

# The Pathway to Achieving Classroom Equity: Computational and Critical Thinking through Storytelling and 3D Models

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**Abstract:** *Alignment with the Montana Indian Education for All (IEFA) Act, tenets of Tribal Critical Race Theory (TribalCrit) (Brayboy, 2006) and the 7 Essential Understandings, results in the effective integration of Computer Science and Storytelling into the classroom. Teacher disposition and pedagogies that reflect current education transformation trends are also discussed.*

**Key Words:** Indigenous, computer science, storytelling

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This manuscript is part of a larger project and is an inter-disciplinary effort, dedicated to discovering answers to the following questions related particularly to Indigenous<sup>1</sup> and Rural middle school students: 1) *Do storytelling and story making serve as effective means to teach computer science to middle school youth?* And 2) *Can the integration of computing skills into the core middle school curriculum increase instruction and student learning of these skills?*<sup>2</sup> We have aligned ourselves with the implementation requirements of the Indian Education for all Act (IEFA), a result of Montana state constitutional law.

The Storytelling project integrates American Indian stories into school curriculum, through lesson plans. The lesson plans are designed to meet various content domains and are developed with a computer science component and a traditional indigenous way of transmitting knowledge

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<sup>1</sup> Within this article we use terminology that includes American Indian, Indian, Native and Indigenous to refer to individuals whose ancestors have inhabited what is now called North America for thousands of years, no political connotation or exclusion of other indigenous nations are intended.

<sup>2</sup> Strategies: Using Storytelling to Improve the Pipeline for Rural and American Indian Students Entering CS.

“Storytelling”. One of the main goals of the Storytelling project is to encourage computational thinking during middle-school years, allowing students to consider computing-related remote jobs at some point in their lives. For this reason, we are working to introduce lesson plans into the classroom, with teacher participation, that support systems of equity through Culturally Responsive Teaching (CRT)<sup>3</sup> (Castagno & Brayboy 2008). The integration of these lesson plans, that merge computer science components with traditional Indigenous ways of transmitting knowledge via “Storytelling”, is accomplished by utilizing Alice<sup>4</sup>, a drag and drop software program.

### PROBLEM STATEMENT

The Storytelling project’s goal is to encourage computational thinking during middle-school years, allowing students to consider computing-related remote jobs at some point in their lives. However, we recognize that computing careers are not a usual career-trajectory for members of American Indian communities, and the lack of trained individuals in technical fields, like computer science, is a result of this trend. Also, teacher training and participation play a crucial role in the effectiveness of lesson plan integration into current curricula. The challenges encountered during integration, of newly developed lesson plans, can include: school policy, teachers’ disposition, tight schedules, differing pedagogical stances, and teaching methods.

### REVIEW OF LITERATURE

A review of current pedagogies, and theoretical studies provided a base for understanding matters concerning classroom curriculum, and teacher disposition. One important caveat with respect to using storytelling to teaching computational thinking is that indigenous thinking and oral storytelling are circular compared to the linear Western thinking and organization of written discourse (Fixico, 2013) (Piquemal, 2003). Furthermore, storytelling for indigenous communities is dynamic and interactive with storyteller and listeners alike participating in an event of (re)creation (Blaeser & Vizenor, 1999). In recognition of these differences between Indigenous and Western storytelling, our curriculum aims to be flexible and acknowledge Native learners’ unique perspectives (Dalton, Dorman, & Byrnes, 2018; Freire, 1970; Rendón, 2009). Likewise, works by current scholars collectively express a fundamental truth about cultural responsibility and social justice, that cannot be ignored; when teaching in a classroom that represents diversity the “learner” must be respected for individual lived experiences (Smith, 2003; Gay, 2013).

A review of current IEFA requirements and implementation methods, identify a pedagogical framework executed in a way that brings STEM to indigenous and rural learners. IEFA is designed to implement American Indian ways of knowing, cultural and individual differences in teaching through seven essential understandings: (1) Tribal Diversity (2) Indigenous Identity Location (3) Pre- “discovery” (4) Treaty Processes (5) Federal Policy (6) Indigenous Curriculum (7) Tribal Sovereignty Variability. Elser (2010) developed ‘A Practical Guide for Montana Teachers and Administrators Implementing Indian Education for All’ called the “The Framework”. The theoretical foundations for IEFA are informed by the cultural approaches designed by Banks (1997) and the 7 Essential Understandings Regarding Montana Indians.

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<sup>3</sup> Not to be confused with Critical Race Theory.

