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Get Fit! With Math and Lit: A Pilot Program of Physical Activity, Mathematics, and Literacy with Middle Grades Students through Culturally Relevant Pedagogy

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Cover Page Footnote

We have no conflicts of interest to disclose. All research and materials were obtained with IRB approval.

Erratum

A previous version of this article listed Dr. Christine Craddock's previous institution.

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Abstract

In an afterschool program at a university literacy center, we piloted the integration of physical activity with multimodal mathematics and literacy exercises. We aimed to incorporate the three tenets of culturally relevant pedagogy (CRP) including academic success, cultural competence, and critical consciousness with middle grades participants by utilizing a sports-based youth development model (SBYD), Teaching Personal and Social Responsibility (TPSR). Participants participated in 30-minute sessions bi-weekly over two months, which included reflective discussions and journaling to begin and end activities, respectively. Participants were invited to suggest activities during sessions and interact cooperatively with facilitators and peers. They also engaged in a focus group toward the end of the pilot program to provide their perspectives and feedback. We detail beginning takeaways from the program initiative and interrogate possible improvements and adaptations for other middle level settings. Finally, we aim to provide educational and community implications related to future implementations of this program or similar ones in diverse contexts.

Keywords: *physical activity, culturally relevant, new literacies, interdisciplinary, positive youth development*

Our afterschool pilot program was designed to integrate physical activity with mathematics and literacy through multimodal practices (Kress, 2010) and culturally relevant pedagogy (CRP) (Ladson-Billings, 1995). The program utilized the Teaching Personal and Social Responsibility model (TPSR) a sports-based youth development approach (SBYD) (Balague, 2016) and intended to promote academic success, cultural competence, and critical consciousness through physical activity sessions primarily serving middle grades youth. As a pair of researchers, we identify as first, a professor in Kinesiology, and second, a professor in Teacher Education with specializations and certifications in mathematics, language, and literacy.

Over two months, middle grades participants attended physical activity sessions twice a week lasting approximately 30 minutes at our university's literacy center located in the nexus of the city's downtown blocks. It is situated in a community center that houses local non-profit organizations dedicated to providing innovative and equitable access to educational opportunities, mental and physical care, and healthy food in under-resourced or underserved areas. Participants are referred to the literacy center by their schools and can voluntarily choose to receive tutoring. They could also elect to attend our physical activity sessions before or after tutoring.

Framing the Program with Relevant Research

A positive youth development framework proffers an asset-based approach to youth programs (Lerner et al., 2005). Some specific physical education (PE) models like SBYD promote life skills and utilize a positive youth development foundation. That is, promoting youth's development through sport by focusing on life skills, positive relationships, and program related outcomes (Holt et al., 2020). This means focusing on the holistic development of youth rather than a deficit reduction perspective (Damon, 2004). While SBYD can be used as a platform to empower youth to critically assess and transform oppressive structures, Coakley (2016) asserts these applications are widely underutilized. Similarly, researchers have applied cultural responsiveness (Gay, 2000) and CRP as frameworks to PE but generally limit their focus to physical literacy (Flory & McCaughtry, 2011).

A specific model, TPSR, utilizes sport and physical activity as a means of teaching skills like effort, respect, helping others, goal setting, and transference alongside physical literacy (Hellison, 2011). In TPSR, life skills are taught through physical activity using a format including relational time, awareness talk, a closing circle, and reflection. Specifically, the Reflective Educational Approach to Character and Health (REACH) is one afterschool physical activity program that integrates journaling and CRP's tenets, but calls for continued research in community applications (Frederick et al., 2020). Notably, these models include aspects of CRP while often missing opportunities to prioritize academic success (Pinkerton & Martinek, 2022). Finally, the models naturally embed multimodal literacies without specifically alluding to their role, which merit more attention as to their possibilities for facilitating CRP in middle grades.

Multimodality describes how individuals represent, communicate, or make meaning through multiple modes including speech, text, gestures, images, colors, sounds, signs, and symbols (Stein, 2008). Thus, PE, mathematics, and literacy instruction are each inherently multimodal (Arzarello & Robutti, 2010; Chandler-Olcott, 2017; Daher, 2014; Freeman et al., 2016). Nonetheless, not all educators recognize the value and/or nature of multimodal literacies and their capacity for cultivating CRP (Taylor, 2018). Similarly, though multimodal literacies can be used for interdisciplinary applications in middle grades courses, the combination is largely unexplored in physical activity (Craddock, 2022; Hill, 2014).

