Impact of a Computer-Based, Social-Emotional Learning Intervention On School Outcomes Among Rural Early Adolescents

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ABSTRACT

This randomized controlled trial examined the impact on rural early adolescents of Ripple Effects computerized, social-emotional learning intervention. The intervention was self-regulated completion of 42 multimedia tutorials. Adults monitored compliance, but mediated no content. All students exercised the option to privately address personal issues. The post-intervention treatment group grade point average was nearly a full grade higher than the control group, $p<.05$. Treatment group discipline referral rates were 20% lower, not a significant difference. There were no significant differences for absenteeism, tardies, attitudes about marijuana or alcohol, or locus of control. Evidence supports the conclusion that Ripple Effects is promising as a capacity-building intervention to support academic improvement among rural elementary school students.

KEY WORDS: rural; software; social-emotional learning; academics; early adolescence; mental health;

BACKGROUND

Both physical isolation and narrow ethnicity characterize rural life in the United States. Rural adolescents face the same developmental challenges as their urban and suburban counterparts. However, they face different contextual ones and have different school outcomes. The dropout rate for rural Caucasian students is 10%, and for Native American students is 30%. In California, where this study took place, rural scores on the National Assessment of Educational Progress and graduation rates are among the lowest in the nation (Johnson & Strange, 2007). Twelve- to thirteen-year-old rural youth are more than twice as likely as urban youth to abuse alcohol (VanGundy, 2006). Alcohol abuse among rural Native American youth is higher than for their Caucasian counterparts. Geographic isolation and related economic, cultural, social and emotional challenges contribute to these outcomes.

Ripple Effects is a student-centered, self-regulated, evidence-based, computerized social-emotional learning (SEL) intervention that addresses the non-academic factors in school and life success. It can be configured to promote self-efficacy, as well as for other primary, secondary and tertiary interventions. It is in use in more than 500 school districts,

including dozens of rural ones, across the United States and Canada.

Data from two prior studies indicated the program had promising but not proven positive effects on school outcomes, when used independently by students, without adult mediation of content (Ray, 1999; Stern & Repa, 2000). This report discusses one of a series of six concurrent National Institute on Drug Abuse-funded studies, begun in 2003, to systematically examine the impacts of Ripple Effects on attitudes, behavior and academic performance among diverse groups of adolescents.

METHODS

Purpose and Design

The purpose of this study was to evaluate both implementation process fidelity and intervention efficacy of Ripple Effects computer-based training on internal and external school-related outcomes among rural students.

Design. The school-level study was a longitudinal, repeated measures (pre-test/post-test), randomized controlled trial (RCT), conducted under real world conditions, without any direct involvement of program developers in delivery of the intervention. Success was measured by the extent to which exposure to Ripple Effects changed students' attitudes, behavior and academic performance. Individual students were the unit of analysis.

We tested these hypotheses: (1) Under real world school conditions, if given the opportunity and access to technology: a) students would comply with group level requirements for use of the software; b) with no more than three hours of training on the intervention, staff would monitor and ensure that use; and c) students would accept an invitation to explore additional tutorials of personal interest. (2) If treatment students had three or more hours of exposure to the computerized SEL intervention, when compared with control group students, their: a) school outcomes would improve; b) perceptions of harm and norms against use of alcohol and marijuana would increase; c) internal locus of control scores would increase. Figure 1 provides a flowchart of the research design.

