Typology of delivery quality: latent profile analysis of teacher engagement and delivery techniques in a school-based prevention intervention, *keepin’ it REAL* curriculum

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Abstract

Enhancing the delivery quality of school-based, evidence-based prevention programs is one key to ensuring uniform program effects on student outcomes. Program evaluations often focus on content dosage when implementing prevention curricula, however, less is known about implementation quality of prevention content, especially among teachers who may or may not have a prevention background. The goal of the current study is to add to the scholarly literature on implementation quality for a school-based substance use prevention intervention. Twenty-five schools in Ohio and Pennsylvania implemented the original *keepin’ REAL* (*kiR*) substance use prevention curriculum. Each of the 10, 40–45 min lessons of the *kiR* curriculum was video recorded. Coders observed and rated a random sample of 276 videos reflecting 78 classes taught by 31 teachers. Codes included teachers’ delivery techniques (e.g. lecture, discussion, demonstration and role play) and engagement with students (e.g. attentiveness, enthusiasm and positivity). Based on the video ratings, a latent profile analysis was run to identify typology of delivery quality. Five profiles were identified: holistic approach, attentive teacher-orientated approach, enthusiastic lecture approach, engaged interactive learning approach and skill practice-only approach. This study provides a descriptive typology of delivery quality while implementing a school-based substance use prevention intervention.

Introduction

Enhancing quality of delivery in school-based interventions is one key to ensuring positive and more uniform program effects on student outcomes [1, 2]. Even evidence-based programs can result in minimal or null effects if delivered with poor quality [2–4]. Thus, researchers have recently increased attention to implementation research [5–7]. Evidence from this line of research affirms that interactive delivery techniques and positive, proactive classroom management tend to promote desired program outcomes [5, 3, 8, 9] with a handful of recent studies demonstrating that delivery quality (e.g. students’ engagement with the material) is as important as fidelity (i.e. adherence) in predicting outcomes [10, 11]. Although promoting interactive delivery is an important aim for program developers, less is known about what this looks like in the classroom when teachers without a background in prevention
deliver prevention curricula. One might ask, ‘What patterns of delivery techniques do teachers manifest when implementing prevention curricula?’ The current study adds to the scholarly literature on implementation quality by providing a description of typology of delivery quality.

Implementation quality

Implementation quality is crucial to interventions because studies have consistently demonstrated that the positive effects of programming are more likely to be achieved when delivery quality is high [5, 3, 9]. These studies assess quality of delivery in different ways, including implementers’ knowledge of a program, enthusiasm for the program, classroom management, as well as student interaction, attentiveness, engagement and responsiveness in class [12–17].

Overall, empirical evidence supports the positive effects of implementation on students’ outcomes when delivered with high quality [3, 9]. In particular, high levels of teachers’ enthusiasm and control in teaching as well as student-centered methods are likely to lead to higher levels of student involvement in class discussions, improved social competency, as well as changes in normative beliefs, school bonding and substance use behaviors [4, 8, 9]. In other words, teachers who effectively maintained control over the class while delivering the program in an enthusiastic manner encourage students to be involved in discussion which leads to positive skill development and lower substance use behaviors.

However, prevention science is not the only discipline attending to these practices. Implementation practices also are grounded in educational theory. Education scholars are interested in practices that engage students. Rather than examining interactive and non-interactive delivery techniques; however, education scholars often dichotomize teaching practices into either direct instruction or minimally guided instruction [18–20]. The former is characterized by teachers directly delivering information to the students and the latter is demonstrated by facilitating student self-directed learning. To summarize, prevention researchers have paid a great deal of attention to quality of delivery in implementation, whereas education scholars have specifically examined teachers’ instructional approaches in a pursuit of establishing pedagogical epistemology.

The present study seeks to extend this line of health education research by describing delivery quality by integrating the perspectives of prevention science and education. Although previous prevention research examines quality of delivery in terms of teacher engagement, the current study conceptualized quality of delivery as both teacher engagement (attentiveness, positivity and enthusiasm) and delivery techniques (lecture, demonstration, discussion and role play) in order to identify and describe delivery profiles that capture a range of interactivity and delivery techniques.