This blended view toward multimodality and CRP in physical activity engenders a framework joining disciplinary and social literacy perspectives. PE, literacy, and mathematics use specific multimodal literacies germane to their disciplines and contexts, so exploring their discourses involves sociocultural perspectives (Shanahan & Shanahan, 2017). In other words, the multimodal register of each cannot be separated from social and cultural ways they are enacted (Kress, 2010).

Finally, there are consistent calls for quality middle grades instruction to be exploratory, integrative, and diverse while fostering active, purposeful, and democratic applications (Association for Middle Level Education, AMLE, 2020). AMLE also posits successful middle schools collaborate with community partners and asserts that education for young adolescents must be responsive, challenging, empowering, equitable, and engaging. We aimed to embrace

these perspectives and this type of community cooperation with middle grades students through the pilot program.

Program Design and Participation

Middle grades students of different races and genders were recruited and consented to participate in the program through our university's literacy center. Participants were students already attending literacy tutoring at the center who were interested in the additional activity we advertised to parents and youth in an information session on site. As will be further discussed, diversifying, broadening, and improving this recruitment process to increase the participant pool is a major goal from our initial implementation.

Because it was our first time working together as Kinesiology and Mathematics/Literacy educators, our plans and process for developing the program and activity sessions were cyclic, evolving over time and practice. We knew we wanted to design sessions of physical activity that utilized the TPSR framework beginning with small group relational time and awareness talk about life skills. These skills promote cultural, social, and emotional awareness alongside individual and community ownership of what TPSR calls voices and choices. We aimed to provide equitable access for youth to engage in physical activity and critical conversations while empowering them with the agency to engage in mathematics and literacy exercises.

The choices for physical activities revolved largely around multimodal equipment we purchased including colorful bean bags, ropes, sidewalk chalk, and poly spots labeled with numbers, letters, character traits, and physical motions (see Figure 1) that could be creatively and authentically combined during sessions into multimodal games, team building exercises, literacy practices, and mathematics problems.

Figure 1:

Examples of Multimodal Physical Activity Equipment

It was our goal to intentionally incorporate functional, disciplinary mathematics and physical literacies that included counting repetitions, multiplying to create sets, and dividing physical exercises amongst our group to share in team efforts.

Moreover, as we debriefed after sessions to plan each week's activities, we continued to expand in our understandings of each other's fields and expertise, including ways multimodality could reciprocally influence physical activity choices and engagement in innovative ways. Developing activities that included meaningful physical exercises to promote health and time on task, along with authentic mathematical and literacy practices, is a process we have continually reflected upon, discussed, improved, interrogated, and explored. Additionally, ongoing formative assessment and observations of our participants' literacy and mathematical capabilities at multiple grade levels influenced our decisions for these tasks.

As a specific example of our spontaneous—yet intentional—adaptations, our community center space included a large flatscreen television that projected a laptop. We used this as an interactive board with a stylus to facilitate multimodal literacies like playing music and YouTube videos, writing words, counting numbers and images, and drawing pictures as appropriate with activities. This visual and technological aid turned out to be an unexpected scaffolding support for the multimodal literacies in practice. Participants also seemed surprisingly enthusiastic about interacting with it (see Figure 2). Since one essential component of TPSR validates participant input and interaction with activities, participant suggestions were incorporated and acknowledged through this device and in other ways during activities. The final minutes of each session also ended with reflective journal prompts incorporating text and drawing (see Figure 3 for planning and prompt examples).

