The effectiveness of the Zones of Regulation curriculum in improving self-regulation and/or behaviour in students

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Abstract

Background: Self-regulation relates to the ability to control one's emotions and behaviour, get along with others and engage in learning. The Zones of Regulation curriculum uses a cognitive behavioural approach delivered over 18 sessions to assist students to build self-regulation skills. Initial scoping research failed to identify any comprehensive studies addressing the effectiveness of the curriculum. **Review question:** What is the evidence for the effectiveness of the Zones of Regulation curriculum in improving self-regulation and/or behaviour in students? **Data sources:** As the peer-reviewed database search failed to produce any studies that met the inclusion criteria, articles came from a theses database search (n=4) and handsearching the reference lists of the four included studies (n=2). **Appraisal and synthesis methods:** Critical Appraisal Tools (CATs) were used to assess risk of bias within each thesis and scoring system was developed to provide an overall rating. Each study was analysed against the NHMRC dimensions of evidence and synthesis involved comparison of all studies across the five dimensions. **Results:** Four of the six theses found that The Zones improved the ability of primary school students to self-regulate. The others contained inconclusive results. Aside from one thesis, all had a moderate to high risk of bias. **Limitations:** Limitations of this review include location bias, language bias and lack of standardisation of the scoring system developed for assessing the risk of bias within each thesis. **Conclusions and implications of key findings:** Overall there was an inconsistency in the results between the theses (though it leaned towards a positive result) and all but one did not perform well against the NHMRC dimensions of evidence. As such the current best evidence is inconclusive related to the use of the Zones of Regulation. It is recommended that this intervention is used with close monitoring and outcome measurement in practice. There is an urgent need for better quality research studies to provide research evidence for this intervention.

Introduction

Self-regulation relates to the ability to control one's emotions and behaviour, get along with others and engage in learning (Pandey et al., 2018). It is defined as the process of wilfully achieving goal-directed behaviour via utilisation of one's executive functions (Pandey et al., 2018). Such executive functions include (but are not limited to) impulse control, cognitive flexibility and sustained and/or selective attention (Pandey et al., 2018).

Research has shown that self-regulation is an important determinant of health and wellbeing across the lifespan (Pandey et al., 2018). An Australian study authored by Homel and Edwards (2018) found that children with poorer self-regulation are less likely to experience a positive approach to early learning, school and engagement in tasks and are more likely to exhibit problems with behaviour resulting in more conflicts and a greater requirement for discipline from teachers. Conversely, children who exhibit greater self-regulation tend to achieve greater academic performance and have comparatively better physical and mental health (Pandey et al., 2018). Adults who exhibit poorer self-regulation are more likely to experience unemployment, mental illness, substance dependence and other unfavourable outcomes (Pandey et al., 2018).

The Zones of Regulation curriculum (The Zones; ZOR) was developed by an American occupational therapist in 2011 to assist individual students with mental and neurobiological disorders to regulate their behaviour (Kuyper, 2013). Over time it has been utilised with children with other (or no) diagnoses, and also as a whole classroom approach (Kuyper, 2013). The Zones can be used with students from preschool through to secondary age, including young adults (Kuyper, 2013).

The Zones uses a cognitive behavioural approach delivered over 18 sessions to build students' skills in sensory regulation, emotion regulation and also specific executive functions (such as flexible thinking and impulse control) (Kuyper, 2013). Four zones (red, yellow, green

and blue) are used to assist students to categorise their emotions and levels of alertness (Kuyper, 2013).

The Zones includes strategies to generalise students' new skills to other environments, enabling more meaningful engagement within a variety of contexts (Kuyper, 2013).

An initial scoping of The Zones revealed very limited information which was predominantly either authored by the developer or in the form of theses. All sources measured improvements in student self-regulation and behaviour as key outcomes, were authored within the United States (US) and focused on preschool and primary school students. As in the US, in South Australia occupational therapists sometimes work within schools either through funding provided to individual students by the National Disability Insurance Scheme and/or at the discretion of each school whether public, private or independent. Initial scoping of The Zones showed that it is being used within (South) Australia (e.g. websites offering training sessions) but failed to reveal specifically where and how.

On its official website The Zones is currently described as a "practice based on evidence versus an evidence-based practice" (Kuypers, 2020). There currently appears to be no clear source that provides a thorough analysis of the effectiveness of The Zones either within the US, Australia or elsewhere. Therefore, this evidence review aims to capture and synthesise the best evidence currently available regarding the effectiveness of the Zones of Regulation curriculum in improving self-regulation and/or behaviour in students. The review question was stated as: What is the evidence for the effectiveness of the Zones of Regulation curriculum in improving self-regulation and/or behaviour in students?

Methodology

Information sources

To access the highest quality of evidence peer reviewed journal articles were searched for on 21st August 2020. Databases searched included Cochrane Library, Education collection, Education database, ERIC, Medline, Ovid Emcare, Proquest Central, Pubmed, SAGE journals and Scopus. As peer reviewed literature is prone to publication bias and subsequent screening against the inclusion/exclusion criteria yielded no results, theses databases were also searched. This form of grey literature was selected as most of the information related to The Zones uncovered during the scoping research was in the form of theses. DART Europe E-thesis Portal, EThOS, Proquest dissertations and theses global and Trove were searched on 24th August 2020. As the theses database search and subsequent screening yielded insufficient studies (n = 4), hand searching the reference lists of included theses was undertaken on 1st September 2020.

The University of South Australia (UniSA) teaches in both Education and Occupational Therapy, the two key disciplines associated with The Zones. It can be assumed that as a teaching university, the Uni SA library holds a large range of high-quality evidence within its database (though will not contain all possible relevant evidence). As such, it was used to identify databases containing peer reviewed journal articles and theses. For peer reviewed evidence, database abstracts contained within the categories 'Education' and 'Health Sciences' were searched, due to the relevance of both areas. Databases were selected due to their relevance to the topic. A relatively large number of databases containing peer reviewed articles were selected in order to increase the likelihood of hits, given that the initial scoping of the topic identified limited published information on The Zones. For theses, databases were selected based on their relevance and to increase the likelihood of results/hits. Trove was specifically selected to identify any studies authored within Australia. The process for database

selection was undertaken independently by two researchers who later decided on inclusions based on relevance and agreement by both parties.