Methods

This current implementation study is part of a larger evaluation of the keepin’ it REAL (kiR) middle school substance use prevention curriculum. Two versions of the curriculum were implemented in this study. The first was the original version [21], which was evaluated in a group randomized trial that demonstrated efficacy in reducing substance use [22]. The second was a rural adaptation created for this project [23]. Guided by the principle of cultural grounding [24, 25], the rural version of kiR integrated elements of rural culture into content examples and scenarios. For purposes of this study, the implementations (original and rural) were combined because the lesson elements and implementation requirements remained consistent between versions.

keepin’ it REAL (kiR) was chosen for a number of reasons. Since the original kiR curriculum proved effective in reducing substance use in a randomized clinical trial [22], it is listed as evidence-based intervention on the National Registry of Evidence-based Programs and Practices and other websites. This original version was adopted by D.A.R.E. America for national and international dissemination resulting in what is believed to be the widest dissemination of any school-based substance use prevention program. As part of that adoption, the original kiR was adapted for
use by D.A.R.E. officers [26, 27]. The D.A.R.E. adaptation is not the original that is included in this study, but differs minimally. The D.A.R.E. updates include revised student examples, new videos and increased specificity of instructions [28]. For clarity, it was the original and rural versions of kiR, not the D.A.R.E version, that was taught in this study with implementation by teachers, not officers. Given its widespread use through US school districts as well as through D.A.R.E., it is particularly important to understand how kiR is implemented. kiR consists of 10, 45 min lessons teaching youth knowledge, motivation and communication skills to refuse drug offers [29]. The curriculum includes five videos, an introductory video and four videos demonstrating the refusal strategies (REAL: ‘Refuse,’ ‘Explain,’ ‘Avoid’ and ‘Leave’) found in drug offer situations [30–32]. The lessons in both curricula are parallel (e.g. Lesson 1: Choices, Lesson 2: Risks) and each lesson contains activities that utilize class discussion, demonstration and role play as well as lecture to explain the concepts to students. These components are distributed consistently across all 10 lessons in each curriculum.

### Sample of schools, teachers and training

Teachers in our sample worked in 25 rural schools across Ohio and Pennsylvania. The kiR curriculum was implemented in schools assigned to one of two treatment conditions in classroom settings with seventh grade students. Schools in the treatment conditions received either a rural curriculum where teachers delivered a version of kiR curriculum adapted for rural students (n = 14) or a classic curriculum where teachers delivered the original urban version of the kiR curriculum (n = 11) (see Ref. [33]). Teachers (n = 31) received kiR training during a standard 1-day workshop conducted by the site liaisons and project staff. Teachers received a detailed curriculum manual and training in research-related activities including instruction and practice using study-supplied camcorders for videotaping each lesson. All teachers in treatment schools consented to use video recordings for the research project. Teachers were instructed to set up the camcorder at the back of the room so the video would primarily capture their movements.

### Video data and coder reliability

Teachers (n = 31) video recorded each of the 10 kiR lessons for every class to which they delivered the curriculum, resulting in a total of 780, 10–45 min videos. Due to various human and technical errors, however, a total of 550 videos had both audio and video data. We eliminated the first and last lessons from analysis because they were unlikely to be representative of implementation quality. From the remaining eight lessons, four videos from each class were randomly assigned for coding. A stratified sampling procedure was used such that two of the videos taught REAL resistance strategies and included a video-demonstration component (i.e. lessons 4–7) and two covered other curriculum content, such as assertive communication (i.e. lessons 2, 3, 8 and 9). Thus, out of a total of 550 videos, 276 were selected for coding. Additional details regarding video data and selection procedure are reported in Pettigrew et al. [11, 34].

To enhance the credibility and replicability of the video coding, a team of six coders received approximately 12–14 h of training over 8 weeks. Training included didactic instruction on the operational definitions for each code, and ongoing coder meetings to clarify and discuss coders’ uncertainty of operational definitions, as well as to periodically check coder reliability using videos from previous studies as practice. In order to diminish concerns regarding coding bias, training continued until inter-coder reliability (Krippendorff’s alpha, [35]) of 0.80 was reached. After establishing reliability, coders independently rated the videos for the current study. Coding reliability was assessed by testing agreement on items that rated teacher engagement and delivery techniques on four different occasions over a 12-month coding period with the following degree of agreement (Krippendorff’s alpha): 0.94, 0.93, 0.84 and 0.92.
Measures

Teacher engagement
Three items were modified from Bumbarger [36] to measure teacher engagement. Coders rated the videos on three, four point agree–disagree scales (1 = strongly disagree, 4 = strongly agree) indicating the degree to which teachers were engaged. The three items were: (i) the teacher was attentive to the students and activities during the lesson; (ii) the teacher was energetic when teaching the lesson and (iii) the teacher was positive during the lesson.

