Establishing Validity and Reliability

New Jersey Lesson Plan Rubric for the SubjectToClimate Website

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Overview

We will enhance climate knowledge and inspire action by making climate change teaching and learning accessible to all

Context

In September 2022, New Jersey will be the first state in the US to include climate change standards across grade levels and content areas. The New Jersey Climate Change Education Initiative was founded to develop the tools that would be necessary for the implementation.

Assessing Resources for the New Jersey StC Portal

For the New-Jersey specific tool, StC plans to modify their rubric to evaluate sources based on the standards most important to the state. As such, StC participated in a focus group with various stakeholders (i.e. NJCCEI members and colleagues from their respective partner organizations, informal educators, practicing teacher leaders, school administrators, and StC staff). StC then produced a revised rubric, incorporating these suggestions.

Establishing Reliability of the Rubric

Dr. Lauren Madden recruited a pool of teachers to test the reliability of the rubric; the greater the level of agreement between rubric scores, the better the rubric standard.

Conclusions

From this data, we can conclude that the rubric is being used reliably by knowledgeable teachers.

5 Categories of Assessment for Coders

Justice
Conveys ideas and actions of justice to the students.

Social-Emotional Learning (SEL)
Students gain self-awareness.

Student Action
Inspires and empowers students to take climate action.

Depth
Challenges students with the complexities of the climate crisis.

Burden
Minimizes the burden of implementation for teachers.

Abstract

In June 2020, New Jersey's First Lady, Mrs. Tammy Murphy announced that New Jersey would be the first state in the US to include climate change standards across grade levels and content areas (Office of New Jersey Governor, 2020). These standards will be implemented in September 2022. The New Jersey Climate Change Education Initiative was founded to aid with the implementation. The initiative's first task was to support the development of an easy-to-use search tool for teachers to find curricular tools, so they partnered with SubjectToClimate, a nonprofit organization connecting K-12 educators of all subjects to credible, unbiased, and engaging materials on climate change at no cost. StC co-founders Margaret Wang and David Jaffe collaborated with NJCCEI to develop a New Jersey-specific version of their site. To form this site, StC modified its rubric to evaluate the materials on its site, so that evaluation criteria focus on the most pertinent standards in New Jersey. Following the development of the new rubric, StC completed rigorous reliability tests with a substantive focus group of teachers. The rubric garnered 80% agreement, indicating that it is being used reliably amongst a variety of teachers. From this data, we can conclude that the rubric is being used reliably by knowledgeable teachers.

The rubric garnered 80% agreement, indicating that it is being used reliably amongst a variety of teachers.

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Context

In June 2020, New Jersey's First Lady, Mrs. Tammy Murphy announced that New Jersey would be the first state in the US to include climate change standards across grade levels and content areas (Office of New Jersey Governor, 2020).

These standards were developed by the New Jersey Department of Education (NJDOE) (n.d.) and underwent thorough review by teachers and other stakeholders (e.g. teacher educators at institutions of higher education, school administrators, and content area experts) over the course of several years. Implementation of these standards is set to formally begin in September 2022.

In an effort to support the successful roll out of these standards, a statewide committee was convened under the leadership of Sustainable Jersey's Executive Director Mr. Randall Solomon and New Jersey School Boards Association's Senior Manager for STEAM and Sustainable Schools, Mr. John Henry. This committee, composed of experts in climate change education and make recommendations for teachers, schools, and school systems. Dr. Lauren Madden, an academic external to the committee gathered these recommendations from committee members and other close colleagues via several surveys and discussions, and synthesized these findings to develop a formal report (referred to as the Report for the remainder of this document), released in February 2022 (Madden & Climate Change Education Thought Leadership Committee, 2022).

The recommendations in the report fell into four major categories: professional learning, curricular resources, community-based climate change education, and support from boards of education. Curricular resources are essential and must be in place and readily available to teachers well in advance of September 2022.With the release of the standards themselves, the NJDOE released some sample instructional resources for teachers to get started, available on their website. However, more tools are needed to support the larger implementation of these new standards.

