

Head, Heart, Hands: A Rubric for Creating Inclusive STEM Learning Environments

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Abstract

This paper explores the implementation and efficacy of a novel rubric designed for pre-college STEM educators participating in a six-month professional development program focusing on creating inclusive STEM learning environments. The rubric, grounded in contemporary educational theory, emphasizes 27 key elements categorized under three main tenets: cognitive engagement (Head), emotional engagement (Heart), and active participation (Hands) in STEM. Educators first employed this rubric during a summer institute, applying it to observations made in engineering summer camps. Then, they used the rubric within their classrooms and STEM clubs. Their assessments aimed to classify observed teaching practices and learning environments as "Inequitable and Exclusive," "Performative or Status Quo," or "Equitable and Inclusive." Aside from an assessment tool, the rubric provides a framework for improving the learning environment.

The paper investigates how educators integrated the rubric into their practice and its impact on enhancing inclusive teaching methodologies in STEM education. The study contextualizes the rubric within a rich theoretical framework, drawing upon literature in educational psychology, inclusive pedagogy, and STEM education research. The findings offer insights into how educators discern and foster inclusivity in STEM learning environments, providing evidence of the rubric's utility in professional development. This study contributes to the field by offering a validated tool for educators to self-assess and evolve their pedagogical approaches towards more inclusive STEM education, ultimately aiming to broaden STEM participation across diverse student populations.

Introduction

Creating inclusive learning environments in STEM (Science, Technology, Engineering, and Mathematics) is essential. The rationale is straightforward: if we are not intentionally inclusive, we risk being unintentionally exclusive. Historically, systemic barriers have marginalized women, people of color, and other underrepresented groups in STEM fields. These barriers persist today, underscoring the need for deliberate efforts to ensure every student feels valued, included, and affirmed. Such environments are critical for fostering a sense of belonging, which is key to motivating students to persist in STEM disciplines.

The primary purpose of this paper is to present the Head, Heart, Hands rubric, and we offer an examination of the application and impact of the rubric in a professional development program for pre-college STEM educators. The narrative of this application aims to demonstrate how the

rubric can be a powerful tool for developing learning environments that welcome a diverse array of students, thereby supporting broader participation in STEM fields.

Origin and Evolution of the Rubric

The origin and evolution of the Head, Heart, Hands rubric reveals a thoughtful process aimed at addressing the challenges educators face in synthesizing and applying inclusive practices in STEM education. The rubric was developed by Meagan Pollock as an extension of her work as a consultant for the National Alliance for Partnerships in Equity (NAPE) and adapted to support the specific needs of the *Catalyzing Inclusive STEM Experiences All Year Round* (CISTEME365) I-TEST grant's fifth cohort of a professional development program (NSF #1850398). The first iteration of the rubric was funded by a grant from the Flour Foundation (2020), and the second iteration by the Toyota USA Foundation (2023).

The rubric's development was motivated by a recognition of a persistent challenge among educators in integrating a multitude of strategies and concepts taught during professional development into their teaching practices. Despite providing educators with extensive resources and training, an observed gap between the acquisition of knowledge and its practical application was persistent. This gap was partly due to the overwhelming nature of the information and the difficulty in accessing or recalling it when needed. To address this, Pollock sought to create a tool that would package the essential elements of inclusive teaching practices in a clear, concise, and accessible manner.

The rubric embodies the core themes typically taught within her and NAPE's educational equity programs and then sorted by cognitive engagement (Head), emotional engagement (Heart), and active participation (Hands). These categories were chosen to simplify the framework for educators, making it easier for them to understand and apply the principles of inclusive education. The rubric was designed to serve as a quick reference guide that educators could readily use to assess and enhance their teaching strategies, ensuring they cater to the diverse needs of their students.

About the Rubric

To effectively discuss the rubric used for fostering inclusive STEM learning environments, it's essential to first establish a clear understanding of its structure and purpose. Below is a detailed description of the rubric that has been recontextualized from its original application in manufacturing to its broader use in inclusive STEM education. The rubric is structured into three primary sections—Head, Heart, and Hands—each representing critical facets of the learning experience and corresponding to cognitive engagement, emotional engagement, and active participation. Our application of the 3H model[1] is rooted Piaget's constructivist learning theories[2], Vygotsky's Zone of Proximal Development[3], brain-based learning like that of Smilkstein[4], self-efficacy[5], and cultural responsive teaching[6].

Head (Cognitive Engagement): This section of the rubric focuses on self-efficacy, asking, "Can I do it?" It evaluates how educational activities and facilitators help students connect to their prior knowledge and skills, thereby boosting confidence and a belief in their ability to succeed in STEM fields. It assesses the diversity of representation, accessibility, and challenges to norms and stereotypes, crucial elements to building self-efficacy and reducing stereotype threat[7]. The rubric delineates between actions that are inequitable and exclusive, performative or status quo, and equitable and inclusive, with the latter representing an environment where activities are differentiated, and every student receives the support needed to make connections to their capabilities[8].