Delivery techniques
Four items were modified from Bumbarger [36] to measure delivery techniques. Coders indicated the relative amount of time the teacher spent using each of four different techniques using a five point agree–disagree scale (1 = not used, 2 = rarely used, 3 = sometimes used, 4 = often used and 5 = frequently used). The four delivery techniques were lecture, discussion, demonstration and role play. Lecture was defined as speaking at or to the class in a one-way fashion with little exchange between teacher and student. Discussion was defined as the exchange, exploration and possibly the debate of ideas. Demonstration was defined as showing something, illustrating, providing an example or displaying a behavior. Finally, role play was defined as providing opportunity to practice or see techniques ‘in action,’ or by applying knowledge in role play or other activities. Ratings assessed the coders’ perception of the frequency of their use of each technique (e.g. x amount of time was spent in class discussion) rather than the teachers’ effectiveness in using each of these techniques (e.g. the teacher led a good discussion).

Statistical analysis
The primary goal of this article is to identify patterns in the ways that teachers deliver prevention curricula, incorporating both teacher engagement and delivery techniques. In order to accomplish this goal, a latent profile analysis (LPA) was run using 276 coded lessons. LPA enables researchers to classify distinctive latent classes based on common characteristics of observed continuous indicators from individual video coding [37, 38].

Mplus Version 5.1 [39] was used to identify subgroups of delivery quality based on teacher engagement and delivery techniques. Due to the nature of video selection and coding, there was no missingness (i.e. all selected lessons were coded). A series of latent profile analyses were run and compared to determine the optimal model fit (i.e. models with 1-class through n-class solutions). Model fit criteria such as the log likelihood, Akaike’s Information Criterion (AIC; Akaike 1974), the Bayesian Information Criterion (BIC; Schwartz 1978), entropy and interpretability of results were considered to determine the optimal model [38]. Optimal model fit is defined by a smaller value of AIC and BIC, along with higher entropy value (i.e. closer to one). Although the BIC decreased from the first class model to the three-class model and then started to go up from the three-class model to the five-class model, the AIC continued to decrease from the first-class model to the five-class model. As a result, it was revealed that the five-class latent model provided a more optimal solution than the one-, two-, three-, four- or six-class models (Log likelihood = −2054.453, AIC = 4200.907, BIC = 4367.445, Entropy = 0.973). That is, the five-class model classified five distinctive patterns of delivery quality based on the latent class probability of teacher engagement and delivery techniques. Table I presents the fit criteria for each model.

Once the appropriate model solution was determined, class membership was identified using maximum rule assignment, which indicates that the highest conditional item response probability ultimately represents the class membership of each group [40]. The conditional probability is the likelihood of representing specific characteristics in each latent class and values closest to 1 suggest higher probability of defining characteristics of delivery quality in each latent class. In the present study, the average conditional probability for each class, ranging from 0.96 to 1, easily identified class membership
considering 0.80 as an adequate conditional probability for each latent class [40].

**Results**

To interpret the five typologies of delivery quality, Table II presents latent class membership probabilities and descriptive statistics associated with each class and Table III shows the item–response probabilities for each item conditional on membership in each latent class. Class 1 (34%, \(n = 93\)) was characterized by attentive and positive teacher engagement with a lack of enthusiasm. These teachers used lecture, discussion, demonstration and role play evenly, which closely aligns with how each kiR lesson is designed to be taught in class. The probability of latent membership for Class 1 was 99.6%. We labeled Class 1 as the ‘holistic approach.’

Class 2 (17%, \(n = 48\)) was characterized by positive teacher engagement and high degrees of demonstration and lecture, a moderate degree of discussion and a low degree of role play. The probability of latent membership for Class 2 was 96.4%. We labeled Class 2 as the ‘attentive teacher oriented approach.’

Class 3 (6%, \(n = 18\)) was characterized by positive teacher engagement with a high degree of lecture, moderate degrees of discussion and demonstration and a low degree of role play. The probability of latent membership for Class 3 was 99.8%. We labeled Class 3 as the ‘enthusiastic lecture approach.’