A subgroup of the thought leader committee, convened as the New Jersey Climate Change Education Initiative (NJCCEI) to further support teachers, schools, and school systems in adopting climate change education. This group includes:

- Sustainable Jersey (Mr. Randall Solomon)
- New Jersey School Boards Association (Mr. John Henry)
- New Jersey Audubon (Ms. Dale Rosselet & Ms. Allison Mulch)
- National Wildlife Foundation (Ms. Curtis Fisher)
- The College of New Jersey School of Education (Dr. Lauren Madden)

NJCCEI's first task was to support the development of an easily searchable tool for teachers to use in identifying curricular tools. In 2021, NJCCEI forged a formal partnership with SubjectToClimate (StC), a nonprofit organization connecting K-12 educators of all subjects to credible, unbiased, and engaging materials on climate change at no cost. The materials include resources from other organizations that they curate and add synposes, teaching tips, and scientist notes to as well as inquiry-based lesson plans that are developed by a taskforce of teachers. SubjectToClimate's co-founders Ms. Margaret Wang and Mr. David Jaffe worked in close collaboration with the NJCCEI group to create a plan to develop a New Jersey-specific version of the site to ensure resources available align well with New Jersey's new standards and allow for teachers to find New Jersey-specific context and examples throughout the sample lessons. SubjectToClimate has already recruited a cadre of expert teachers from across New Jersey to contribute and provide feedback on resources in this portal.

Assessing Resources for the New Jersey StC Portal

SubjectToClimate already uses a screening process for all the third-party teaching resources that are in its database.

A scientist review team, consisting of credentialed scientists in climate-related fields and led by an Intergovernmental Panel on Climate Change (IPCC) Climate Expert Reviewer, first conducts a credibility review for organizations that provide resources for their webpage. This team randomly selects approximately 10% of the resources and does a credibility check based on relevance, quality, conflict of interest, keywords and phrases, and a quantitative confidence scale. If the organization passes credibility review, the scientist review team will proceed to conduct credibility checks for each resource that is shortlisted by the teacher review team. Next, a team of practicing and former teachers, who have at least two years of formal or informal teaching experience, passed an application process, and took a fundamental climate change course, uses a rubric to review prospective resources and evaluate the relevance to learning standards, pedagogic effectiveness, and ease of use.

Once these reviews are complete, the whole database is consistently reviewed for additional criteria such as variety in perspectives, accessibility, and representation of marginalized communities. The resources used in the lesson plans created by the teacher taskforce are also evaluated using the same screening process described above. Moreover, the lesson plans available on StC are screened through a multitude of processes.

This thorough screening process establishes content and construct validity in the lesson plans included among StC's resources. However, in order to ensure the New Jersey-specific StC portal's resources are well aligned with the goals of the Report, a lesson plan rubric was developed by the StC team. This rubric represented a modification of their existing lesson plan rubric while also including alignment to

New Jersey's Climate Change Education Standards, the Climate Literacy and Energy Awareness Network's (CLEAN) review process (n.d.), and the North American Association for Environmental Education's Framework for K-12 Environmental Education (2004). A focus group discussion was held with a group of stakeholders critical to the conversation on climate change education in New Jersey including NJCCEI members and colleagues from their respective partner organizations, informal educators, practicing teacher leaders, school administrators, and StC staff. Together, this group offered further suggestions for modifying the proposed rubric. These suggestions were incorporated into a revised rubric for New Jersey specific lessons. This revised rubric (see Figure 1 below) ncludes a checklist forthe presence or absence of certain key elements (e.g. assessment, interdisciplinary elements, etc.), followed by a rubric with five categories upon which the lesson is rated on a three-point scale (exemplary, average, or low) (see Figure 2 next page).