Heart (Emotional Engagement): "Do I want to do it?" is the key question here, aimed at attracting and motivating student agency[9]. This component measures the extent to which positive career messaging[10] and multiple work[11] and cultural values[12], as well as funds of knowledge[13] are integrated into STEM education. It encourages educators to use aspirational and relatable messages to inspire students, highlighting the creative and collaborative nature of STEM professionals. The rubric's stages range from a lack of positive messaging to fully integrated messaging that conveys the meaningful impact and opportunities within STEM fields.

Hands (Active Participation): Finally, "Let me try it?" encapsulates the essence of this section. It promotes student-centered learning and active participation through project or problem-based learning (PBL). Most of this section of the rubric draws from the "Ensuring Equity in PBL Reflection Tool"[14]. This part of the rubric examines the degree to which students are allowed to exert agency and participate in team-learning environments that reflect real-world contexts and social impacts. The rubric encourages activities that engage every student, ensuring that all educational experiences are hands-on and relevant to students' lived experiences and socioeconomic backgrounds.

Each of these sections contains specific items, totaling 27, which describe behaviors and practices ranging from those that perpetuate inequity to those that foster an inclusive atmosphere. For example, under the "Head" section, item 1 addresses the importance of connecting new content to students' prior mastery experiences. In an "Inequitable & Exclusive" environment, no effort is made to establish this connection, whereas in an "Equitable & Inclusive" setting, facilitators work with every student to ensure that the new content is relatable to their existing knowledge.

Rubrics are common educator tools for assessing student progress, so adapting a rubric-based approach to instruction is an easy adaptation for educators[15]. The Head, Heart, Hands rubric provides a comprehensive evaluation tool, allowing educators to reflect on and assess the inclusivity of their practices across three distinct but interconnected dimensions. It offers a progressive continuum, enabling educators to identify areas of strength and opportunities for growth in creating STEM learning environments that are truly inclusive and conducive to all students' success.

Application of the Rubric

In its practical application during a summer training program for precollege STEM educators, the rubric was used to observe and evaluate teaching practices in real-time, particularly during STEM camps that ran parallel to the professional development sessions. This hands-on application allowed educators to directly relate the rubric's criteria to observable practices, aiding in their understanding and ability to identify areas for improvement. The program ran virtually for six months, and the educators continued to apply the tool to their informal and formal learning environments, as well as their action research projects, a culminating effort of their participation in the program.

The implementation of the Head, Heart, Hands rubric throughout the professional development program represented a comprehensive strategy aimed at infusing inclusive teaching practices into STEM education. This multifaceted application was both strategic and deliberate, intended to empower educators with the tools and perspectives necessary to cultivate learning environments that are welcoming and accessible to all students. The rubric's role extended beyond a mere evaluative instrument; it served as a catalyst for deepening educators' understanding of inclusivity and its critical importance in STEM disciplines. This introduction sets the stage for a detailed exploration of how the rubric was leveraged during the summer training program and its continued impact in the subsequent educational activities of the participants.

During the Summer Training Program, the rubric was primarily employed as an observational tool. Educators were prompted to use it as a lens to scrutinize teaching practices within STEM camps that coincided with their professional development sessions. This method was designed to highlight instances of cognitive, emotional, and active engagement, offering a real-time context for identifying and appreciating the nuances of inclusive education. By observing these practices in action, educators could see the principles of the rubric come to life, fostering a deeper understanding of how to apply these insights within their own teaching contexts.

Simultaneously, the rubric provided a structured framework for evaluation and reflection. Acknowledging the initial discomfort some educators felt when tasked with evaluating their peers, especially during sessions led by the grant's principal investigator and camp instructor, the rubric aimed to transcend personal judgments by concentrating on pedagogical effectiveness and inclusivity. This shift towards a more objective analysis of teaching strategies allowed educators to critically assess learning environments and identify areas for enhancement, promoting a culture of continuous improvement.

Moreover, the rubric facilitated a feedback mechanism that encouraged educators to articulate their observations and insights regarding teaching practices observed during the STEM camps. Despite some hesitations related to the perception of evaluating colleagues, this process was instrumental in nurturing a reflective practice among educators. By providing targeted feedback,

participants engaged in constructive dialogues about pedagogical approaches, further embedding the principles of inclusivity into their professional ethos.

Post-training application of the rubric saw its integration into educators' ongoing teaching practices. As a reflection tool, the rubric enabled educators to systematically assess their classroom and STEM club activities, ensuring that they consistently applied the Head, Heart, Hands criteria. This ongoing engagement with the rubric encouraged educators to internalize its concepts, making inclusivity a central consideration in their pedagogical planning and execution.

In addition, the rubric was adaptively used in action research projects, underscoring its versatility and applicability across various educational initiatives. Although it was not initially specified as a requirement for these projects, educators intuitively incorporated the rubric into their research methodologies. This spontaneous adoption highlights the rubric's utility in structuring inquiries into inclusive practices, enabling educators to conduct meaningful investigations that contribute to the broader discourse on equity in STEM education.

Through both its immediate application during the summer training and its sustained influence on educators' practices thereafter, the Head, Heart, Hands rubric exemplifies a dynamic and effective tool for advancing inclusivity in STEM education. This account of its use underscores the significant role such frameworks can play in empowering educators to create more equitable and engaging learning environments[16].