Search strategy

The research question was broken down into its components using a PIO format. The population was identified as 'students', intervention as 'Zones of Regulation', and outcome as 'improvement in *self-regulation* and/or *behaviour'*. Two researchers independently undertook further scoping of relevant sources (e.g. peer reviewed journals related to the topic of self-regulation, Google) reflecting the PIO keywords/phrases and reunited to finalise alternative keywords and search terms (Table 1).

Consensus was reached by all researchers to conduct search strategies for all types of evidence (peer-reviewed and theses) only including the 'I' and to further screen for 'P' and 'O' within the full text screening phase (and for this reason wildcards and truncations were not required to be developed). This decision was made to capture as much relevant evidence as possible during the evidence search, given the limited information identified within the initial scoping research. As such the master search strategy was developed in Medline using 'Zones of Regulation' (Appendix A), and this adapted to all other database searches included within the study, according to any potential unique sets of advanced search operators. It is noted that alternative phrases to 'Zones of Regulation' including 'ZOR' and 'The Zones' were not included in the search strategy as initial attempts to do so yielded only additional irrelevant results. The process for hand-searching is included in the 'study selection' section below.

Table 1 Research Question Components

Question Element	Keyword	Search Terms
I (Intervention)	Zones of Regulation	Zones of Regulation

Question Element	Keyword	**Alternative Keywords**
P (Population/Participant)	students	pupil OR learner OR scholar OR child OR children
O (Outcome)	self-regulation OR/	regulate OR self-regulate OR self regulate OR self regulation OR self-control OR self control OR emotion regulation OR emotional regulation OR regulation OR dysregulation OR social emotional OR social-emotional or socialemotional OR/
	behaviour	behavior OR conduct

Limits applied to the searches include:

- Peer reviewed

- Full text

- Human

- English language

- Date of publication: 2011-current

The limit 'peer reviewed' was applied to capture evidence that is more likely to be of a higher quality, 'full text' and in 'English language' to enable the researchers to draw data from and appraise complete studies, publication range of '2011-current' to capture studies published since the development of The Zones and until the current time, and 'human' to exclude other species that are unlikely to be relevant. These were adapted to all database searches aside from those relating to theses where the peer-reviewed limit was omitted.

Complete peer-reviewed literature and theses search strategies can be found as Appendices A and B, respectively.

Eligibility criteria

All researchers came together to formulate inclusion/exclusion criteria for articles considered for the review. The criteria and rationale for selection of each is found in Table 2 below.

Table 2 Inclusion/Exclusion Criteria

Inclusion	Exclusion	Rationale
English language	Non-English language	To enable the researchers to draw data from and appraise studies in a language understood to them
Full text	Abstract only	To enable the researchers to draw data from and appraise complete studies
Article written after 2010	Article written before 2011	To capture studies published since the development of The Zones and until the current time
Accessible for free through the Uni SA library catalogue or internet	Available at cost	Due to the absence of a budget for the review
Evidence limited to humans	Evidence not limited to humans (e.g. animals)	To exclude other species that are likely to be irrelevant
Focus of the evidence is on the Zones of Regulation as developed by Kuypers 2011.	Focus of the evidence is on the Zones of Regulation not developed by Kuypers 2011.	To source evidence that is relevant to the research question, specifically the intervention
Includes outcome/s related to self-regulation, behaviour or alternative keyword/s (see Table 2)	Does not include outcome/s related to self-regulation, behaviour or alternative keyword/s (see Table 2)	To source evidence that is relevant to the research question, specifically the outcome/s
Includes at least one primary or secondary student (or alternative keyword/s), with or without a diagnosis (see Table 2)	Does not include at least one primary or secondary student (or alternative keyword/s), with or without a diagnosis (see Table 2)	To source evidence that is relevant to the research question, specifically the population/participants

Study selection

All database searches for peer-reviewed articles and later theses were conducted independently by two of the researchers who conferred on the hits and then uploaded one set into EndNote. One researcher then screened for duplicates in EndNote. The studies were then

uploaded into Covidence where initial screening was undertaken by viewing each article title and/or abstract. This was done by two researchers independently who later met to reach consensus on their findings. Full text versions of all remaining articles were then assessed against the inclusion/exclusion criteria (Table 2) by two researchers independently of each other, who then conferred and came to agreement on the results.

Upon finalisation of the database searches and screening, reference lists of included articles were hand searched independently by two researchers who assessed the full text version of potential articles against the inclusion/exclusion criteria. The researchers subsequently reunited to come to a mutual agreement on study exclusions/inclusions.

Copies of all information related to the above process have been saved for future reference. The search history was saved within each database and articles remaining after duplicates were removed and screening were saved in EndNote and Covidence, respectively. All researchers have password access to all of the above sources. Also, PDF versions of all of the articles included in this study were emailed to each researcher. Finally, an adapted PRISMA Flow Diagram was used to record the evidence selection process/results.

Data extraction

To record key data related to each of the studies a data extraction table was developed by the researchers as a group. Data extraction for each included study was undertaken independently by two researchers who subsequently conferred on the results before agreeing on final details for inclusion. Data extraction inclusions are listed in Table 3.

Table 3 Data Extraction Table Inclusions

Category	Subcategory
Study	author/s, year, country, origin (e.g. database, internet etc), study paradigm/design (eg quantitative: RCT), research question/study objectives
Subjects	number, age, characteristics (e.g. year 3 students), condition (e.g. ASD, ADHD)
Intervention	intervention (standard or any variations), therapist, therapist training, dosage (number of sessions), dosage (how many weeks), dosage (duration), dosage (other)
Outcome	outcome measure 1, outcome measure 2, outcome measure 3, measurement 1, measurement 2, measurement 3, measurement 4
Results	outcome measure 1, outcome measure 2, outcome measure 3, outcome measure 4

Assessing risk of bias

Critical Appraisal Tools (CATs) were used to assess risk of bias within each thesis included in the review. The McMaster Critical Review Form - Qualitative Studies (Version 2.0) (Letts et al., 2007) and the HCPRDU Evaluation Tool for Mixed Methods Studies (Long et al. 2002) were selected to assess risk of bias in the qualitative and mixed methods theses, respectively. Due to some variation in the designs of quantitative studies included in the evidence review and to ensure a uniform process for critical appraisal across study designs, the McMaster Critical Review Form - Quantitative Studies (Law et al., 1998) was selected to assess risk of bias within each quantitative thesis.