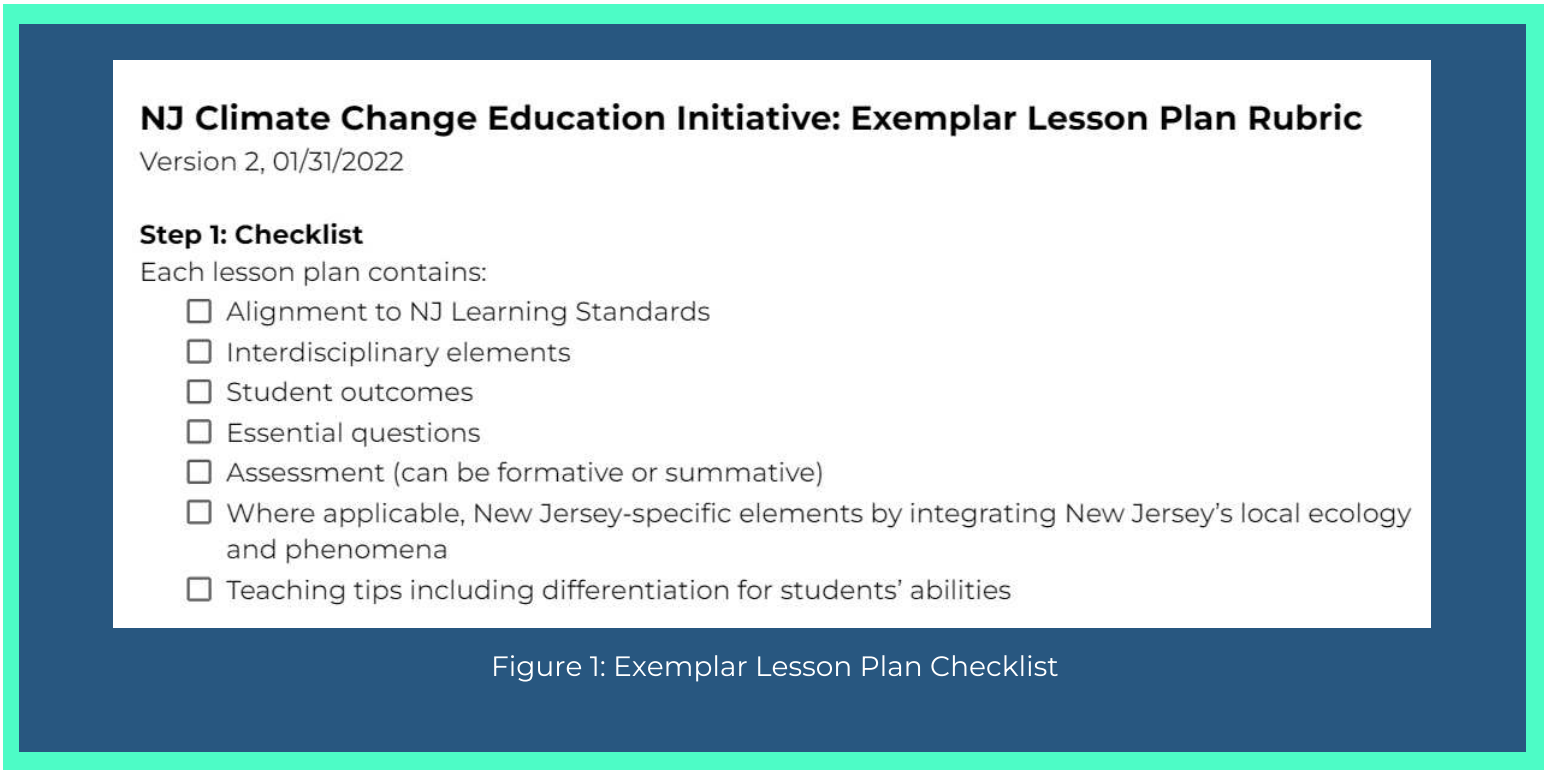

Figure 1: Exemplar Lesson Plan Checklist

Indicators	Exemplar (3)	Average (2)	Low (1)
Justice	The lesson plan is centered around diverse perspectives seeking and creating space for narratives and voices that have historically been hidden. The activities and resources used throughout the lesson plan are highly effective in conveying ideas and actions of justice to the students.	The lesson plan makes an attempt to include diverse perspectives in one section of the lesson plan and creates some space for historically hidden narratives. The activities and resources used allow students to begin thinking about ideas and actions of justice.	The lesson plan makes no attempt to seek diverse perspectives and maintains an incomplete narrative. The activities and resources used limit students' abilities to expand their ideas and actions of justice.
SEL	The lesson plan is fully aligned to the values of the Social-Emotional Learning Alliance for New Jersey by fostering students' self-awareness, self-management, social awareness, responsible decision-making, and/or relationship skills. Overall, the lesson plan is highly effective at allowing students to be aware and manage their emotions in ways that allow them to be a positive force in confronting the climate crisis. The lesson plan requires students to gain an awareness of feelings, values, attitudes, and perceptions at the heart of environmental issues, as appropriate for different development levels.	The lesson plan is somewhat aligned to the values of the Social-Emotional Learning Alliance for New Jersey. The lesson plan is somewhat effective at offering space for students to process and transform their emotions. The lesson plan touches upon students' feelings, values, attitudes, and perceptions and is developmentally appropriate.	The lesson plan is not aligned to the values of the Social-Emotional Learning Alliance for New Jersey. The lesson plan is burdensome and anxiety-provoking. Students may leave the class feeling deflated without an effective emotional management strategy or process to utilize. The lesson plan does not appropriately balance students' developmental needs.