Analysis

In the section that follows, we summarize five data sources used to ascertain the impact of the Head, Heart, Hands Rubric on participant learning. Over several months, these sources provided comprehensive insights into how the rubric was applied and its effectiveness in enhancing teaching practices within STEM education. Each source reflects a different stage in the professional development journey, from immediate application during a weeklong program to long-term integration into classroom practices, culminating in a virtual conference presentation of Action Research for Equity Projects. This multi-faceted approach helps in understanding both the immediate and sustained impacts of the rubric on educators' pedagogical strategies and their students' learning experiences.

Data Source: Discord Channel (July 2023)

During the weeklong professional development program, Discord (digital communication platform that allows for real-time discussions) served as a pivotal platform for interactive dialogue and practical application of the Head, Heart, Hands Rubric, which guides the creation of inclusive STEM learning environments. Throughout the sessions, educators actively engaged in discussions that revolved around the core elements of the rubric—cognitive, emotional, and

behavioral engagement—demonstrating its integration into their pedagogical reflections and practices.

Facilitators used Discord to query educators and invite them to reflect on various teaching strategies and scenarios, suggesting modifications to enhance inclusivity and accessibility, in alignment with the rubric's criteria. For instance, discussions about replacing the example of hair growth with more universally relatable topics like sleep or screen time addressed the 'Head' category by making content more relevant to students' lived experiences. Similarly, suggestions to replace "parents" with "guardians" to avoid exclusivity highlighted the 'Heart' aspect, fostering emotional safety and inclusivity. Furthermore, educators reflected on the need for visual aids and scaffolding strategies, resonating with the 'Hands' component, which emphasizes active, accessible participation. These interactions not only underscored the utility of Discord as a tool for ongoing professional dialogue but also illustrated the rubric's real-time application and iterative refinement, enhancing the educators' ability to foster more equitable and engaging STEM learning environments.

Data Source: Daily Debriefs (July 2023)

In evaluating the use and practice of the Head, Heart, Hands Rubric during a weeklong professional development program, participant feedback collected via VideoAsk highlighted key aspects of its implementation and impact. Educators consistently noted that the rubric effectively guided the structure and execution of activities, particularly in fostering an environment conducive to hands-on learning and active engagement. Feedback emphasized the rubric's role in encouraging a focus on inclusive and equitable practices, which were particularly evident in activities that required collaborative problem-solving and critical thinking.

Challenges identified in the feedback pertained mainly to the application of the rubric's criteria in real-time teaching scenarios. Some educators found it challenging to integrate the rubric seamlessly into dynamic classroom settings, particularly during complex engineering tasks that demanded high levels of cognitive engagement from students. This was compounded by the need for clearer guidance on adapting the rubric's principles to diverse learning preferences and needs.

Improvements suggested by participants included the need for more explicit integration of the rubric's components throughout the professional development sessions. Specifically, there was a call for more frequent and detailed discussions on how to apply each element of the rubric during lesson planning and execution. Additionally, educators expressed a desire for more robust support materials and training sessions focused on the practical application of the rubric to ensure that its use becomes a routine part of instructional practices rather than an adjunct tool.

Overall, while the Head, Heart, Hands Rubric was recognized for its potential to enhance educational practices by embedding inclusive and equitable strategies into teaching, the feedback

highlighted the necessity for ongoing training and resources to fully realize its benefits in diverse educational settings.

Data Source: Learning Community Pre-work (Sep 2023)

Two months following an intensive week of professional learning, program participants gathered virtually to engage in a reflective exercise using the Head, Heart, Hands Rubric. This session was designed to apply the rubric within various STEM contexts, allowing educators to categorize and reflect on their teaching practices. Participants were tasked with observing and reporting on at least three items from the rubric, representing each of the levels: Inequitable & Exclusive, Performative or Status Quo, and Equitable & Inclusive. Data collected through a survey tool was then analyzed to assess the rubric's impact and utility in enhancing educational practices.

Utilization of the Rubric: Educators effectively employed the rubric to distinguish and categorize their practices across the continuum from "Inequitable & Exclusive" to "Equitable & Inclusive." This process highlighted the rubric's significant role as a reflective instrument, enabling educators to identify specific areas where their instructional methods excel and where improvement is necessary.

Recognition of Inclusive Practices: The feedback indicated a strong awareness and implementation of "Equitable & Inclusive" practices among the educators. Many shared their proactive measures in promoting diverse career pathways, ensuring accessibility in learning experiences, and enhancing student agency and participation. These reflections suggest that the rubric not only aids in recognizing effective inclusive strategies but also supports their reinforcement in educational settings.

Identification of Performative Practices: Some participants acknowledged that their practices fell into the "Performative or Status Quo" category, revealing a level of inclusivity that might be deemed superficial. This realization is crucial as it underlines the importance of the rubric in not only validating positive educational practices but also in identifying areas where inclusivity efforts are insufficient and require deeper integration.

Acknowledgment of Exclusionary Practices: Additionally, there were admissions of "Inequitable & Exclusive" practices. Such candid self-assessment demonstrates the rubric's capability to spotlight major inclusivity shortfalls, setting the stage for necessary corrective actions to ensure that educational environments do not marginalize or overlook any student group.

