parents included in this pilot study reduce the confidence readers can place in these findings and limit our ability to draw meaningful conclusions from these stakeholders. Only two teachers participated in the study. The participating teachers agreed to the student participation over the research period but they did not participate in any pedagogical assessment or measurement. It is important to acknowledge that while all parents consented to their child's participation, they did not actively participate in the study. Parents that responded did not get the opportunity to look at the KneoWorld platform extensively. The data from parents thus needs to be viewed with a small degree of caution. Additional research, including larger samples of teachers and parents, is necessary to answer the original research questions from these stakeholder perspectives.

Incomplete pre and post assessment data was provided by Roosevelt Franklin School for the student participants included in this pilot study. Consequently, it was not possible to evaluate skill development in any subject domain for any of the student participants.

## RECOMMENDATIONS FOR PRODUCT IMPROVEMENT AND FUTURE DIRECTIONS

The current KNeoMedia ESP SG offers a strong foundation for additional development. The most robust research standards for single-subject research design, as identified by the US Department of Education, What Works Clearinghouse, have been integrated into this pilot study research. The student participants in this study have all been removed from a mainstream school placement, and many have been identified as having the serious behavioural challenges fitting the description of Oppositional Defiant Disorder (ODD). While students with ODD are frequently denied access to classroom experiences, often set on a pathway to an excluded future at a young age, the students in this study typically exhibited high to extremely high rates of task engagement when using the KNeoMedia ESP platform. Most encouragingly, many of the students were regularly observed enjoying their experiences with this technology, and were noted to engage in highly appropriate conversations with peers that related to the relevant tasks.

Several recommendations have been provided for future development of the KNeoMedia platform that may position the game as a vehicle for alternate testing of students who may otherwise not participate in formal classroom testing as a result of conditions such as ODD, anxiety, or other neuropsychological challenges. Recommendations have also been made to harness the potential of the platform to develop essential social skills that are frequently the cause of challenging behaviour and exclusion from mainstream educational settings.

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