A scoring system was developed (initially by one of the researchers and finalised as a group) and applied to each CAT to develop a general representation of the risk of bias within each study. The following key was designed and applied to each question that was able to be answered with a yes/no response, within each CAT:

Yes = 1; No = 0; N/A = 0; Not addressed = 0.

The total number of points allocated to each study was calculated with maximum scores as follows:

McMaster Quantitative = 14

McMaster Qualitative = 22

Evaluation Tool for Mixed Methods Studies = 20.

The maximum scores were used to calculate the risk of bias as a percentage (total score/maximum score x 100 = y. 100 - y = risk of bias). Bandwidths were developed to provide a broad categorisation of the risk of bias contained within each study and to enable comparison (see Table 4).

Table 4 Risk of Bias Categories

Risk of Bias Percentage	Risk of Bias Categories
1-20%	Low Risk of Bias
21-40%	Moderate Risk of Bias
41-60%	High Risk of Bias
61-80%	Very High Risk of Bias
81-100%	Extremely High Risk of Bias

Two researchers independently applied the relevant CAT to assess risk of bias in each article and assigned a score based on the key presented above. They later conferred on their drafts to produce the final completed CAT and raw score, percentage and categorisation for risk of bias. This information was later used in conjunction with the other four elements of the NHMRC dimensions of evidence (National Health and Medical Research Council [NHMRC], 2000) to synthesise all of the evidence contained in the review, in order to answer the research question.

Processes for ensuring rigour in the evidence review process

To facilitate rigour in the evidence review process, most components of the process (eg searching databases, undertaking initial screening of studies, screening against inclusion/exclusion criteria in full text mode, extracting dat, completing and scoring CATs etc) were undertaken independently by two of the researchers who then conferred to reach agreement on each component. (It is noted here that deferral to a third researcher in the event of a disagreement was not required). At other times the entire research team worked together to undertake components of the process (eg formulating the research question, assimilating information contained in the included theses to answer the clinical question etc).

As much as possible standardised or resources typically used for systematic reviews were used to support the study including EndNote, Covidence, published CATS, the Prisma Flow Diagram, NHMRC evidence hierarchy (NHMRC, 1999) and the NHMRC dimensions of evidence (NHMRC, 2000).

To minimise outcome reporting bias all outcomes for all studies were included in the evidence review (and were appropriate to do so).

Results

Evidence found

The peer reviewed database search yielded 1491 results; Education Collection ($n = 10$), Education Database ($n = 10$), Proquest Central ($n = 15$), Pubmed ($n = 1402$) and Scopus ($n = 54$). 28 duplicates were removed in EndNote. Initial screening in Covidence excluded 1440 articles, leaving 23 articles for full text screening. Reasons for exclusion included that the articles were unrelated to education, students or the Zones of Regulation. The process of full text screening based on inclusion/exclusion criteria excluded 23 articles. Reasons for exclusion included: the focus of the article was not on the Zones of Regulation as developed by Kuypers

(20) and the article was not accessible for free through the UniSA library catalogue or internet (3). This left 0 peer reviewed articles for inclusion in the review.

Results of the theses database search yielded 118 results; Proquest Thesis ($n = 101$), Ethos ($n = 5$) and Trove ($n = 12$). 1 duplicate was removed in EndNote. Initial screening in Covidence excluded 60 articles, leaving 57 articles for full text screening. Reasons for exclusion included that the articles were unrelated to education, students or the Zones of Regulation. The process of full text screening based on inclusion/exclusion criteria excluded 43 articles. Reasons for exclusion included: the focus of the article was not on the Zones of Regulation as developed by Kuypers (42) and the article was not accessible for free through the UniSA library catalogue or internet (1). This left 4 theses for inclusion in the review.

The reference lists of the 4 included theses were hand searched. This process yielded 2 additional theses that met the inclusion criteria.

In total 6 articles (theses), were identified for inclusion in the review.

Data extracted

The 6 theses identified for inclusion in the review were authored between 2017 and 2019. All included studies involved elementary (primary) students within mainstream classrooms. Three of the studies involved implementation of the full intervention (18 sessions), two a reduced number of sessions (Hoffman, 2018; Quale, 2019) and one did not specify (Kisiel, 2019). Results were inconsistent across the studies. A basic summary of key findings from each study are included in Table 5 below. A comprehensive data extraction table is included as Appendix C.

Critical appraisal

Results from scoring risk of bias for each individual study are provided in Table 6 and key information related to each is discussed further below. Completed CATs are included as Appendices D (Dunn, 2019), E (Hoffman, 2018), F (Karhoff, 2017), G (Kiesel, 2019), H (Munro, 2017) and I (Quale, 2019).

Using the formula described previously, the thesis by Dunn (2019) scored 14%, indicating a low risk of bias. Reflective of quasi-experimental study designs allocation bias (to the intervention and control group) was evident. Due to the nature of the study the possibility of contamination was unable to be controlled for. No longer term outcome measures were taken.