This comprehensive analysis underscores the rubric's effectiveness as a developmental tool for educators, guiding them toward more equitable and inclusive teaching practices within the STEM disciplines.

Data Source: Virtual Showcase Conference (Jan 2024)

Action Research for Equity Projects[17] (AREP) are undertaken by practitioners to explore and improve equity within their educational practices. Participants of a professional development program completed these projects, culminating in presentations at a recent virtual conference. These projects typically involve collecting and analyzing both quantitative and qualitative data to implement and assess strategic changes that promote equity and inclusivity in learning environments.

One participant's abstract exemplified the direct application of the rubric by focusing on "Positive STEAM career messaging: debunking stereotypes of STEAM careers." This project highlighted how educators encouraged students to explore diverse STEAM careers, effectively applying the 'Heart' component of the rubric by promoting career exploration that challenges traditional norms. This was achieved through activities like "STEAM career exploration through Science Buddies" and presentations on varied educational pathways, demonstrating a practical implementation of the rubric's principles to broaden students' perceptions of potential career opportunities. This approach aligns with the rubric's goal to foster environments where all students can see themselves in various future roles, thereby enhancing inclusivity.

The frequent mention of the rubric without prompting during presentations underscores its value as a foundational tool in professional development. Educators not only utilize the rubric to evaluate and refine their teaching practices but also to consciously integrate equity-oriented strategies into their curriculum, further evidenced by the detailed initiatives described in their research projects. This active engagement with the rubric highlights its effectiveness in supporting educators to make more informed, reflective, and impactful decisions in their pursuit of equity in education.

Data Source: Post Program Feedback (April 2024)

Eight and a half months following a comprehensive professional development session, program participants were surveyed to assess the enduring impact of the Head, Heart, Hands Rubric on their teaching practices. This survey was pivotal in evaluating how educators integrated the rubric's components into their daily instructional methods and the broader implications for student engagement and inclusivity in STEM education.

Integration of Rubric into Teaching Practices: Educators reported successfully applying the rubric to enhance the inclusivity and engagement of their lessons. One educator noted, "Highlighting careers in STEAM fields both for traditional and non-traditional career pathways throughout the year creates an environment where STEAM fields are presented as being for all students." This exemplifies the rubric's utility in promoting diverse career paths, crucial for broadening students' aspirations and self-perception in STEAM roles.

“I was always rereading each of the different components when creating or redesigning activities/lessons. This repetitive process caused me to really focus in on all of my lessons and their desired outcomes.”

“When planning lessons I try to be aware of not over using any one component. I try to balance the head, heart and hands activities.”

“The rubric offered a starting place to assure that students were getting what they needed.”

Impact on Student Engagement: A significant increase in student participation and inquiry about STEAM fields was observed, suggesting that the rubric's application made the classroom environment more inviting and intellectually stimulating. "I noticed my shy students asking more questions, getting enthusiastic about the activities, opening up to their peers, etc.," reflects the change in student dynamics as a direct outcome of implementing strategies from the rubric.

Rubric as a Reflective Tool for Educators: The rubric proved essential in helping educators identify areas for improvement. For instance, one teacher adjusted their approach by adding more STEAM career highlights to their classes, while another remarked on the profound impact of incorporating empathy in problem-solving, indicating a shift towards more student-led learning experiences. "It gave me time to think about different areas that I needed to improve," shared another educator, underscoring the rubric's role in fostering self-reflection and professional growth.

“It allowed me to notice little things I was doing in a lesson or during my delivery of a lesson. I started really looking at the lesson I have already created and possibly tweaking it.

“I tended to over use head and not any heart so I have been trying to use more heart components.”

Suggestions for Rubric Enhancement: While feedback on the rubric's current format was overwhelmingly positive, suggestions for improvement included providing more examples and activities to better illustrate each component's application. This feedback points to a desire for more concrete guidance on implementing the rubric's principles effectively.

Recommendations for Ongoing Use: Unanimously, educators recommended the continued use of the rubric in professional development, citing its clarity and utility in foundational curriculum planning. "It offers a strong foundation when planning curriculum and programs," one educator affirmed, highlighting the rubric's effectiveness in structuring educational content that is both inclusive and engaging.

Testimonials and Quantitative Feedback: The quantitative ratings from the survey reinforced these positive sentiments, with high marks across all areas, particularly in enhancing educators' understanding of creating inclusive learning environments and the rubric's overall user-friendliness.

“I wanted to have a more purposeful and inclusive program. Using the [rubric] allowed me to see where we needed to start and how to plan. This rubric allowed me to have meaning and purpose so that my students were more engaged.”

In conclusion, the Head, Heart, Hands Rubric has established itself as an invaluable tool for educators, guiding them toward more thoughtful, inclusive, and effective teaching practices. The feedback collected not only validates the rubric's current effectiveness but also offers constructive pathways for its enhancement, ensuring its relevance and impact in future educational settings.

Benefits of Using the Rubric

The inclusion and practical use of the Head, Heart, Hands rubric in the professional development program provided several distinct benefits for this cohort over previous groups that did not have the same level of engagement with such a tool. In this section, we outline the advantages gained from integrating the rubric into the training and its subsequent application in educational settings.