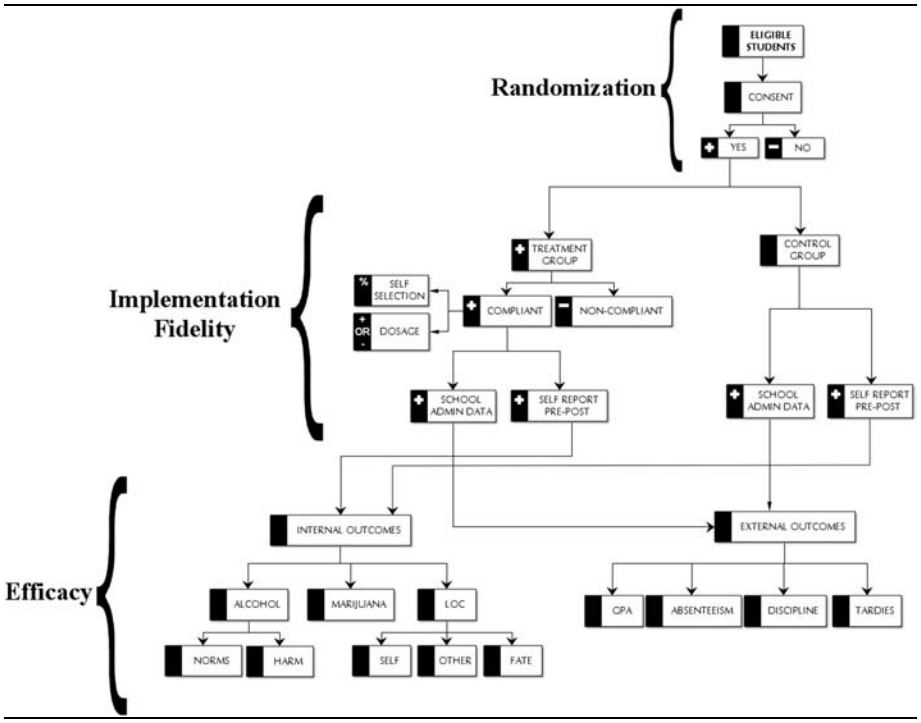

Figure 1: Flowchart of the Research Design

Assignment to Condition

At the end of the prior school year, using their first hand knowledge of student performance, sixth grade teachers sorted students into two groups to create two academically equivalent seventh grade language arts classes. In the fall of 2003-2004, by flip of coin, one of two seventh grade classes was chosen to become the treatment group. The other became the control group. Teacher effect was not a factor because no teachers mediated any part of the content.

Conditions of use. Twice per week for seven weeks, during language arts class, students in the experimental group were taken by the math teacher to the computer lab. There, students engaged in self-regulated completion of assigned topics from the prefigured scope and sequence. Total possible exposure was two hours per student per week, including time for logging in and out. Two of those sessions were devoted to completion of the pre- and post-test surveys, so a maximum of 12 hours of exposure to the training was possible. A teacher assigned the required set of tutorials and checked student electronic scorecards to verify completion of assigned content, but otherwise had no involvement in delivery of the intervention.

Control condition. Students in the control condition did "business as usual," with live instruction in their language arts class. The intervention was made available to them at the end of the study.

Setting

The setting was an elementary school based in rural Northern California. In 2003-2004, the school served 390 students in grades K-7. The school district covers an area half the size of Rhode Island. The rural geography fosters an independent spirit for which this rural district is known. Previously a vibrant logging community, the logging industry has shrunk. The marijuana industry has partly replaced it and is now an important part of a significant underground economy in the area. Medical marijuana is legalized. Methamphetamine use has greatly increased in the past decade, but alcohol remains by far the largest source of substance abuse.

Participants

Fifty-three of the school's 54 seventh graders actively consented to participate in this study: 58% male; 2% African American, 2% Asian American, 9% Native American, and the remaining 87% Caucasian. Thirty-six percent of the students were eligible for Free or Reduced Lunch—a rate higher than the national average. Twenty-six were in the treatment group (TG), and 27 in the control group (CG).

Intervention

The intervention was a subset of tutorials from Ripple Effects software. At the time of this study, Ripple Effects teen version of computerized SEL training included 178 multimedia tutorials (now 390). It is designed to build protective factors, reduce risk factors, and solve problems in non-academic areas correlated with school success. The tutorials are reading-independent training modules, which take about 15 minutes each, on average, to complete. They are made up of photos, illustrations, videos, peer-narrated text, audio and interactive exercises, with a hip-hop look and feel.