Figure 2:

A Collection of PDF Images from Evolving Cycles Our Projected Activities

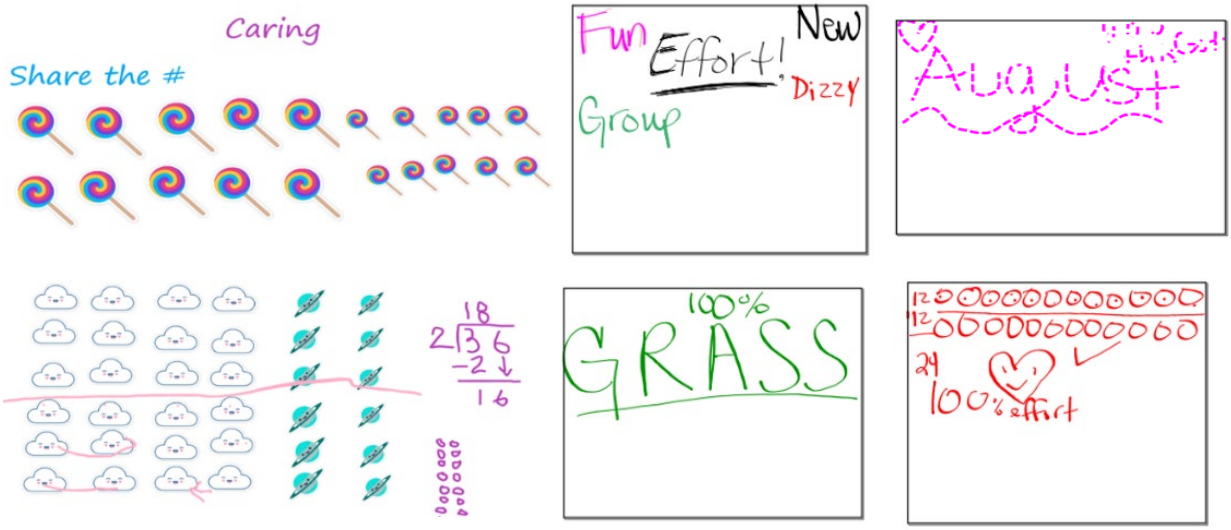


Figure 3:

Program Planning Outlines

Sample Weekly Session Agendas

Tuesday

- Stretched together while sharing each other's name and discussing the vocab word of the day – RESPECT.
  - What does respect mean? What does it mean to you? How do you know if someone is being respectful to you? What does it look like when you are respectful to someone? How can we show respect to one another today during activity?
- Activities
  - 2 participants each selected a number and discussed if they wanted to add or subtract the numbers. Then each participant computed the number. Example P1 selected 5 and P2 selected 3 they decided to add the numbers, and each computed the number and whispered the answer to the leader 8. P3 then spelled out a physical activity for us to perform that many repetitions of. All participants took turns doing each part of the activity.
  - "Boggle" (kind of). All the Poly spot letters were on the ground. Participants took turns spelling out 5 words each of their choice by jumping from one Poly spot to the next. While one participant was physically spelling words the other participants were to write the word in their journal that the active participant was spelling.
- Journal prompt: Respect – what does it mean?

Thursday

- Stretched together while sharing each other's name and discussing the vocab word of the day – CARING
  - How do we care for others?
- Activities
  - Splitting reps in half or helping each other with completing the physical activity tasks.