Enhanced Engagement and Application: The cohort that actively practiced using the rubric during the professional development program demonstrated a higher level of engagement with the material. The hands-on experience with the rubric allowed them to better understand and apply the concepts of inclusive education within their teaching practices. This active engagement was evidenced by more productive action research projects, suggesting that the rubric facilitated a deeper comprehension and integration of inclusive strategies.

Improved Reflection and Self-Assessment: Practicing with the rubric enabled educators to reflect more effectively on their teaching practices. The structured framework of the rubric provided clear criteria for evaluating inclusivity within their classrooms, making self-assessment more accessible and actionable. This reflective practice likely contributed to the observed improvements in teaching methodologies and the adoption of more inclusive approaches.

Increased Cohesion and Consistency: The use of the rubric introduced a common language and set of criteria for discussing and assessing inclusive teaching practices. This common framework helped to unify the cohort's understanding of inclusivity, leading to more consistent application of the principles across different educational contexts. The shared experience of learning and applying the rubric also fostered a sense of community and mutual support among the participants.

Encouragement of Active Learning: The requirement to observe and apply the rubric in real-time settings, such as STEM camps, encouraged educators to engage in active learning. This approach not only reinforced the theoretical knowledge gained during the professional development program but also highlighted the practical implications of inclusive teaching strategies. The dual focus on content acquisition and pedagogical application enriched the educators' learning experience.

Facilitation of Targeted Improvements: The specificity of the rubric, with its distinct categories of Head, Heart, Hands, allowed educators to identify targeted areas for improvement in their teaching practices. This granularity enabled more focused efforts to enhance inclusivity, rather than a more generalized attempt to improve teaching without a clear direction.

Sustained Use Beyond Training: Finally, the practice of using the rubric during the professional development program seemed to encourage its continued use beyond the initial training context. Educators were more likely to utilize the rubric as a guide and reflective tool in their ongoing teaching practice, suggesting that early and active engagement with the rubric promoted its integration into their educational approach.

Challenges and Future Improvements

The deployment of the Head, Heart, Hands rubric within the professional development program unearthed various challenges and insights that underscore the necessity for its refinement and more strategic application. Central to these challenges were educators' unease with peer evaluation and the complexities of simultaneously learning new curriculum content while applying the rubric's criteria. These experiences prompt a reevaluation of the rubric's structure and the support mechanisms surrounding its use, aiming to enhance its practicality and effectiveness in fostering inclusive educational environments.

Streamlining and Differentiation for Clarity and Usability: The rubric's criteria require simplification to ensure clarity and ease of understanding, which could involve consolidating overlapping elements and focusing on key inclusive practices. Additionally, introducing distinct levels of implementation could enable educators to better gauge progress and set specific improvement goals, thereby accommodating diverse teaching contexts and learning needs.

Enhanced Scaffolding and Support: Addressing the dual challenge of learning and application necessitates improved scaffolding. This might encompass providing educators with more structured guidance, exemplar applications of the rubric, and opportunities for reflection, all aimed at bridging the gap between theoretical knowledge and practical pedagogy.

Constructive Feedback Mechanisms: To alleviate the discomfort associated with peer evaluation, developing more structured feedback channels that emphasize constructive critique over personal judgment could foster a culture of open, reflective practice. This involves ensuring

anonymity where necessary and concentrating feedback on pedagogical strategies rather than individual performance.

Active Learning and Continuous Engagement: The rubric's integration into the learning process must be dynamic, encouraging active participation through workshops, role-playing, or case studies that require practical application of its principles. Moreover, continuous engagement with the rubric post-training—through regular check-ins, online forums, or integration into personal development plans—will sustain its application and relevance.

Research, Adaptability, and Digital Tools: Empirical validation of the rubric through research on its impact on teaching practices and student outcomes will solidify its foundation. Adaptability to various educational contexts enhances its utility across different settings and age groups. Furthermore, the development of digital tools to facilitate rubric use could introduce interactive elements, progress tracking, and personalized feedback, making the rubric more accessible and engaging for educators.

Inclusivity and Cultural Competence: Finally, ensuring the rubric is sensitive to diverse cultural contexts and addresses the needs of all students, especially those from historically marginalized communities, is crucial. This may involve gathering input from a wide range of stakeholders in its development process to ensure it embodies a comprehensive approach to inclusivity.

In summary, while the rubric has proven to be a valuable tool in advancing inclusive practices within STEM education, its further refinement and the enhancement of support mechanisms surrounding its use are essential. Addressing the outlined challenges and areas for improvement will ensure the rubric not only serves as a guide but also as a catalyst for meaningful pedagogical change.

Conclusion

In conclusion, the Head, Heart, Hands rubric serves as a pragmatic tool in the pursuit of inclusivity within STEM education. This paper has detailed the rubric's design and application, highlighting its role in aiding educators to critically assess and improve their teaching practices. The use of the rubric in professional development programs has demonstrated its effectiveness in providing a structured approach to fostering environments where all students feel valued.

However, the implementation of the rubric has also surfaced challenges, notably in peer evaluation and the simultaneous learning and application of new content. These challenges have prompted suggestions for refinement, emphasizing the need for a more streamlined, user-friendly design and additional support for educators in applying the rubric.