The intervention examined here was a "self-efficacy" configuration of the Ripple Effects software. Self-efficacy is the context-specific belief in one's capacity to master what is needed to succeed (Bandura, 1997). Success in this case was defined by schools as academic achievement and reduction in behavioral problems, and by researchers as also including positive changes in attitudes toward alcohol, marijuana and locus of control. A scope and sequence was designed to promote cognitive, social and emotional capacity-building toward those intended ends.

Twenty-one of the tutorials comprised the core components of a self-efficacy curriculum. Twenty-two additional tutorials were collaboratively chosen by staff during a three-hour, pre-intervention training session, to address their students' needs. All 135 remaining tutorials were available for students to privately explore to address individual interests or risks.

Learning process. Independent of specific content, the *Whole Spectrum Learning System* that powers Ripple Effects SEL software (Figure 2) contains instructional methodologies that have been linked to successful development of self-efficacy: guided mastery, self-regulated learning, observational learning, systematic self-reflection, transfer training, and skill rehearsal (Bandura, 1997). All of these modes of learning are introduced with a case study scenario (context-specific application). Additional elements of the system include continuous assessment of content mastery through interactive games; reading independence through peer narration and illustrations; narrative/story as teaching tool, including first person video true stories; and positive reinforcement for completion of the learning process.

Implementer training. The math teacher, a media lab facilitator, and the Principal received a single, three-hour training to orient them to the software, help them customize the scope and sequence for their site-specific context, prepare them to monitor compliance and track student progress. Implementers received no content-related training and were specifically instructed not to put themselves between students and their use of the computer program. Only the math teacher oversaw all student use of the software.