Indicators	Exemplar (3)	Average (2)	Low (1)
Student Action	The lesson plan inspires students to take climate action and goes beyond to create the resources and space for students to collaborate and take action. The lesson teaches students to be imaginative, reflective, and empowered.	The lesson plan states that taking climate action is important and helps students to brainstorm climate solutions and projects but does not provide the support needed for students to actually take action.	The lesson plan encourages students to take climate action but does not provide the resources and space necessary for students to take action.
Burden	The lesson plan greatly minimizes the burden of implementation for teachers and is extremely easy to follow. The lesson plan includes all the resources that a teacher would need to teach the lesson as well as all the materials the students would need. A teaching script may be included to support teachers, especially non-science teachers.	The lesson plan somewhat minimizes the burden of implementation for teachers. The lesson plan includes some of the resources that a teacher would need to implement the lesson, but teachers would still need to put in extra preparation time. Non-science teachers or teachers new to teaching about climate change may still find this lesson plan challenging.	The lesson plan does not minimize the burden of implementation for teachers. Teachers would need a lot of preparation time to teach the lesson. Non-science teachers or teachers new to teaching about climate change may still find this lesson plan challenging.
Depth	The lesson plan fosters a deep understanding of environmental concepts, conditions, and issues. The lesson plan dares to challenge students with the complexities of the climate crisis but does so in ways that are accessible and relevant to students.	The lesson plan fosters some understanding of environmental concepts, conditions, and issues. The lesson plan portrays the complexities of the climate crisis.	The lesson plan offers only a superficial understanding of environmental concepts, conditions, and issues. The lesson plan oversimplifies the complexities of the climate crisis.
	I opt out of scoring this category.		
Total Score			

Figure 2: Exemplar Lesson Plan Rubric

Establishing Reliability of the Rubric

While previous measures can assure us that the rubric itself is valid, the work of screening the lesson plans for the New Jersey-specific portal will be done by many individuals, and thus there is a need to ensure that raters are using the rubric reliably.

Generally speaking, inter-rater reliability studies typically focus on comparing the scores of 2-3 "coders" after training on how to use the tool (in this case the rubric), and 70% agreement or better is considered reliable.[1] In studies using likert-type scales with a wide range, adjacent scores are preferred to those with vast differences, and coded as in agreement (e.g. a score of 7 and 8 on an 8-point scale are considered in agreement). Given our time constraints we opted not to train coders on using the rubric developed through the focus group discussion. We also recruited a larger than typical pool of coders (n=9) to test the rubric.

Coders were recruited through contacting teachers within our professional network. We contacted a pool of approximately 40 New Jersey public school teachers who had a minimum of three years of classroom teaching experience, and documented extensive professional learning in climate change or environmental education. This professional learning was either through pre-professional coursework (completing a 5-course minor in environmental sustainability education) or participating in ongoing grant-funded professional development projects that included 10+ hours of contact time. Nine teachers responded representing six school districts, urban and suburban environments, and grades K-6.

These teacher coders were sent a sample lesson from the StC website[2](targeted at grades 3-5) and the rubric itself as a Google

[1] For more detailed information on calculating Inter-rater reliability see: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3402032/
[2] For a link to the lesson plan, see: https://subjecttoclimate.org/lesson-plan/059ad2aa-635f-4dd4-a32a-3278fdd5960b

Form. We first calculated an overall percentage of agreement among teachers' scores on the entire rubric. This was calculated by assigning a numerical value of 0 or 1 to the checklist items (absent or present) and 1, 2, or 3 to the scores of the various rubric categories, totaling individual scorers's ratings, and calculating the variance across total scores. Across the entire rubric we are at approximately 80% agreement, indicating that the rubric is being used reliably by a variety of teachers. Next, we considered agreement within the teachers' scores among individual items on the rubric. Across most items we had ~90-100% agreement, with a few closer to the 70% range. One category, depth, had more varied responses, and we were able to address these differences, as detailed later in this report.