Improvements such as clearer criteria, levels of implementation, and the provision of scaffolded learning experiences are proposed to enhance the rubric's usability. Additionally, creating a

culture of constructive feedback and continuous engagement with the rubric can further embed inclusivity into teaching practices.

Research into the rubric's impact on teaching and learning outcomes, coupled with the development of digital tools, can broaden its application and effectiveness. Ensuring the rubric is adaptable and culturally competent remains essential, as it must resonate with and be applicable to diverse educational settings and student demographics.

Ultimately, while the rubric is a valuable instrument for advancing inclusive practices, it is the commitment to its ongoing development and application that will truly catalyze change in STEM education. By addressing the identified areas for improvement, the rubric can better serve as a practical guide for educators striving to create equitable and engaging learning environments for all students.

Access the Head, Heart, Hands Rubric



The version of the rubric used in this study is in the appendix. Download it at <https://drmp.co/HHHrubric>.

Stay Updated: Visit us at the link above or via the QR code to download the current or any available future versions of the Head, Heart, Hands Rubric. You can also join our mailing list to receive notifications about future updates and resources.

This QR code leads to a single access point where you can easily download the rubric and stay informed on developments and enhancements.

Acknowledgments

Major iterations of the rubric were paid for by grants from the Fluor Foundation and the Toyota USA Education Foundation to the National Alliance for Partnerships in Equity. The program described in this paper was funded by the National Science Foundation. Early collaborators and contributors to variations of the rubric include Tegwin Pulley, Audrey Selden, Mimi Lufkin, Julia Thompson, and Michelle Brown. Special thanks to our CISTEME365 participants for their support in realizing the potential of this resource.

References

1. Gazibara, S. (2013). "Head, Heart and Hands Learning"-A challenge for contemporary education. *The Journal of Education, Culture, and Society*, 4(1), 71-82.
2. Piaget, J. (1964). Cognitive Development in Children Development and Learning. *Journal of Research in Science Teaching*, 2, 176-186.
3. Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes*. Massachusetts: Harvard University Press.
4. Smilkstein, R. (2011). *We're Born to Learn: Using the Brain's Natural Learning Process to Create Today's Curriculum*. Corwin Press.
5. Bandura, A. (1977). Self-efficacy: toward a unifying theory of behavioral change. *Psychological review*, 84(2), 191.
6. Hammond, Z. (2014). *Culturally responsive teaching and the brain: Promoting authentic engagement and rigor among culturally and linguistically diverse students*. Corwin Press.
7. Steele, C. M. (2011). *Whistling Vivaldi: How stereotypes affect us and what we can do*. WW Norton & Company.
8. Smith, A., & Chestnutt, C. (2021). Differentiation for equity. *Journal of Higher Education Theory and Practice*, 21(6).
9. Bandura, A. (2014). Exercise of personal agency through the self-efficacy mechanism. In *Self-efficacy* (pp. 3-38). Taylor & Francis.
10. Pearson, G. (2008). Changing the conversation: messages for improving public understanding of engineering.
11. Ros, M., Schwartz, S. H., & Surkiss, S. (1999). Basic individual values, work values, and the meaning of work. *Applied psychology*, 48(1), 49-71.
12. Hofstede, G. (2011). Dimensionalizing cultures: The Hofstede model in context. *Online readings in psychology and culture*, 2(1), 8.
13. González, N., Moll, L. C., & Amanti, C. (Eds.). (2006). *Funds of knowledge: Theorizing practices in households, communities, and classrooms*. Routledge.
14. Brown, M., Thompson, J., & Pollock, M. (2017). *Ensuring Equity in Problem Based Learning*. NAPE. Gap, PA.
15. Luft, J. A. (1999). Rubrics: Design and use in science teacher education. *Journal of Science Teacher Education*, 10(2), 107-121.
16. Tatto, M. T. (Ed.). (2024). *Empowering Teachers for Equitable and Sustainable Education: Action Research, Teacher Agency, and Online Community*. Taylor & Francis.
17. Williams, B. (2016). INCREASING ACCESS, EQUITY AND DIVERSITY: NAPE's Program Improvement Process for Equity. *Techniques Magazine* by ACTEOnline. <https://www.acteonline.org/wp-content/uploads/2018/05/Techniques-NovDec2016-NAPEProgramImprovementProcessEquity.pdf>

Appendix: Rubric

Rubric for Equitable & Inclusive STEM Learning Environments

Through thoughtful action, we can create equitable and inclusive environments that encourage, facilitate, and accelerate every student's success in STEM. Use this rubric to help you plan.