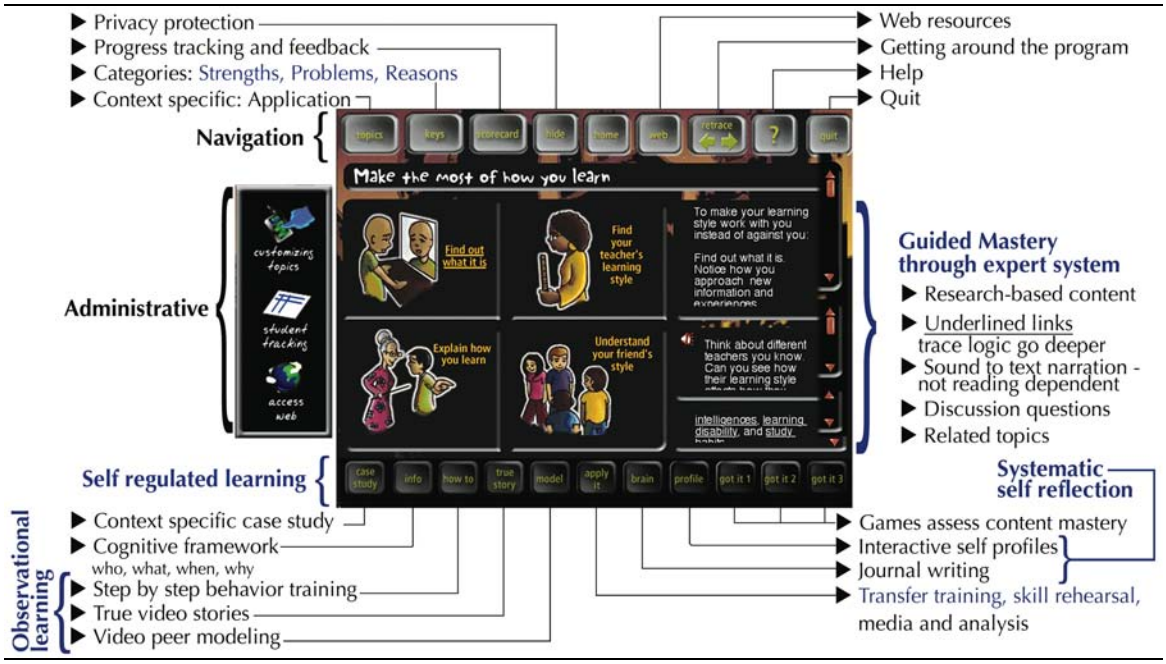

Figure 2: Diagram of the Whole Spectrum, Self-Regulated Learning System

Outcome Measures

The analysis included multiple, quantitative and qualitative, process and outcome measures.

Quantitative process measures. Quantitative process measures included enrollment attrition, study attrition, intervention attrition (compliance), dosage, and self-selection of optional tutorials.

We classified as "enrollment attrition" the percentage of students for whom there was no pre- or post-intervention administrative data, because their family had moved or they had been removed from school. We classified as "study attrition" the percentage of students who were physically enrolled in school, but dropped out of the study, or did not comply with study protocols, either because they withdrew consent or because they could not gain access to the technology. We classified as "intervention attrition" the percentage of treatment group students who had consented to the study and had access to the technology, but, for whatever reason, were non-compliant. That is, they did not have minimal exposure, defined as completion of interactive exercises from at least 12 tutorials (equivalent to three contact hours, or 29% of the total assigned content). For all compliant students, "dosage" measured the level of exposure to the required tutorials. We included in efficacy and dosage analysis all students who had at least three hours of exposure to the software program. Exposure to student self-selected content was a yes/no event; we did not analyze that dosage.

Quantitative outcome measures. Quantitative outcome measures included no fewer than 12 measures of concept mastery, five objective school achievement measures, and two self-report measures.

Each tutorial included at least one measure of concept mastery: a set of six multiple choice questions, disguised as an interactive game. The tests are structured such that students cannot complete the game and earn points until every answer is correct. Students could experiment with answers until they arrived at the correct one.

The five quantitative school achievement measures were: grade point average (GPA), days absent, tardies, suspensions and discipline referrals.

Quantitative outcome measures also included two computer-based, pre- and post-self-report surveys on attitudes toward alcohol and marijuana, and perceived locus of control. Both self-report surveys were adaptations of previously validated instruments. The Monitoring the Future (MTF) survey measures norms and perceptions of harm about alcohol, marijuana and other drugs. The Multi-dimensional Health Locus of Control (MHLC) scales measure attribution of life events to internal (Self) or external (Fate/Other) factors. For both scales, Ripple Effects adapted the format to peer-narrated, computerized delivery, with a hip-hop look and feel, a game-like structure of reinforcement for any answer, and automated data collection. For the locus of control scales, Ripple Effects adapted the "Other" subscale to include other social forces, such as racism, as well as other powerful people.

The reliability coefficient for the REMTF scale on norms and perceptions about alcohol was 0.74, while the coefficients for marijuana norms (0.88) and risks (0.85) were sufficiently high to enable them to be analyzed separately. The RELC scales for Self and Fate both had pre- and post-test alpha values of 0.70. The alpha values for the Other scale, which included the substantive content adaptations, were 0.59 for the pre-test and 0.71 for the post-test. Since the pre-test did not meet the 0.70 criterion, we analyzed that post-test data alone.

Qualitative measures. Qualitative process and outcome measures were interview data on perception of program usage, barriers to use, and perceived value from implementer perspectives.

Data Collection

Compliance, dosage and concept mastery. Ripple Effects software automatically collected data on compliance and dosage rates. Dosage was directly tied to completion of the

interactive games that measured concept mastery. If students were awarded points for a tutorial, it signified they had successfully provided all the correct answers to the quiz.

School data. School administrators provided pre-intervention demographic data, including Free or Reduced Lunch status, an equivalent for socio-economic status, Limited English Proficiency (LEP), gender and ethnicity. They also provided enrollment attrition data, and data on GPA, absenteeism, tardies, suspensions, and discipline referrals for the first semester of the year of the study.