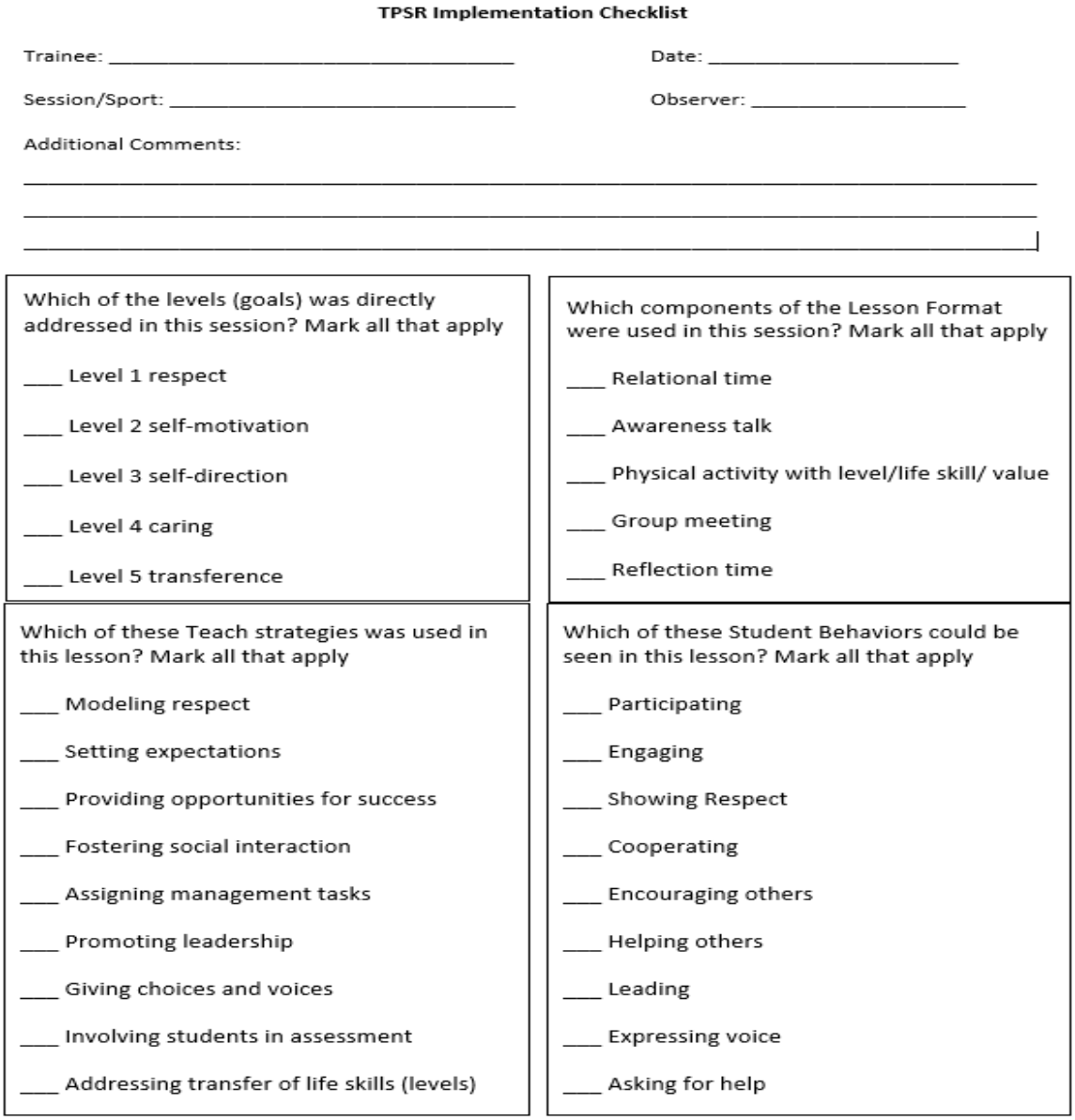
    Participant selected the activities we did based on those on the Poly Spot.

    - Partner rowing
    - Partner sit and reach stretch
    - Partner sit to stand
    - Partner relay to run back and forth across the room
    - Partner plank high fives
    - Partner squat (I go you go like a see-saw)
    - Participants can spell out the activity or select one from the Poly spots
  - Stepping stones game – letters in a "lake" must make a word on Poly spot letters to get across the lake
- Journal prompt: How did you help someone today? Or what did you help someone do today?

We recorded reflective observations of each session, conducted a TPSR checklist (Figure 4), saved PDF images from our interactive board, and took photos of participant journal entries after every session. Additionally, we conducted a focus group toward the end of the pilot program allowing participants to interact and discuss their experiences, perceptions, feedback, engagement, suggestions, and learning. This also informed our decisions and perspectives for future implementations of the program.

Figure 4:

TPSR Checklist



TPSR Implementation Checklist

Trainee: _____ Date: _____

Session/Sport: _____ Observer: _____

Additional Comments:

_____

_____

_____

Which of the levels (goals) was directly addressed in this session? Mark all that apply

___ Level 1 respect

___ Level 2 self-motivation

___ Level 3 self-direction

___ Level 4 caring

___ Level 5 transference

Which components of the Lesson Format were used in this session? Mark all that apply