Class 4 (38%, \(n = 104\)) was characterized by positive teacher engagement and high degrees of discussion, demonstration and lecture, and a low degree of role play. The probability of latent membership for Class 4 was 99.6%. We labeled Class 4 as the ‘engaged interactive learning approach.’
Finally, Class 5 (5%, \(n = 13\)) was characterized by less positive teacher engagement and a moderate degree of role play, and low degrees of lecture, discussion and demonstration. The probability of latent membership for Class 5 was 100%. We labeled Class 5 as the ‘skill practice only approach.’

In comparing the classes, there are some differences of type, although most are differences of degree. Class 1 represents a difference in kind because it involves an even use of all the delivery techniques. As a result, we label it ‘holistic.’ Class 5, too, is a difference in kind because it largely involves skill practice rather than the other techniques.

Classes 2–4 are more different in degree of teacher engagement. Specifically, teachers from lessons identified as Class 2 showed the highest attentiveness (mean = 4) and moderate degrees of positivism (mean = 3.3) and enthusiasm (mean = 3) where as teachers in Class 3 showed the highest enthusiasm (mean = 4) and moderate degrees of positivism (mean = 3.6) and attentiveness (mean = 3). In other words, teachers in both typologies showed at least moderate levels of at least three factors, but differed in which was the highest and which was lowest. Those in Class 2 showed the highest level of attentiveness whereas teachers in Class 3 showed the lowest level of attentiveness. Additionally, teachers in Class 2 showed the lowest degree of enthusiasm, whereas teachers in Class 3 showed the highest degree of enthusiasm. In contrast to these, Class 4 showed the highest digresses of all types of teacher engagement (attentiveness mean = 4, enthusiasm mean = 4 and positivism mean = 3.8).

Delivery techniques in Classes 2–4 also showed differences. Teachers in Class 2 practiced high degrees of demonstration (mean = 3.7) and lecture (mean = 3.7), a moderate degree of discussion (mean = 3.3) and a low degree of role play (mean = 2.8). Teachers in Class 3 practiced a high degree of lecture (mean = 4.1), moderate degrees of discussion (mean = 3.3) and demonstration (mean = 3.2) and a low degree of role play (mean = 2.6). Finally, teachers in Class 4 practiced high degrees of discussion (mean = 3.6), demonstration (mean = 3.6) and lecture (mean = 3.6), but a low degree of role play (mean = 2.9). In summary, teachers in Class 2 spent about the same amount of time presenting examples (e.g. teachers showing something, illustrating, providing an example or displaying behavior) and giving lectures (e.g. teachers speaking at or to the class in a one-way fashion with little exchange between teacher and student) whereas teachers in Class 3 spent more time in giving lecture only and teachers in Class 4 spread their time among discussion, demonstration and lecture, but neglecting role play. Thus, we labeled Class 2 as ‘teacher orientated approach,’ Class 3 as ‘lecture approach’ and Class 4 ‘engaged interactive learning.’

### Discussion

The present study reports the development of an empirically derived typology of implementation delivery quality by examining teacher engagement and delivery techniques during the implementation of a school-based substance use prevention intervention, keepin’ it REAL (kiR). Two hundred seventy six videos were analyzed for teacher lesson implementation and a LPA of these data identified five typologies of delivery quality. For discussion purposes, we start by examining how the typologies differ based in their techniques.

Delivery techniques played a major role in defining the subgroups of latent classes. Teacher training and the curriculum guide directed teachers to implement lessons using a four primary delivery techniques: demonstration, discussion, lecture and role play. The majority of teachers (95%) utilized all four
delivery techniques although with differing frequencies (see more details in Table II). The ‘holistic approach’ and ‘enthusiastic lecture approach’ implemented the lessons in similar ways with both using all four techniques at least moderately. The major difference was their use of lecture and role play. The ‘holistic’ approach was consistent with the delivery guidelines stipulated in the keepin’ it REAL curriculum and during teacher training and thus used all four methods evenly and spent more time delivering core elements of prevention lessons through lecture as well as encouraging and facilitating students’ involvement in class discussion. Also, ‘holistic’ teachers allotted time to providing examples (e.g. sharing hypothetical scenarios or narratives) and directing students in role play activities. On the other hand, teachers employing the ‘enthusiastic lecture approach’ spent most of class time explaining key concepts through lecture. Discussion and demonstration were at times used, while students’ rarely participated in role play activities.