The thesis by Hoffman (2018) scored 50% for risk of bias, indicating a high risk of bias. The intervention was not described in detail, the study did not address outcome measure reliability or validity, no longer term outcome measures were taken and the risk of cointervention was not discussed. The study was not large enough (n = 4) to show an important difference/effect if it should occur. Maturation bias may have affected the results.
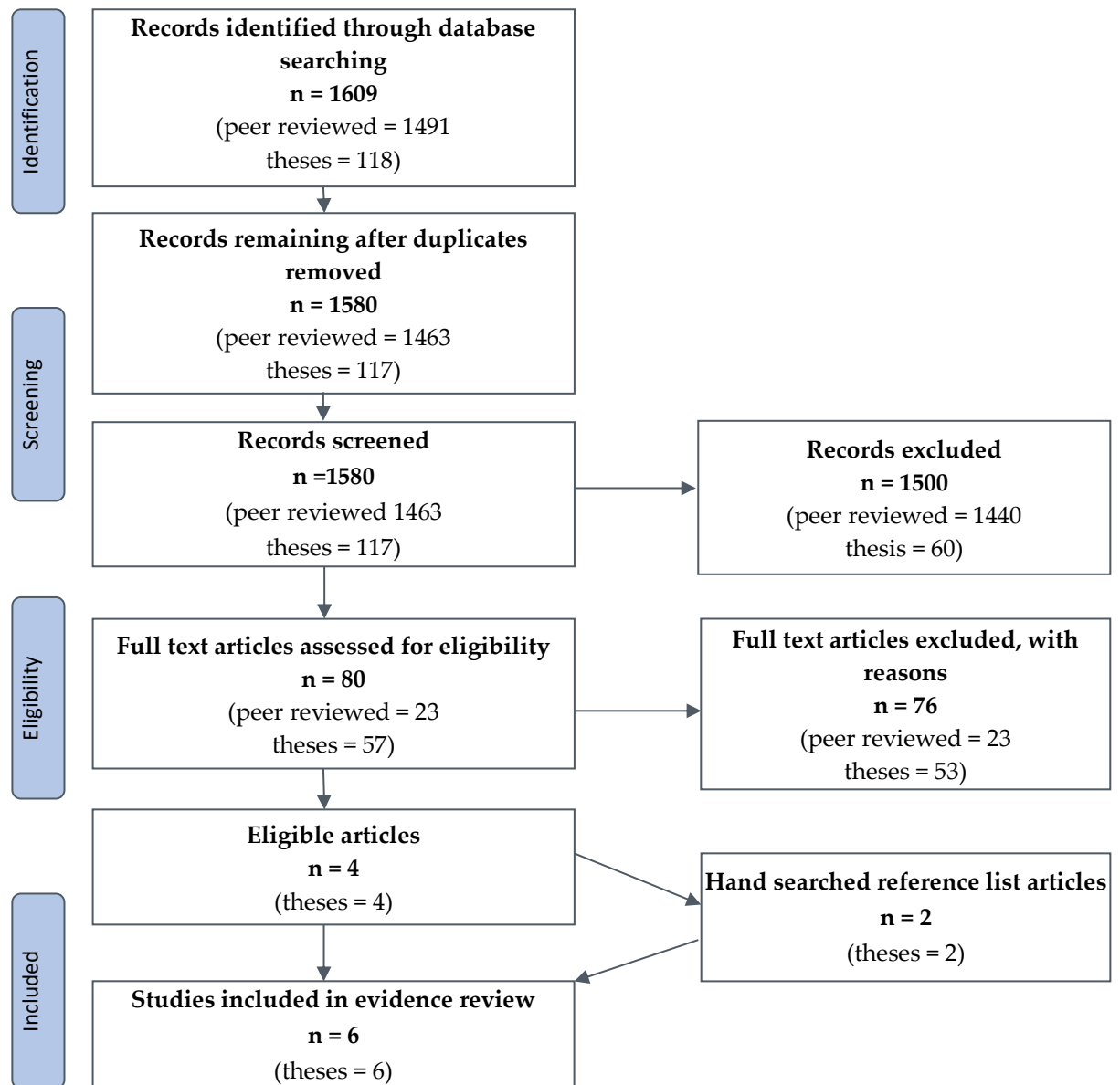
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Figure 1 Adapted PRISMA flow diagram

Table 5 Summary of Data for all Articles

Author/Date	Design	Research Question/s	Sample Size/Characteristics	Intervention	Results
Dunn (2019)	Thesis: Quantitative - Quasi-experimental	What is the impact of the Zones of Regulation curriculum on the knowledge and application of socialemotional competence skills in second grade students: 1. as measured by teacher ratings? 2. as measured student self-ratings? 3. in high poverty schools compared to low poverty schools, as measured by teacher ratings and student self-ratings?	12 classrooms from 3 elementary schools, 18-20 students/class (2 classes from each school in the control group and 2 in the intervention group)	ZOR	Results indicated medium to large effect sizes in all dependent measures* for students in low poverty schools who received the intervention. (.83 to 10.69). All but one teacher rating was also medium to large (.53 to 1.49). Results revealed greater gains in the intervention than control classrooms for both teacher and self-rated social-emotional competence. Statistically significant changes were found for the SEARS Composite** ($t(1.3) = 10.7$, $p = .03$) and the self-rating*** ($t(1.8) = 5.1$, $p = .04$) for students in low poverty schools who received the intervention
Hoffman (2018)	Thesis: Quantitative - Pre-post	1. What is the impact of the Zones of Regulation curriculum on the number of conflicts in the classroom? 2. Will the chosen four third grade students with difficulty self-regulating be able to appropriately identify what zone they are in during check-in times?	n = 4 (3rd grade students who had difficulties with self-regulation)	ZOR – 9 adapted sessions	No evidence of an increase or decrease in conflicts. Students were better able to identify and categorize their feelings.

Karhoff (2017)	Thesis: Quantitative – Single-subject	What is the effect of the Zones of Regulation curriculum on the problem behaviors exhibited at school by an elementary male student?	n = 1 (student who had difficulties with self-regulation)	ZOR	The overall frequency of problem behaviours increased during the study.
Kisiel (2019)	Thesis: Mixed Methods – Case study	Do teachers perceive the Zones of Regulation to be an effective self-regulation curriculum in their school?	n = 10 (teachers – study focused on their perceptions)	ZOR - the school was already administering the curriculum	Overall teachers found that the Zones of Regulation was an effective program that improved student's ability to identify emotions and self-regulate
Munro (2017)	Thesis: Qualitative – Action research	Is the Zones of Regulation Program an efficacious program for teaching self-regulation skills and strategies to grade 3 and grade 4 children?	n = 20 (8-10 year old students in a mainstream grade 3/4 classroom)	ZOR	Zones of Regulation was valuable in teaching self-regulation skills and strategies.
Quale (2019)	Thesis: Quantitative – Single-subject	What is the impact of using portions of the Zones of Regulation on the nonparticipation behaviors of students with disabilities?	n = 3 (grade 2/3 students with ADHD, ASD or exhibiting non-participation behaviours)	ZOR – 11 sessions	Some positive effects during implementation, no conclusive evidence that this was long-lasting.