___ Relational time

___ Awareness talk

___ Physical activity with level/life skill/ value

___ Group meeting

___ Reflection time

Which of these Teach strategies was used in this lesson? Mark all that apply

___ Modeling respect

___ Setting expectations

___ Providing opportunities for success

___ Fostering social interaction

___ Assigning management tasks

___ Promoting leadership

___ Giving choices and voices

___ Involving students in assessment

___ Addressing transfer of life skills (levels)

Which of these Student Behaviors could be seen in this lesson? Mark all that apply

___ Participating

___ Engaging

___ Showing Respect

___ Cooperating

___ Encouraging others

___ Helping others

___ Leading

___ Expressing voice

___ Asking for help

Beginning Takeaways from the Program in Practice

Our preliminary implementation has revealed complexities we plan to explore and improve to develop the pilot program from its current context. Moreover, we recognize possibilities for adapting it to other places and spaces including schools, community centers, and even middle grades content classrooms and gymnasiums. To summarize and capture some program experiences, we highlight three instances of *centering* that occurred during participants'

negotiation of physical activity, which included the centering of multimodality, the centering of facilitators and "school-mode" behaviors (as termed by one of our participants), and the centering of participant identities.

Firstly, multimodal literacies were centered as a common thread or vehicle for facilitating CRP with participants during activities. Activities that intentionally combined multimodal aspects of physical activity, mathematics, and literacy also authentically illuminated their relevance for participants leading to heightened engagement. For example, participants were likely to engage with a life skill and apply it to their physical activity when we wrote it on the projection and combined it with conversations, images, and teamwork that promoted the given word in an integrated way.

Similarly, participants critically engaged with problem-solving and numbers when they could "see" them on the projection, bean bags, and poly spots, or count with fingers, each other, and physical repetitions with their bodies. Finally, participants frequently journaled in multimodal ways rather than plain written text, preferring writing and drawing pictures in response to prompts.

Additionally, our beginning implementations of the program demonstrate the centered role of facilitators more so as teachers or instructors in negotiating meaningful academic experiences with participants. In many ways, we see this as a strength since we, as facilitators, intentionally participated in activities to build relationships, rapport, and trust. However, TPSR is also designed to promote social interaction between peers, so our efforts to build community, teamwork, and conversation within the group were largely developmental.

Interestingly, while the multimodal integration of literacy and mathematics into physical activity promoted engagement, it also elicited "school-mode" behaviors. In other words, participants often centralized writing on the "board" and interacting with facilitators rather than each other. Additionally, participants showed excitement and confidence in engaging with digital literacies and technology, volunteering to be the ones to write, draw, and search the internet for videos on the "board". Even in our focus group, one participant suggested the possible incorporation of online competitive games like Kahoot! or Blooket that center around a projector and are generally used for formative assessment in school.

The applications of physical, mathematics, and literacy we saw during sessions were encouraging; we could formatively assess multiple skills with participants in small groups almost continually through sessions in verbal, written, and physical ways. However, there were instances toward the end of sessions when students expressed being tired of "school-mode" and certain literacy components. They would sometimes disengage with writing, briefly journal using one sentence, or prefer drawings over text. For now, we realize how complex it is to mediate a balance between portions of our sessions that promote academic success without recreating restrictive or oppressive structures. We hope to improve further implementations and determine how to illuminate these academic behaviors as relevant and appealing for students while also maintaining fidelity to TPSR and CRP tenets.

Finally, honoring identities was central to engagement during activities in terms of participants feeling welcome to make mistakes, read, write, spell, compute, and use their voices and bodies in fun, interactive, and contemplative ways. The small group physical activity format encouraged opportunities for ownership that included reflection, engagement, and interaction creating a safe space for participants to exercise, communicate, problem-solve, and make relevant connections to their identities. Attention to life skills also demonstrated opportunities for nurturing participants' identities while promoting cultural, social, and emotional competence along with physical activity.

For instance, one participant suggested we incorporate music and dance into sessions which then became a common component in activities. From this suggestion, we were able to make up a game called musical poly spots, find a FortNite sight word rap, and incorporate other contemporary music videos with movements like the "dab" involving skip counting. Additionally, another participant shared how much he enjoyed watching World Wrestling Entertainment (WWE), so we watched two videos of wrestling highlights before one session. Accordingly, we chose physical activities and repetitions for sets as a group that would make us "strong" like the wrestlers. However, we also discussed the need to choose physical activities that would allow us to be respectful of others (our word for that day) like pushups, squats, and shadowboxing without making contact. We were later heartbroken to find out from this participant in a separate session that he had been physically bullied at school more than once, helping us understand even more his desire to get stronger through physical activity.