Self-report data. During the Fall of 2003, students completed the two computer-based surveys described above, before and within two weeks after the intervention. At least 12 weeks elapsed from teacher training to final survey.

Qualitative data. At several points along the way, the Study Coordinator conducted and documented phone and in-person interviews with the school administrator, technology staff, and the site program facilitator.

Method of Analysis

SPSS was used to run all of the analyses. Several methods of analysis were used, each appropriate to the kind of data being analyzed.

For administrative post-intervention data with normal distribution (GPA), we ran independent-samples t-tests comparing the means of the treatment and control groups. For administrative data factors with non-parametric distribution, such as absenteeism and discipline, we ran the same tests, but also the Games-Howell *posthoc* test for pair-wise comparisons. Severely unequal variances can lead to increased Type I or Type II error, and, with smaller sample sizes, this effect can be increased. Games-Howell corrections are used when variances and group sizes are unequal.

For the self-report data with pre and post values (the REMTF norms and risks scales, and the Fate and Self RELC scales), we ran repeated-measures ANOVAs with a between-subjects factor (study group) correction. For the Other RELC scale, since the pre-test did not meet the 0.70 criterion, we analyzed that post-test data alone with independent samples t-tests.

To establish dosage, RE software created a password-protected file for each student, and tracked completion of interactive exercises for each tutorial, assigning 100 points per exercise. This data was exported from each computer, with names decoupled from identifying numbers, and then data aggregated in centralized files. Dosage was calculated from the point count of each student's total number of completed interactive exercises, which, divided by an average completion rate of four per hour, resulted in per-student hours of exposure.

To see if the number of hours of exposure to Ripple Effects was associated with differences in outcomes, we ran bivariate Pearson product-moment correlations. In cases where there was pre-test data, we ran partial correlations on the post-test data that controlled for the effect of the pretest covariate. For each set of correlations, we used the Bonferroni method to minimize the chances of making a Type I error. All means presented in the text and tables are the raw values unadjusted for the covariates.

RESULTS

Baseline Equivalence

Analysis of pre-test surveys indicated no significant baseline differences between treatment and control groups for any self-report variable (norms or risk related to alcohol and marijuana, or locus of control). At the end of the 2002-2003 school year, based on their joint analysis of year-end performance data, the two sixth grade teachers collaboratively stratified their students by academic performance and social behavior, and then assigned those students equally to one of two language arts classes for seventh grade in 2003-2004. Their goal was to create two academically equal, behaviorally equivalent, and demographically balanced groups. Prior year administrative data was not available to confirm that their efforts were successful, but the fact that both teachers agreed on results lends credence to the process.

Process Outcomes

Technology-related implementation issues. Technology worked smoothly at this site; no technology-related barriers to use arose during the intervention or pre and post testing.

Enrollment attrition. During the intervention period one student moved out of the area, resulting in 2% enrollment attrition as measured by the availability of administrative post-intervention data.

Study attrition. There was no study attrition. All remaining students provided data and fulfilled the requirements of the study, including pretests and posttests. The built-in electronic monitoring, coupled with reports by the facilitator, confirmed that no control group students had contact with the intervention.

Intervention attrition. Intervention attrition was 12%: three treatment group students who were enrolled in the study failed to comply with the required minimum of three hours of exposure.

Dosage. Mean dosage for those who complied was 40 topics, or 94% of total required topics, and approximately 10 contact hours, depending on student pace.

Participation in self-selection option. Eighty-seven percent of the students chose to explore tutorials beyond those assigned. About half the group did an average of 16 additional tutorials beyond the 43 assigned. The other half did just a few.

Quantitative Outcomes

Concept mastery. Analysis of points awarded for multiple-choice games provided evidence that treatment group students demonstrated at least short term mastery of no fewer than 25 key concepts, and an average of 40.