* Dependent measures include : 1) SSIS-SEL - measures self-awareness, self-management, social awareness, relationship skills and responsible decision-making and a composite of all 2) SEARS – measures teacher perception of student characteristics related to friendship skills, empathy, problem solving, self-management, and emotional competence and a composite** of all 3) Researcher Created Student Self-Rating*** - measures student perception of self-awareness, self-management, social awareness, relationship skills and responsible decision-making

Table 6 CAT Results

Article	CAT	Raw Score	Risk of Bias Percentage (a/b x 100 = c. 100 - c = % of bias)	Risk of Bias Categorisation
Dunn (2019)	McMaster – Quantitative	12/14	14%	Low Risk
Hoffman (2018)	McMaster – Quantitative	7/14	50%	High Risk
Karhoff (2017)	McMaster – Quantitative	7/14	50%	High Risk
Kiesel (2019)	HCPRDU Evaluation Tool for Mixed Methods Studies	12/20	40%	Moderate Risk
Munro (2017)	McMaster - Qualitative	17/22	33%	Moderate Risk
Quale (2019)	McMaster - Quantitative	10/14	29%	Moderate Risk

The thesis by Karhoff (2017) scored 50% for risk of bias, indicating a high risk of bias. The intervention was not described in detail and the risk of cointervention was not discussed. The outcome measure was not reliable, its validity was not addressed and no longer-term outcome measures were taken. The study was not large enough (n = 1) to show an important difference if it should occur. Maturation bias may have affected the results.

The thesis by Kiesel (2019) scored 40% for risk of bias, indicating a moderate risk of bias. This was a retrospective study with no controls or pre intervention data collected. Ethical committee approval to conduct the study was not reported. A purposive convenience sample was used. Little detail was provided regarding the setting. The intervention was not described in detail (eg dosage, frequency) and the risk of cointervention was not discussed. Outcome measures were unreliable, data analysis methods were not described, adequate evidence was not provided to support the analysis, and implications for policy were not addressed (though

this would not have been appropriate given the study design and small sample). No longer term outcome measures were taken.

The thesis by Munro (2017) scored 33% for risk of bias, indicating a moderate risk of bias. Convenience sampling was used and so sampling was not done until redundancy in data was reached. A specific method for data analysis was not provided which impacted on the rigour/trustworthiness of the study, as did the (limited) methods used to facilitate confirmability. Overall the study was highly subjective.

The thesis by Quale (2019) scored 29% for risk of bias, indicating a moderate risk of bias. Possibility for co-intervention was not mentioned. The study was not big enough (n =3) to show an important difference should it occur. Inconsistency across subjects in relation to long term outcome measures is likely to have impacted the results. Maturation bias may have affected the results.

Discussion

The aim of this review was to explore the evidence for the effectiveness of the Zones of Regulation curriculum in improving self-regulation skills for students. A total of six research articles were selected during the evidence retrieval process based on the inclusion and exclusion criteria. Each of the articles will be analysed below, with consideration to the NHMRC dimensions of evidence (NHMRC, 2000) and their relevance to our topic of interest.

Dunn's 2019 thesis aimed to explore the effectiveness of social emotional learning (SEL) curriculums in improving social emotional competence skills of elementary students in a general education classroom setting. It may be classified as a quantitative pre-post study which rates III-2 against the NHMRC's evidence hierarchy (NHMRC, 1999). The study scored 14% when evaluating the CAT, deeming it less prone to bias than any of the other theses included in this review. While contamination was unable to be controlled for and no longer-term outcome measures were taken, the study did have a control group and a large sample size

(12 classrooms each averaging 18-21 students across 3 schools) as compared to other studies included. The author concluded that there was a significant improvement in student's social emotional skills following the administration of ZOR. While results supporting the conclusion were found across many outcome criteria, statistically significant results were mainly observed in participants characterised by low poverty. The results were similar for effect size, where medium to large effect sizes were found in the low poverty treatment condition, indicating a high clinical importance. The study demonstrates external validity as it covers the content contained within the review question and may be able to be generalised to similar contexts (i.e. primary schools).

Karhoff's (2017) thesis may be classified as an interrupted time series without concurrent controls (interrupted time series without a parallel control group) quantitative study and rated III-3 against the NHMRC evidence hierarchy (NHMRC, 1999). The researcher aimed to investigate the effectiveness of ZOR in reducing 'problem behaviours' for one elementary male student within a classroom setting. The study scored 50% when scoring the CAT, indicating a high level of bias. Results indicated that the overall frequency of problem behaviours increased during the study, overall problematic behaviours decreased during the final phase of the study but that a consistent pattern for this decline was not observed. The study did not address the statistical significance or the effect size of the results, likely due to a low sample size (n = 1). While the focus of the thesis covers the content contained within the review question, the very small sample size means that it has poor external validity.

Another thesis included in the review was a quantitative study with a single case pre-post design written by Hoffman (2018). This study design rates IV against NHMRC's evidence hierarchy (NHMRC, 1999). The author aimed to explore the effectiveness of the ZOR in decreasing the number of conflicts for four 3rd grade elementary students in a classroom setting. The study scored 50% during critical appraisal, indicating a high level of bias. It is noted here

that only 9 (of 18) adapted ZOR sessions were administered in this study. Hoffman (2018) concluded that there was no increase or decrease in conflicts but that students were better able to identify and categorize their feelings after being taught the curriculum. Statistical precision of the results and effect size were not included in this study due to the small sample size (n = 4). Though the theses questions reflected the review question, the small sample size and a reduced number of ZOR sessions impact on the generalisability of this study.

Like Karhoff's (2017) thesis, the thesis by Quale (2019) may be classified as a comparative study without concurrent controls (interrupted time series without a parallel control group) and rated III-3 against the NHMRC's evidence hierarchy (NHMRC, 1999). The author aimed to investigate the impact of using portions of the Zones of Regulation on the nonparticipation behaviours of three students with disabilities (ADHD and ASD). The study scored 29% when assessing the risk of bias (indicating a moderate risk of bias) and only 11 of 18 ZOR lessons were administered. This was the only study that included longer term outcome measures but they were taken short term (up to 5 days) and an inconsistent number of times across the sample. The thesis concluded that the intervention did have some positive effects during the implementation phase but there was no conclusive evidence that this impact was long-lasting. Statistical significance and effect size of results were not included in this study, likely due to the small sample size. Although the theses question reflected the review question, the small sample size and reduced number of sessions impact on the generalisability of this study.