<sup>4</sup> Alice – Tell Stories. Build Games. Learn to Program. (n.d.). Retrieved from <http://www.alice.org/get-alice/alice-2>

## **RESEARCH METHODOLOGY**

Krippendorff (1989) states that content data analysis is an important tool used to infer contextual meanings from unknowable data points. The process began by finding culturally relatable stories that represent all Montana tribes, without essentializing any of these same tribes. The steps were as follows: 1) read the story in its entirety, step 2) identify specific elements within the story that capture the core message of the story 3) create 3D models for a specific scene. The 3D model development hinged on scenes that were straight-forward and doable in digital environments, and later to be used in the ALICE software platform. Once these steps were completed, the story was then integrated into a new lesson plan. Assessments for content standards requirements, and evaluation for desired outcomes were an integral part of the process during lesson plan development.

## **INTEGRATION**

At the onset, Tribal culture, traditions and diversity presented team members with a challenge during story selection. Thus, the responsibility to maintain story integrity and diversity included sensitivity to cultural nuances. To overcome personal biases, and deficient thinking, it was necessary to align researchers with existing tenets of Tribal Critical Race Theory (TribalCrit) (Brayboy, 2006), 7 Essential Understandings and the IEFA mandate. The intent was to not further marginalize students when encountering multicultural narratives, by being culturally/tribally specific and aware of contemporary Indigenous realities.

## **THE TEACHER**

In response to IEFA implementation, some teachers feel that it can be a distraction from efforts to improve student achievement (Elser, 2010). Culturally responsive pedagogy methods and practice also require additional time and effort, more specifically for those teachers who struggle with the topic of culture difference, not knowing how to handle classroom tension when certain topics arise from conversations surrounding historical facts or non-facts.

Teacher alignment with pedagogies and lesson plan frameworks that support, encourage, and promote reciprocal teacher/student relationships, is essential in creating a space that is safe and productive for teachers and students alike. In order to facilitate teacher introspection, we have adopted the Understanding by Design (UbD) framework that is presently the method of choice for preparing preservice teachers. The 'Framework' teacher guide, focusing on methods, strategies and practice, also assists teachers with integration of Indigenous material.

The project is intentional about not creating new requirements for middle school teachers nor add to their workload. Therefore, we propose the introduction of computer science and computational thinking by integrating it into the curriculum through IEFA.

## **TRANSFORMING PEDAGOGIES**

Pedagogies that support the transformation of education speak of wholeness, reveal the need for contemplative education, mindfulness, and new approaches that introduce meditative methods for teachers to discover inner biases and deal with emotional reactive tendencies. This work is imperative in teacher training, with greater impact for those teachers who become part of a multicultural classroom. Teaching does not exist outside the realm of human interaction. In

support of this concept, Rendón (2010) in *Sentipensante Pedagogy* describes her teaching model as based on integration and consonance, representing the union of sensing and thinking processes and the balance between inner and outer knowing. Actively incorporating the “whole” person concept into our teaching methodologies will inevitably humanize interactions in the classroom. This is how equity enters the classroom. Teacher-student relationships need to be treated as people who “belong” within the same learning space. “Belonging” in the sense of when individuals belong in a community.

## RESULTS

A primary goal for this project is to introduce middle-school students to the field of computer science. However, as a by-product of this introduction, is a potential increase in job opportunities for American Indian students in the future. The Storytelling project may help answer the lack of job opportunities within marginalized communities in rural areas of the state that are the result of colonial systems. This solution is achieved through an innovative approach using ALICE. We strive to find narratives and stories that motivate and evoke a desire in middle-school students to consider a career that involves computational and critical thinking, with anticipation that rewarding career choices are made by these students, once they reach college age.

## IMPORTANCE TO THE FIELD

The aim of this project is to identify workable/replicable material from a computer science viewpoint. The process starts with awareness that the messages and symbols introduced by American Indian stories are rich with cultural and historical information. Thus, respect for cultural identity and life experiences of different tribes and individuals cannot be discounted. Subsequently, thoughtful consideration of cultural charged material is achieved through becoming familiar with the IEFA requirements<sup>5</sup>, to help avoid unintentional bias in our material. The positive, long-term, impact of this introduction will not be limited to the student alone, as we anticipate the economic well-being of rural communities will benefit from skilled workers in the workforce.

The present study is in its initial phase. The team is currently conducting lesson plan pilot sessions, at local middle-schools, to test for integrity. The importance, and contribution to the education field, is yet to be seen. We anticipate it will inform future research in the areas of diversity, computational thinking and computer science. Data will be collected utilizing pre- and post-assessment instruments, with discussion to follow in the near future.

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<sup>5</sup> This is possible via the Office of Public Instruction (OPI) website <http://opi.mt.gov/Educators/Teaching-Learning/Indian-Education>. The database collection holds 140 culturally appropriate vetted stories. They are divided into four levels I-IV. Lesson plans, guides and worksheets are made available for instructors to implement in their curriculum.

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