		INEQUITABLE & EXCLUSIVE	PERFORMATIVE OR STATUS QUO	EQUITABLE & INCLUSIVE
 HEAD <i>Can I do it?</i>				
1	Connect to students know and can do This brain-science truth boosts confidence and self-efficacy!	Planned activities and facilitators make no effort to connect to student's prior mastery experiences.	Planned activities and facilitators make some effort to connect to student's prior mastery experiences, but some students remain on the peripheral.	Activities are differentiated and facilitators work with every student to find a way to connect activities or content to something they know and can do.
2	Diverse representation This includes images, scholars, speakers, authors, role-models, videos, game characters, etc.	Only the normative population is represented. <i>For example: an all white or Asian male panel of engineers.</i>	Representation is mostly normative with the exception of one tokenized individual.	Representation is diverse across gender, race, socio-economic status, ability, etc.
3	Accessible to every student This includes scheduling, cost, physical requirements, culture/climate, etc. In addition, are all components accessible to people with visual, hearing, and physical impairments?	Many barriers exist to access, opportunity, and participation. Inadequate efforts are made to eliminate barriers.	While some efforts to eliminate barriers are in place, and progress has been made, barriers still exist to access, opportunity, and participation.	No known barriers exist to access, opportunity or participation, and intentional supports are provided to increase accessibility.
4	Modeling Simply modeling a task isn't enough! We must model the struggle using what's called a coping model as an instructional aid to promote student motivation and learning.	Students are always instructed under Mastery Model conditions, where students observe a model who presents an error-free process of interpreting information while manipulating task, simulation or activity.	Students are rarely instructed under Coping Model conditions: where students observe a model who makes errors and demonstrates initial difficulties but overcomes them.	Students are most often instructed under Coping Model conditions: where students observe a model who makes errors and demonstrates initial difficulties but overcomes them.
5	Feedback	Students do not receive feedback that conveys high expectations and connects to previous mastery experiences.	Students occasionally receive feedback that conveys high expectations and connects to previous mastery experiences.	Students frequently receive feedback that conveys high expectations and connects to previous mastery experiences.

		INEQUITABLE & EXCLUSIVE	PERFORMATIVE OR STATUS QUO	EQUITABLE & INCLUSIVE
6	Physiological and Emotional Cues	Students are not taught or encouraged to manage stress and anxiety from struggle, failure, and the challenge to persist.	Students encouraged to manage stress and anxiety from struggle, failure, and the challenge to persist, but not taught strategies for doing so.	Students are taught and encouraged to manage stress and anxiety from struggle, failure, and the challenge to persist.
7	Challenges gender norms and stereotypes	Gender norms and stereotypes are perpetuated .	Gender norms and stereotypes are not challenged . <i>For example: Girls or women consistently write the report or presentation, because "girls are neater."</i>	Gender norms and stereotypes are actively and openly challenged .
8	Challenges racial norms and stereotypes	Racial norms and stereotypes are perpetuated .	Racial norms and stereotypes are not challenged . <i>For example: Asian students are assigned the math portion because "Asians are good at math."</i>	Racial norms and stereotypes are actively and openly challenged .
9	Challenges socio-economic status (SES) norms and stereotypes	SES norms and stereotypes are perpetuated .	SES norms and stereotypes are not challenged .	SES norms and stereotypes are actively and openly challenged .
10	Challenge ableist norms and stereotypes	Ableist norms and stereotypes are perpetuated . <i>For example: Students in wheel chairs are discouraged from welding class.</i>	Ableist norms and stereotypes are not challenged .	Ableist norms and stereotypes are actively and openly challenged .



HEART Do I want to do it?

11	Positive career messaging 1) STEM makes a world of difference and helps shape the future 2) STEM is essential to our health, happiness, and safety 3) STEM professionals are creative and collaborative problem-solvers. ¹	Positive messaging is missing from the communication, design, and implementation. <i>For example: STEM is for the elite math and science students, and creativity and collaboration is ignored.</i>	Positive messaging is additive , yet not fully integrated into the communication, design, and implementation.	Positive messaging is fully integrated into the communication, design, and implementation.
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		INEQUITABLE & EXCLUSIVE	PERFORMATIVE OR STATUS QUO	EQUITABLE & INCLUSIVE
12	Multiple work² and cultural values³	Only individualistic cultural values and extrinsic work values are included. Collectivist and other work values are missing . <i>For example: the nature of the intervention is competitive, with no social value.</i>	Collectivist cultural values and social/intrinsic/prestige work values are additive , yet not fully integrated.	Collectivist cultural values and social/intrinsic/prestige work values are fully integrated with normative individualistic and extrinsic work values.
13	Encourages career exploration outside of norms	Students are not encouraged to explore careers outside of norms (<i>meaning gender, race, socio-economic status, ability status, etc., norms</i>).	Students are passively encouraged to explore careers outside of norms.	Students are actively and directly encouraged to explore careers outside of norms. <i>For example: Students are personally invited and encouraged to consider nontraditional careers.</i>
14	Encourages college AND career readiness	Only four-year college pathways are represented as acceptable post-secondary options.	Some two-year college, certificate, and apprentice pathways are included, but implicitly presented as secondary to four-year college pathways.	Two-year college, certificate, apprentice, and four-year college pathways are included, and presented as equally valuable post-secondary options .



HANDS Let me do it?

15	Student-centered Promote student-centered, rather than content or teacher-centered learning.	Activities do not allow student agency (choice) or scaffold learning appropriately.	Activities allow for some level of student agency, or modestly scaffold learning.	Activities allow for student agency and scaffold learning appropriately.
16	Student agency Providing opportunity for students' personal agency on assignments and grading has been correlated to motivation and intellectual development.	Activities do not allow student agency (choice).	Activities infrequently allow student agency (choice).	Activities allow student agency (choice).
17	Scaffolding Providing students with appropriate support can help lead them to success and build self-efficacy. Consider students' Zone of Proximal Development and include supports that encourage further understanding.	Activities do not scaffold learning appropriately.	Activities infrequently scaffold learning appropriately.	Activities scaffold learning appropriately.