Possible Improvements and Adaptations

We firstly identify some major improvements we hope to address that revolve heavily around logistics. Advertising the program, communicating with participants and their guardians, scheduling sessions around tutoring times, and having consistent transportation and attendance were all elements we need to continually develop and support. Similarly, we did not initially receive permission to access participants' academic records with reading and mathematics levels. However, the literacy center does work in conjunction with schools to obtain this information to inform tutoring. It is something we hope to add to our permissions in the future. This is especially significant because our participants represented varied reading and mathematics levels which we could only formatively assess and use to inform participation and decision-making for appropriate activities.

Additionally, we continue to problematize the centering of facilitators. While we find it encouraging that students are not disinclined to engage in "school-mode" behaviors involving an instructor, interactive boards, and journals, we want to make continued endeavors to balance the components of physical activity and responsibility through social interaction. In a singular instance when weather permitted, all participants voted to engage in activities outside. This promoted more peer interaction around hopscotch, jump rope, and poly spots while incorporating literacy and mathematics activities with sidewalk chalk. We hope to investigate and explore capitalizing on these opportunities and participant choices further.

Likewise, we note a lack of development of critical consciousness through our implementations thus far. We posit our goal may be lofty considering our combination of diverse

participant abilities and ages, along with integrated content areas, embedded into just 30 minute sessions. Though we consistently took opportunities to discuss character traits and life applications, our preliminary efforts to incorporate all tenets of CRP might be termed narrow and evolving. All told, we are trying to accomplish quite a bit in a short timeframe and need to reevaluate session lengths, goals, and priorities to create an appropriate, effective blend.

Though this program occurs afterschool in a public community location, it can still be adapted into afterschool programs with willing PE and/or content educators who might collaborate in creating similar sessions for students. This could occur in a club-like program or be offered as a part of mathematics and literacy tutoring sessions already occurring at a middle school. Similarly, some of our ideas, materials, and multimodal emphases can be embedded into disciplinary lessons. Firstly, PE educators can consider practices of multimodality and creatively contemplate possibilities for allowing students to compute, interpret, or enact physical exercises using multimodal tools and images (possibly on task cards) that promote interdisciplinary literacies or problem solving. On the other hand, content educators can consider opportunities for allowing multimodal representations of mathematical concepts or vocabulary involving students' bodies that could incorporate physical activity in a classroom. Finally, the approaches of embedded awareness talk, restorative circles, and journals are applicable across disciplines. A particular school or grade level could adapt or try these reflective implementations in multiple classrooms and content areas to then discuss their combined effects with students.

In sum, the program points to new considerations for addressing vital, intersecting needs of health and success for individual middle grades students and their active participation in a larger community. A unique proposition is raised for challenging traditional notions of integrating physical activity, mathematics, and literacy, illustrating they are all essential components that transcend middle grades students' achievement in and out of school. It directs attention toward innovative possibilities in partnerships with schools, universities, families, educators, and other community stakeholders for implementing interdisciplinary afterschool, enrichment, or intervention programs that focus on these powerful combinations to promote equity, access, and agency.

Educational Significance and Implications

We recognize the dearth in research combining physical, mathematical, and general literacies even though studies in each field separately acknowledge and explore the role of multimodality or components of CRP. Providing middle grades students with opportunities to demonstrate and share understandings of life skills, mathematics, and literacy while participating in physical activity can potentially develop these connections. Additionally, the connections can promote transference and willingness to engage in those areas and activities sometimes begrudged by middle grades learners. This study confirms the value of interdisciplinary implementation of physical activity whether in afterschool programs, PE classes, or content/disciplinary lessons. Our beginning phases of the program also affirm multimodal literacies as a valid component of CRP while illuminating their capacity to negotiate connections between the disciplinary literacies of middle grades instruction. Framing physical activity through CRP highlights connections between these content areas through out-of-school

opportunities which ultimately can translate to increased self-efficacy and perceived relevance for middle grades students in school literacy contexts.

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