Kiesel's (2019) thesis was a retrospective mixed methods case-study. Components of this study (post intervention outcome measures for teacher's perceptions) rate IV against NHMRC's evidence hierarchy (NHMRC, 1999). The study aimed to explore teacher's perspectives (where the teachers were the sample; n = 10) on the effectiveness of The Zones within a primary school setting, where the curriculum was already being administered. Little

detail was provided about administration of The Zones (e.g. dosage, duration etc.). The study scored 40% for risk of bias, indicating a moderate risk of bias. Kiesel (2019) concluded that overall, the teachers found ZOR to be an effective self-regulation curriculum. Statistical significance and effect size of results were not included in this study. Though the theses question reflected the review question, the small sample size and limited detail on how The Zones was administered impacts on the generalisability of this study.

Munro's (2017) thesis was the only qualitative research that was included in the evidence review. It followed an action research study design which cannot be evaluated using the NHMRC evidence hierarchy (NHMRC, 1999). Munro (2017) aimed to explore the effectiveness of ZOR in teaching self-regulation skills to twenty 3rd and 4th grade elementary school students. The study scored 33% when evaluating the CAT, indicating a moderate risk of bias. The researcher concluded that the ZOR resulted in improvements in student's ability to self-regulate, based on analysing and evaluating the researcher's journal entries and student worked samples. Due to the nature of this study statistical significance and effect size of results were not included. The thesis question reflected the review question well and Munro (2017) described the context and assumptions that were central to the research comprehensively. However, the very subjective nature of this study and relatively small sample size may impact on its transferability to other contexts.

In summary, four out of six studies concluded that the ZOR intervention had, to some extent, improved the ability for primary school students to self-regulate. Specifically Kiesel (2019), Munro (2017) and Quale (2019) (who only administered 11 sessions) concluded that the ZOR is effective. All three had small sample sizes and a moderate risk of bias. Dunn (2019) stated that ZOR had shown a significantly positive impact on student's social emotional competence and these conclusions were supported by medium to large effect sizes, results of statistical significance, a large sample and a low risk of bias. Hoffman (2018) reported that the

ZOR lacks the ability to support children in identifying strategies on self-management and regulation though it must be noted that only a portion of the ZOR curriculum was administered in this study and the study had a high risk of bias and a small sample size. Karhoff's (2017) study which had a sample size of 1 and a high risk of bias reported inconclusive results, hence was unable to determine the impact of ZOR on students' ability to self-regulate. Due to this inconsistency between the findings of the theses, a solid conclusion is not able to be made.

All articles included in the review were theses (and therefore did not undergo peer review) and are generally on the lower end when assessed against the NHMRC evidence hierarchy (NHMRC, 1999). Aside from the Dunn (2019) thesis all studies had a small sample size which impacted on the significance of results, both statistically and clinically. Randomised sampling was not able to occur due to study design selection related to the context (school environments). Inconsistency in the results and a lack of investigation of the longer-term impacts of the intervention were also common to the studies. For the reasons listed above, we have concluded that there is a significant lack of high-quality evidence for the effectiveness of ZOR curriculum in improving behaviour and/or self-regulation in students, hence resulting in a low confidence in recommending the use of this intervention in practice until further conclusive research is conducted within this field.

Limitations exist within this evidence review. Firstly, only databases accessible for free via the UniSA library and the internet were included as sources of evidence due to budget constraints. This may result in location bias, where resources related to our topic of interest may be omitted. The inclusion criterion of 'written in the English language' may result in language bias, where studies written in other languages are disregarded. Moreover, the scoring systems for different CATs were neither consistent nor standardised. This is likely to have resulted in discrepancies between scoring across the variety of studies, hence decreasing the reliability of our evidence review.

Conclusion

This review examined the best currently available research to determine the effectiveness of the Zones of Regulation curriculum in assisting primary/secondary students to improve their behaviour and/or self-regulation. No peer reviewed evidence was able to be sourced and so six theses authored between 2017 and 2019 were used for this purpose. All of the theses related to primary, not secondary students. Overall, the findings were weighted towards The Zones being an effective curriculum. However, aside from one of the quantitative studies and the qualitative study, all of the thesis scored relatively low on the NHMRC evidence hierarchy (NHMRC, 1999), recorded a moderate to high risk of bias and contained a small sample size. Small sample sizes prevented calculations related to statistical significance and effect size and generalisation of the results to practise. As such the current best evidence is inconclusive related to the use of the Zones of Regulation. It is recommended that this intervention is used with close monitoring and outcome measurement in practice.

It is recommended that further research be undertaken in relation to The Zones, for both primary and secondary aged students. Measures to increase the quality and believability of the studies (e.g. larger sample size, control groups, delivering all sessions contained in the original curriculum etc) are recommended. Also, the long-term impact of ZOR should also be further investigated, as short-term outcomes may not be as convincing in terms of clinical significance.

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Appendix A Peer-reviewed Evidence Database Search Strategy

Database	Search Strategy
The Cochrane Library	Advanced Search Title, Abstract, Keyword search term/s: "Zones of Regulation" Limits: Jan 2011-Aug 2020
Education collection	Advanced search Search term/s: "Zones of Regulation" Limits: full text, peer reviewed, 1/1/2011-31/8/2020 & English language
Education database	Advanced Search Search term/s: "Zones of Regulation" Limits: full text, peer reviewed, 1/1/2011-31/8/2020 & English language
ERIC	Advanced Search Search term/s: "Zones of Regulation" Limits: 1/1/2011-31/8/2020, peer reviewed & English language
Medline	Advanced Search Subject heading search term/s: Zones of Regulation Keyword search term/s: Zones of Regulation Limits: English language, humans, 2011-2020 & full text
Ovid Emcare	Advanced search Subject heading search strategy: Zones of Regulation Limits: full text, human, English language & 2011-current Keyword search strategy: Zones of Regulation Limits: full text, human, English language & 2011-current
ProQuest Central	Advanced Search Search term/s: "Zones of Regulation" Limits: full text, peer reviewed, publication date range 1/1/2011-31/8/2020 & English language
Pubmed	Advanced Search Text word search term/s: "Zones of Regulation" Limits: full text, English language & human
SAGE Journals	Advanced Search Keywords & Anywhere (title, author, keywords, abstract, affiliation) search term/s: "Zones of Regulation" Limits: 2011-2020
Scopus	Advanced Search Article title, abstract, keywords search term/s: {Zones of Regulation} AND NOT INDEX (medline) Limits: English, human/humans, medline & Medicine/Social Science/Health Professions/Arts & Humanities