Reliability in Scoring in Various Categories

Teacher coders were sent the rubric as a Google Form. The items on the early part of the rubric (the checklist) were listed and scorers indicated whether each item was present or absent.

The checklist includes the following items:

- Alignment to NJ Standards
- Contains Interdisciplinary Elements
- Includes Student Outcomes
- Includes Essential Questions[3]
- Includes Assessment (can be formative or summative)
- Where applicable, includes New Jersey specific elements by integrating New Jersey's local ecology and phenomena.
- Includes teaching tips including differentiation for students' abilities

With respect to the first four items, teacher coders were in 100% agreement that the sample lesson contained each of these features: alignment to New Jersey standards, interdisciplinary elements, student outcomes, and essential questions.

For the last three, eight of nine respondents agreed these items were present, resulting in 89% agreement. This high level of agreement also suggests that assessment, New Jersey specific elements, and differentiation strategies were all sufficiently included in the lesson itself.

There were five categories in which coders could assess the lesson using the rubric to determine whether it was exemplary, average or low. Because this rubric's scale contained just three rating levels (exemplary, average, or high), we do not consider adjacent scores to be in agreement. However, in cases of disagreement, we have indicated whether the differing scores were adjacent or spread farther apart to provide a more complete picture of the range of scores given.

[3] This is an optional category as EQs come from Understanding by Design (Wiggins & McTighe, 2005), a particular type of lesson plan design used in many but not all schools.

With regard to **Justice**, eight of the nine coders found the lesson to be exemplary with respect to this category, resulting in 89% agreement. The other one scorer rated this lesson average, a score adjacent to exemplary.

With regard to **Social-Emotional Learning (SEL)**, seven of the nine coders found the lesson to be average with respect to this category, resulting in 78% agreement. The other two coders rated this lesson exemplary, a score adjacent to average.

With regard to **Student Action**, six of the nine coders found the lesson to be exemplary in this category, resulting in 68% agreement. The other three rated this lesson average, a score adjacent to exemplary.

With regard to **Depth**, four of the nine coders found the lesson to be exemplary in this category, four found it to be average, and one found it to be low. This indicates that the coders were in approximately 44% agreement.

With regard to **Burden**, eight of the nine coders found the lesson to be exemplary with respect to this category, resulting in 89% agreement. The other coder rated this lesson average, a score adjacent to exemplary.

We also allowed teachers to contribute open-ended comments at the conclusion of the survey to contextualize responses if needed. These responses helped to better situate our understanding of the wider variety of scores with respect to the depth category, and helped us to interpret the results. From the teachers who elected to leave open-ended comments, several suggested that they felt less confident in their ability to judge lessons for depth if they were outside their grade level expertise or focus content area. For example, a kindergarten teacher might rate a lesson at the third grade level high for depth while a sixth grade teacher might call it low and a third grade teacher might say average. As a result, we have agreed to include an option for scorers to opt-out of scoring this category if they feel they are unable to assess depth based on their personal experience. While we assert that depth is a critical indicator of the quality of a lesson, we acknowledge that it is not always possible for teachers to accurately score this category without appropriate contextual knowledge.

Conclusions

As a result of the measures taken by the StC team to establish validity of their curricular resources, in concert with our reliability study, we can agree and say with confidence that the rubric is being used reliably by knowledgeable teachers.

Without any modifications, this analysis yielded a high level of agreement among scorers overall and within all but one category. With the modification of the rubric to allow for scorers to opt out of scoring the depth category if they do not have appropriate contextual information, the rubric can be used with even more reliability. As the New Jersey-specific portal develops, we will conduct future studies once the database is complete to ensure the rubric continues to be used reliably.

For further questions about this analysis, please contact Dr. Lauren Madden at: maddenL@tcnj.edu

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