School achievement measures. As can be seen in Table 1, treatment group students who had the Ripple Effects intervention instead of academic instruction for two hours a week had higher academic grades than control group students who received the two hours of instruction in Language Arts. The 23 students in the treatment group had a mean GPA of 3.20, nearly a full point higher than the 26 students in the control group ($p<.01$, Cohen's $d = 0.96$).

The data indicate that there were no significant differences between the two groups for absenteeism. Rates of absences were very low (0.01) for both groups of students. The treatment group had 20% fewer tardies than the control group, but the difference was not significant. The school reported no suspensions during the data collection period.

Table 1.
Differences in Student Outcomes for Ripple Effects and Control Students

	Treatment (N=23)		Control (N=26)			
Outcome	*M*	*SD*	*M*	*SD*	Difference	Cohen's *d*
GPA	3.20	0.77	2.23	1.22	0.97**	0.96
Absenteeism	0.01	0.01	0.01	0.02	0.00	0
Tardies	0.52	0.79	0.65	1.36	-0.13	0.12

Note: $^{*}p < .05$, $^{**}p < .01$

As can be seen in Table 2, although the frequency of overall discipline referrals was 21% less in the treatment than the control group, that difference was not significant.

Self-report surveys. There were no statistically significant differences on either self-report measure. As can be seen in Table 3, there were neither statistically significant nor clinically meaningful changes in norms or perception of harm about alcohol or marijuana. There was almost no change in perception of locus of control from pre- to post-test in either group, and no significant differences between the very small level of change of the two groups (Table 4).

Table 2.
Differences in Average Number of School Discipline Referrals for Ripple Effects and Control Students

	Treatment (N=23)		Control (N=26)			
Referral	M	SD	M	SD	Difference	Cohen's *d*
Defiant or disruptive	0.52	0.85	0.73	0.87	-0.21	0.25
Fighting	0.04	0.21	0.04	0.20	0.01	0.0
Sexual harassment	0.00	0.00	0.12	0.43	-0.12	0.39
Swearing	0.09	0.29	0.08	0.39	0.01	0.03
Talking	0.13	0.34	0.19	0.49	-0.06	0.14
Threaten student	0.13	0.34	0.00	0.00	0.13	0.57
Total number of discipline referrals	0.91	1.12	1.15	1.57	-0.24	0.18

Table 3.
Pre- and Post-Scores and Differences in Changes in Norms and Perceptions of Risk for Alcohol and Marijuana, by Treatment and Control Group

	Pre	Post	Pre → Post	
	M (SD)	M (SD)	Change	Difference in Changes between Groups
Alcohol Norms & Risk				0.21
Treatment	14.04 (3.51)	14.48 (2.73)	0.44	
Control	14.31 (3.39)	14.54 (3.99)	0.23	
Marijuana Norms				1.10
Treatment	6.43 (2.15)	6.87 (1.89)	0.44	
Control	7.31 (2.15)	6.65 (2.45)	-0.66	
Marijuana Risk				
Treatment	8.17 (2.98)	7.70 (2.36)	-0.47	-0.05
Control	9.19 (2.83)	8.77 (2.67)	-0.42	

Table 4.
Pre- and Post-Scores and Differences in Changes in Locus of Control

	Pre	Post	Pre → Post	
	M (SD)	M (SD)	Change	Difference in Changes between Groups
Internal (Self)				0.39
Treatment	25.14 (4.43)	25.02 (5.50)	-0.12	
Control	24.73 (3.78)	24.23 (3.13)	-0.50	
External (Fate)				-0.24
Treatment	39.18 (7.01)	39.64 (6.77)	0.46	
Control	41.38 (3.99)	42.08 (4.38)	0.70	

Notes: Higher numbers equal a stronger association with the scale. Sample consists of 22 students in treatment group and 26 students in control group.

Dosage effects. With such high dosage overall, no dosage-related effects could be detected.