Teachers in the remaining typologies did not use all four techniques with any significant frequency. The latent classes, labeled the ‘attentive teacher orientated and engaged interactive learning approaches,’ were similar in terms of delivery techniques but varied somewhat in the use of discussion and role play. Teachers employing the ‘attentive teacher orientated approach’ spent most of the class time lecturing about core components of lessons and providing demonstrative examples and allotted less time to facilitating discussion and role play. By contrast, teachers employing an ‘engaged interactive learning approach’ spent comparable amounts of time in lecture, demonstration, and discussion and devoted much less time to role play activities. In contrast, teachers employing a ‘skill practice only approach’ involved students in role play activities and utilized delivery techniques of lecture, discussions and demonstrations infrequently. The remaining 5% used the ‘skill practice only approach’ which allowed students to practice refusal skills through role play but rarely used lecture, discussion or demonstration.

Finally, it was theorized that both techniques and engagement needed to be considered in order to describe implementation process. Our findings are consistent with this assumption. Among the five typologies, three of these typologies, ‘attentive teacher orientated approach,’ ‘enthusiastic lecture approach’ and ‘engaged interactive learning approach,’ are characterized by positive teacher engagement demonstrated by attentive, enthusiastic and positive teacher interaction with students during the implementation.

On the other hand, teachers who were identified as ‘holistic approach’ and ‘skill practice only approach’ demonstrated less enthusiastic attitudes toward students. Perhaps those utilizing the ‘holistic’ approach were so focused on what they were doing that they neglected how they did it and how it was received. It should be noted that ‘skill practice only’ approach showed the lowest degree of teachers’ attention and positive attitude to students. Although one might assume the skill practice would be highly engaging, consistent with educational theory in the absence of a context for the skill practice students were, in fact, less engaged, than they are when a more balanced approach is used. The ‘skill practice only’ approach also may be indicative less engaged or motivated teachers. These findings await further research.

From the standpoint of fidelity, it is promising to note that most teachers used all four delivery techniques stipulated in the curriculum and teacher training. What remains to be seen is how the balance of the implementation practices impacts implementation quality, skill development and ultimately program outcomes. The goal of this article is to describe this typology and, based on extant literature in both education and prevention, we expect this typology transcends implementation of a single curriculum.

The findings of this research are important, but the study is not without its limitations. First, the five typologies were examined with the lesson as a unit of analysis. Since lessons were nested in classes, which in turn, were nested by teachers and schools, it may be possible that a single teacher who taught multiple classes using similar delivery techniques was overly influential in the typology. It will be fruitful for future research to examine what happens when one teacher employs two or more different
delivery types across different lessons instead of employing one type consistently across lessons. Future research also needs to consider lesson, class, teacher and school as units of analysis for quality of delivery using techniques such as hieratical linear modeling that enables to analyze data nested in multi-levels and allows more precise results of analysis.

Second, while the current findings described characteristics of delivery quality in the implementation of a prevention intervention, additional research needs to link the typology identified in this study to program outcomes such as students’ skill development and learning as well as ultimately their substance use. In the scholarship of education, there has been on-going debate about what is the most effective teaching pedagogy for students’ knowledge acquisition—direct instruction or minimally guided instruction [18–20]. Future studies of implementation practices in substance abuse prevention need to determine whether the effectiveness of implementation quality differs depending on type of delivery and/or which delivery type is most effective when implemented in an intervention.

Finally, beyond describing the types of implementer delivery styles, research should link these teacher behaviors to questions of fidelity (i.e. did the delivery adhere to program philosophy and prescribed practices) and quality (i.e. how well is the spirit of the lesson taught). The quality of delivery is an essential component to the effectiveness of prevention intervention [11–13, 16]. Utilizing the current typology and linking it to fidelity and quality will allow future researchers to evaluate whether a particular delivery quality is more influential on students’ behavioral outcomes or not.

**Conclusion**

The findings of this study reveal that most of teachers delivered lessons in an engaged, positive manner, yet there was significant variation in the implementation of prescribed delivery quality. Analyses describe five typologies reflecting differing degrees of delivery techniques and engagement in their teaching. The findings of this study clearly illustrate differences in how teachers implement prevention lessons and contribute to the literature on implementation quality by not just revealing that teachers do, in fact, differ in their teaching of prevention curricula; but, by identifying and describing ‘how’ teachers deliver prevention lessons in terms of both engagement and specific delivery techniques.

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