		INEQUITABLE & EXCLUSIVE	PERFORMATIVE OR STATUS QUO	EQUITABLE & INCLUSIVE
18	Team-learning environments Activities include no team learning.	Activities include no team learning.	Activities infrequently include team learning.	Activities include team learning.
19	Intentionally selecting teams Having only one ethnic or gender minority in a group can be isolating and create a negative experience for the students, especially in a nontraditional major or career choice. Teachers should form teams that have at least two students from an underrepresented group together.	Teams are not intentionally selected so that no student is the “only” traditionally marginalized person in the group, either by race, gender, ability, or language skill.	Teams are infrequently intentionally selected so that no student is the “only” traditionally marginalized person in the group, either by race, gender, ability, or language skill.	Teams are frequently intentionally selected so that no student is the “only” traditionally marginalized person in the group, either by race, gender, ability, or language skill.
20	Rotating roles Student roles within a team may be limited to gender or racial stereotypes. Allowing students to choose their role initially provides them with some level of comfort. It is important to then require students to rotate roles so that students learn new skills and are not limited by gender or racial norms.	Teams are not asked to rotate roles, such as leader, writer, etc.	Teams are encouraged but not required to rotate roles, such as leader, writer, etc.	Teams are required to rotate roles, such as leader, writer, etc.
21	Reflect on and celebrate diversity Providing teams with the opportunity to reflect on and value the contributions of each team member can build collaboration within teams. Ask students to evaluate and discuss their contributions to help individuals see their own and others’ value on the team.	Teams are not asked to reflect on the value that each team member brings to the project.	Teams are asked but not required to reflect on the value that each team member brings to the project.	Teams are required to reflect on the value that each team member brings to the project.
22	Monitoring team discourse and roles Listen for conversations that may make a student feel uncomfortable, identify instances where privilege plays a role in decisions or roles, and monitor the actual roles students are enacting, regardless of official roles.	Teams are not monitored for roles and discourse.	Teams are monitored for roles and discourse but little to no action is taken to correct issues.	Teams are monitored for roles and discourse and specific action is taken to correct issues.

		INEQUITABLE & EXCLUSIVE	PERFORMATIVE OR STATUS QUO	EQUITABLE & INCLUSIVE
23	Assessment Gender norms and race dynamics are often present in peer reviews. Teachers should consider a combination of individual contributions and peer evaluations, as well as giving students agency in the grading format or process.	Students are not assessed using best practices for equitable grading.	Students are infrequently assessed using best practices for equitable grading.	Students are assessed using best practices for equitable grading.
24	Hands-on activities that engage EVERY student	Activities are not hands-on, when EVERY student actively engage in doing some type of physical manipulation.	Activities are hands-on, but EVERY student is not actively engage in doing some type of physical manipulation.	Activities are hands-on, and EVERY student is actively engage in doing some type of physical manipulation.
25	Social impact When activities have a real-world context with a social impact, it is more interesting to all students.	Activities do not have a real-world context that relates to social impact.	Activities provide a real-world context but does not relate to social impact.	Activities provide a real-world context AND helps student connect to and relate the to a broader social impact.
26	Lived experiences A project that is situated in an unfamiliar context for students will not be motivational. In contrast a project that stems from students' own culture, identity, and lived experiences will be engaging.	Activities are not situated in a familiar context for students. <i>For example: Students who have never spent time on or near water may be confused by projects related to boating.</i>	Activities are situated in a familiar context for students for majority groups, but not considerate of students from non-majority groups.	Activities are situated in a familiar context for students for EVERY student.
27	Socioeconomic relevancy Projects should not require technologies, materials, or knowledge to which students do not have access.	Projects require technologies, materials, knowledge, or expense that is inaccessible to low socio-economic students.	Projects do NOT require technologies, materials, knowledge, or expense that is inaccessible to low socio-economic students.	All technologies, materials, knowledge, or expenses required are provided to every student.

Endnotes

- 1 **STEM Messaging:** National Academy of Engineering. 2008. Changing the Conversation: Messages for Improving Public Understanding of Engineering. Washington, DC: The National Academies Press. <https://doi.org/10.17226/12187>. See also NAPE's Explore STEM Careers Toolkit: <https://napequity.org/product/stem-toolkit/> Watch a quick overview here: <https://www.youtube.com/watch?v=wJp4Cte6ZMU&t=682s>
- 2 **Work Values:** Learn more: <https://nape.courses/topic/stem-4-1-agenda-2/> See also NAPE's Explore STEM Careers Toolkit: <https://napequity.org/product/stem-toolkit/> Watch a quick overview of work values here: <https://www.youtube.com/watch?v=wJp4Cte6ZMU&t=964s>
- 3 **Cultural Values:** Watch a video "Individualism vs Collectivism: Why it Matters in the Classroom" https://youtu.be/5mlGIS_ObIE