Appendix B Thesis Search Strategy

Database	Search Strategy
DART Europe E-thesis Portal	Search Search term/s: "Zones of Regulation" Limits: English
EThOS: Electronic Thesis Online System	Advanced Search Search term/s: Zones of Regulation Limits: English
ProQuest dissertations & theses global	Advanced Search Anywhere search term/s: "Zones of Regulation" Limits: full text, 2011-2020, English & Dissertations & Theses
Theses Canada Portal (Aurora)	Advanced search Any keyword search term/s: Zones of Regulation Limits: 2011-2020, English & thesis/dissertations
Trove Subcategory: Research & Reports	Advanced Search Keywords search term/s: 'The Phrase' "Zones of Regulation" Limits: 2021-2020, English, Australian content & thesis

Appendix C Data Extraction Table

Study						Subjects	
Author	Year	Country	Origin	Study design	Research question	Number	Age
Dunn, ME	2019	America	Database	Thesis: Quantitative - quasi-experimental, wait-list comparison, non-equivalent group design with pretest and posttest measures	What is the impact of the Zones of Regulation curriculum on the knowledge and application of socialemotional competence skills in second grade students, as measured : 1) by teacher ratings? 2) by student self-ratings? 3) in second grade students in high poverty schools compared to low poverty schools, as measured by teacher ratings and student self-ratings?	12 classrooms across 3 elementary schools, 2 from each school in the control group and x2 in the intervention group. Average class size for School A & B = 18 and for C = 21.	grade 2
Hoffman, J	2018	America	Hand-searched, internet	Thesis: Quantitative - Pre-post	1. What is the impact of the Zones of Regulation curriculum on the number of conflicts in the classroom? 2. Will the chosen four third grade students with difficulty self-regulating be able to appropriately identify what zone they are in during check-in times?	4	3rd grade
Karhoff, L	2017	America	Database	Thesis: Quantitative - single-subject (ABAB) design	What is the effect of the Zones of Regulation curriculum on the problem behaviors exhibited at school by an elementary male student?	1	5th grade
Kisiel, K	2019	America	Database	Thesis: Mixed Methods - Case Study	Do teachers perceive the Zones of Regulation to be an effective self-regulation curriculum in their school?	10	n/a
Munro KL	2017	Canada	Hand-searched, internet	Thesis: Qualitative - Action research design	Is the Zones of Regulation Program an efficacious program for teaching self-regulation skills and strategies to grade 3 and grade 4 children?	20: 22 were in the class, only 20 parents provided consent	8-10 years old
Quale, M	2019	America	Database	Thesis: Quantitative - Single subject study with an ABAB multiple baseline across subjects	"What is the impact of using portions of the Zones of Regulation on the nonparticipation behaviors of students with disabilities?"	3	grade 2/3

Subjects			Intervention				
Author	Characteristics	Condition	Type of Ix	Therapist	Training	Dosage - no. of sessions	Dosage - How many weeks
Dunn, ME	Elementary school students in general education classrooms	high / low poverty background	ZOR	classroom teacher, guidance counsellor, behaviour interventionist or a combination of the 3	Teachers	18	Instruction took place during a time period determined by the classroom teacher, with 2-3 sessions/week
Hoffman, J	mostly have some difficulties with self regulation	Student 1 had EBD (Emotional Behaviour Disorder), S2 had OCD, S3 had no diagnosis, S4 came from a trauma background	adapted strategies from the ZOR curriculum	Teacher	Qualified	9	5 weeks
Karhoff, L	Elementary school student	No diagnosis but "demonstrated a lack of self-regulation skills in the classroom that manifested as problem behaviors including talking out of turn, non-participation in instructional activities, off task in the classroom, non-compliance, physical aggression, verbal-offense, lying, and defiance"	ZOR	Researcher (not the child's usual teacher but a special education teacher at the same school)	Unknown	Phase 1 (none/day*), Phase 2 (once/day*), Phase 3 (none/day*), Phase 4 (once/day*) *5 days/week	Phase 1 (1 week), Phase 2 (2 weeks), Phase 3 (1 week), Phase 4 (2 weeks)
Kisiel, K	Teachers at an elementary school where the ZOR curriculum was already being implemented	n/a					
Munro KL	grade 3 and 4 students in a regular class	nil	ZOR	Teacher	Qualified	18	18 weeks
Quale, M	elementary students	with ASD/ADHD; exhibiting non-participation behaviours	ZOR (11 of 18 lessons)	Teacher (not the students classroom teacher)	Special Education Teacher	14	20 days

Author	Dosage - duration	Dosage - Other	Outcome measure	
			Outcome measure 1	Outcome measure 2
Dunn, ME	30-60min	Lesson instruction took place in the large group setting, with students seated at their desks and the teacher instructing from the front of the classroom. Students moved into small groups established by the teacher to complete SEL lesson activities.	SSIS SEL (measures self-awareness, self-management, social awareness, relationship skills and responsible decision-making and a composite of all)	SEARS (measures teacher perception of student characteristics related to friendship skills, empathy, problem solving, self-management, and emotional competence and a composite of all)
Hoffman, J	Not specified	N/A	No. of conflicts per day data table - recorded by teacher	Self assessment worksheet - to identify emotions
Karhoff, L	30 minutes	one on one	Behavioral function checklist developed by the researcher (measuring talking out of turn, non-participation in instructional activities, off task in the classroom, non-compliance, physical aggression, verbal-offense, lying, and defiance) checklist	n/a
Kisiel, K			Quantitative - A modified version of a Likert scale survey developed by Kuypers asking: "Since the beginning of the school year, my students, overall, have improved their ability to... Q1. identify a range of emotions Q2. read their own body cues to determine emotions they are experiencing Q3. understand how their behaviors affects how others view them Q4. identify triggers that influence their behavior Q5. use tools to regulate themselves when experiencing intense emotions Q6. identify which zone they are in and problem solve ways to get back to the green zone"	Qualitative - two open ended questions (attached to the Likert scale survey) on what the teachers a) liked most and b) liked least about the Zone of Regulation.
Munro KL	40-60 minutes	-	Observations-noted down in journal entries	Samples of students work
Quale, M	30 minutes	-	Researcher created checklist measuring 'non-participation behaviours' including: off task behaviour, non-compliance behaviour & talking out of turn behaviours	-