Qualitative Outcomes: Staff Reports

The math teacher who facilitated the program found it easy to implement, had few barriers, and felt the student experience of the software was positive overall.

DISCUSSION

Significance of Findings

The very low attrition and high dosage rates support the hypothesis that Ripple Effects software-based, self-regulated training can be implemented with more fidelity than most live SEL instruction programs, even when implementers have only three hours of training and no expertise in the content. This has special relevance in rural areas where it is particularly difficult to provide the level of extensive training needed for teachers to deliver effective social-emotional learning interventions.

Almost all the students in the treatment group took advantage of the opportunity to privately address some topic of personal interest to them. This challenges the notion that providing individualized guidance to students must be completely dependent on the expertise of mental health professionals. It also challenges the notion that rural people are reluctant to take advantage of mental health services. They may simply be reluctant to have their friends and neighbors know about it. Technology offers a hopeful alternative.

The finding that this program, which was designed to promote social-emotional competence, had as its main effect improved academic achievement—even though time spent on a key academic area (language arts) was reduced by 40% during the period of the study—is unexpected. However, it is consistent with a growing body of evidence about the positive impact on academic achievement of live SEL instruction (Durlak & Weissberg, 2007; Greenberg, et al, 2003; Zins, Weissberg, Wang, & Walberg, 2004).

The sizes of post-intervention differences in frequency of overall discipline referrals (21% less for TG) and specific referrals for defiant/disruptive behavior (29% less for TG), while not statistically significant, are clinically meaningful (Cohen's d = 0.18, and 0.25, respectively). This level of reduction in discipline referrals can have a marked effect on

school climate, and school climate is strongly correlated with academic outcomes. Twenty percent is considered a reasonable effect size to use in doing power analyses, and is a level that is statistically significant in many larger studies of live SEL interventions.

The lack of impact on locus of control is consistent with prior research, which has shown locus of control to be difficult to change with any short-term intervention.

The program's apparent ineffectiveness in moving norms or perception of harm about alcohol or marijuana needs further exploration. It is not surprising that it would take more than short-term exposure to a single intervention to change attitudes toward alcohol and marijuana in an area where alcohol abuse rates are high, marijuana use has been legalized for medical purposes, and the marijuana industry directly and indirectly affects many families in the area. In other studies in this series, trends on these same measures have been alternately positive, neutral and negative. Much needs to be learned about under what conditions, and with whom, this intervention may be more effective in positively impacting attitudes about marijuana and alcohol.

Limitations of Study

A direct measure self-efficacy was not included in this study. It would be a valuable addition to the analysis of locus of control. The combination of small sample size and large variance among students in behavioral offenses at this school (and in most schools) reduced the chance of detecting significance of substantive changes. This combination also increased the possibility of Type II errors. The Games-Howell posthoc correction reduced that risk but didn't eliminate it.

Administrative baseline data was not available to confirm the success of the prior year's sixth grade teachers' efforts to create seventh grade classes that were equivalent at baseline. It is possible that there were student differences that had not been recognized by their teachers, when making class assignments at the end of the prior year, which could account for the meaningful academic and behavioral changes in the treatment group. While recognizing the greater statistical value of strictly quantitative, administrative pre-test data, we believe it would be inappropriate to discount the collective judgment of the teachers who actually had prior year contact with these students and very deliberately formed two baseline equivalent groups.

CONCLUSION

The evidence supports the hypothesis that the Ripple Effects software is an effective SEL intervention to promote academic achievement among early adolescents. Attracting highly qualified teachers is a continuous challenge in rural areas. Anticipating that these teachers will have expertise in the full body of best practices not only for their academic instructional areas, but also in the rapidly growing field of social-emotional learning, is unrealistic. Having evidence-based practices for SEL "in the box" in the form of a software tool is a capacity-building option that could support both academic improvement and better behavioral outcomes in these rural districts.

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