Author	Outcome measure 3	Measurement 1	Measurement 2	Measurement 3	Measurement 4
Dunn, ME	Researcher Created 'Student Self-Rating' (measures student perception of self-awareness, self-management, social awareness, relationship skills and responsible decision-making)	Pretest - all outcome measures administered by teacher (week 0)	Posttest - all outcome measures administered by teacher (after full implementation of Int)	-	-
Hoffman, J	-	Baseline Phase: data table daily for 20 days, self assessment worksheet twice daily for 1 week prior to intervention commencement	Intervention Phase: data table daily for 18 days (average taken to make up to 20 days), self assessment worksheet twice daily from week 6 of intervention commencement	-	-
Karhoff, L	n/a	Phase 1 (The researcher observed the subject in each class period of the day for a total of 30 minutes for 1 week)	Phase 2 (The researcher observed the subject in each class period of the day for a total of 30 minutes for 2 weeks)	Phase 3 (The researcher observed the subject in each class period of the day for a total of 30 minutes for 1 week)	Phase 4 (The researcher observed the subject in each class period of the day for a total of 30 minutes for 2 weeks)
Kisiel, K	-	Single survey completed "just over halfway through the school year"	-	-	-
Munro KL	-	Observations noted down in journal entries throughout the period of the intervention and samples of students work taken from the same period	-	-	-
Quale, M	-	Baseline Phase: daily for 3 [student 1], 6 [S2], & 9 [S3] days	Intervention Phase: everyday between: [S1 = day 4-15], [S2 = day 7-17], [S3 = day 10-20]	Maintenance Phase: everyday between: [S1 = day 16-20], [S2 = day 18-20], [S3 = none], had 0 days of recordings	-

	Results		
Author	**Outcome measure 1**	**Outcome measure 2**	**Outcome measure 3**
Dunn, ME	Pretest measures: Raw data contained in Table 1 pg 69	Posttest measures: statistically significant changes were found in the low poverty treatment condition and the self-rating: Raw data contained in Table 1 pg 69	-
Hoffman, J	Baseline Phase - average no of conflicts/day = 3, students recorded a total of 21 basic feeling (Level 1) matches and 7 specific feeling (Level 2) matches	Intervention Phase - average no of conflicts/day = 2.11, students recorded a total of 13 basic feeling (Level 1) matches and 15 specific feeling (Level 2) matches	-
Karhoff, L	Phase 1 = 77 (inappropriate behaviours)	Phase 2 Week 1 = 104, Week 2 = 94	Phase 3 = 108
Kisiel, K	Majority responses provided here (complete table listed on pg 28): Q1 = somewhat agree (50%), Q2 = somewhat agree (50%), Q3 = somewhat agree (70%), Q4 = somewhat agree (70%), Q5 = somewhat agree (50%), Q6 = somewhat agree (50%)	a) liked most = self regulation tools and visual aids b) liked least = lack of training for teachers	-
Munro KL	Researcher observed improvement in practical skills and strategies in the students' to increase ability to self regulate		
Quale, M	Baseline Phase: Non-participation behaviours Student A = 18 Student B = 12.6, Student C = 13.1 (individual results were also recorded for the x3 specific behaviours listed left)	Intervention Phase: Non-participation behaviours Student A = 13.1, Student B = 8.2, Student C = 9.1 (individual results were also recorded for the x3 specific behaviours listed left)	Maintenance Phase: Non-participation behaviours Student A = 15, Student B = 10.6, Student C = not recorded (individual results were also recorded for the x3 specific behaviours listed left)

Author	Outcome measure 4	Conclusions (direct quote from the abstract)
Dunn, ME	-	Results indicated medium to large effect sizes in all dependent measures in the low poverty treatment condition (.83 to 10.69). All but one teacher rating were also medium to large (.53 to 1.49). The student ratings were inconsistent across conditions, with medium and large positive and negative effects in both treatment and control conditions. Results revealed greater gains in the intervention classrooms for both teacher and self-rated social-emotional competence when compared with the scores from the control classrooms. Statistically significant changes were found in the low poverty treatment condition for the SEARS Composite; $t(1.3) = 10.7$, $p = .03$; and for the self-rating; $t(1.8) = 5.1$, $p = .04$. ANOVA results did not reveal any significant interactions, indicating the impact of the SEL lessons was inconsistent across conditions, poverty status, and individual teachers within groups. Fidelity of implementation was high, and results of the social validity surveys found that both teachers and students rated the lessons favorably.
Hoffman, J	-	The results were inconsistent; there was no evidence of an increase or decrease in conflicts resulting from the implementation of the Zones of Regulation curriculum. Results from participation of a group of 4 students indicated that their identification and categorization post intervention gravitated mostly around Level 2 feelings, which are most specific (e.g., anxious, calm, elated) in comparison to Level 1 (e.g., happy, sad, mad) which these students tended to identify with prior to intervention. This indicated that those 4 students were better able to identify and categorize their feelings after being taught the Zones of Regulation curriculum.
Karhoff, L	Phase 4 Week 1 = 108, Week 2 = 75	Results indicated that the overall frequency of problem behaviors increased during the study; however, specific types of behaviors decreased while other types of types of behaviors increased. "
Kisiel, K	-	The teachers' responses to the survey were analyzed, and overall teachers found that the Zones of Regulation was an effective program.
Munro KL		As a result of this action research project, the researcher's subjective evaluation was that Zones of Regulation was valuable in teaching self-regulation skills and strategies.
Quale, M	-	The Zones o f Regulation curriculum did have some positive effects while the intervention was being implemented, though there is not conclusive evidence that this impact was long-lasting.