Inquiry Learning for Our Students and Our Future

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The Problem

We currently are experiencing divisions in our society that are harmful to our social relationships and our democracy. Such divisions always have been present, due partly to the narrow worldviews and false beliefs held by some individuals resulting in racism, gender discrimination, and stereotyping of social and political groups different from their own. However, the recent dominance of social media (along with many positive effects) has greatly increased the amount of misinformation, disinformation, and hate speech being circulated throughout society (Konieczny, 2022). One example of disinformation is connecting negative phenomena like unemployment, low wages, scarce resources, and crime to unrelated things like immigration (Consterdine, 2024). Another example is the denial of historical realities such as the Holocaust, climate change, and mass shootings like Sandy Hook (Biltoft, 2020).

A particularly serious threat to a civil society is the use of disinformation by some politicians, media personalities, and organized extremist groups to gain power, profit, or influence. Disinformation can lead to, or reinforce false beliefs about, negative attitudes toward, and mistreatment of, historically marginalized groups. Disinformation concerning political issues, health concerns, climate change, and economic affairs can lead to a polarized society and threaten democracy (Konieczny, 2022).

Our PreK-12 schools could and should be the greatest deterrent to misinformation and disinformation and our strongest means of preparing young persons for democratic citizenship, defined by the Education for Democratic Citizenship program as "citizenship based on the principles and values of human rights, respect of human dignity, pluralism, cultural diversity, and the primacy of law" (O'Shea, 2003, p. 10). However, both longstanding and recent barriers to democratic schooling exist. For several decades now, schools, school administrators, and teachers have been encumbered by government-mandated curricula focused on lower-level cognitive skills and high-stakes achievement tests enforcing the teaching of such curricula (Collins et al., 2019). Our current emphasis on narrow curricula and test prep has lowered many students' interest, motivation, and learning. As Anderson and Winthrop (2025) state:

> A shocking number of young people don't see the point of school anymore. As a result, they lose motivation and drop out…. Kids witness the world around them—wars, social injustice, climate change, disinformation, technology that can write novels and counsel on heartbreak—and wonder why on earth they have to learn the Pythagorean theorem. (p. xiii)

More recently, many schools have been confronted with other challenges, including state legislatures and state boards of education banning programs, books, and teaching focused on DEI, the evils of slavery, and LGBTQ issues while infusing religion into public schools (Kuelzer-Eckhout & Houser, 2014). In the United States, PreK-12 schools are being directly challenged by the very antidemocratic forces that public schools were created to defend against

by our forebearers. Such extremism threatens both our students' and our society's long-term future.

Today's educators are faced with a dilemma: How can they assist students to develop the skills and dispositions for critical thinking, differentiating information from misinformation and disinformation, collaborative problem solving, and democratic citizenship when conventional schools are not prepared to do so, and some external forces are bent on resisting such learning? In this article, I propose student inquiry as a solution but also recommend a developmental approach to student inquiry as the most likely way to achieve necessary reforms.

The Proposed Solution: Inquiry Learning

The solution proposed in this article is a shift in PreK-12 schools to inquiry learning, which is rooted in social reconstruction theory (SRT). First, SRT holds that society is in need of reconstruction, and will need to be reconstructed periodically throughout the future. Second, SRT argues that education should accept a critical role in such reconstruction, making students aware of the need for social change and providing them with the conviction and capacity to bring about that change. A teacher embracing SRT "should create a conducive atmosphere to inquiry within the classroom, so that students can question the assumptions of status quo. The classroom atmosphere should enhance analysis, criticism, and action research" (Kandemir, 2021, p. 4). An educator who has adopted SRT "not only motivates the students to investigate pressing and controversial issues and problems and provide alternatives to them; he or she also encourages their students to be actively involved in community projects" (Tan, 2006, p. 36). Finally, a full commitment to SRT means that "a multidisciplinary and interdisciplinary curriculum is adopted" (Tan, 2006, p. 35)

Inquiry learning assists student growth and development in school and, because students bring their inquiry skills and dispositions with them into adulthood, can assist fellow citizens throughout their lives. Moreover, a citizenry with inquiry skills will promote the type of democratic society defined by Dewey (1916):

> A democracy is more than a form of government; it is primarily a mode of associated living, of joint communicated experience. The extension in space of the number of individuals who participate in an interest so that each has to refer [their] own action to that of others, and to consider the action of others to give point and direction to [their] own, is equivalent to the breaking down of those barriers of class, race, and national territory which kept [individuals] from perceiving the full import of their activity. (p. 87)

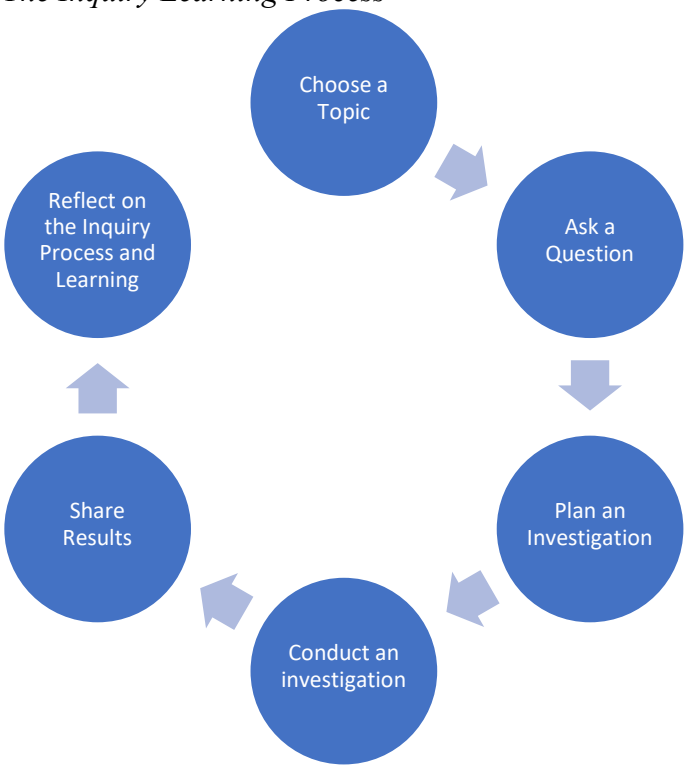
According to Hattie (2009), students engaged in inquiry learning are involved "in the process of observing, posing questions, engaging in experimentation or exploration, and learning to analyze and reason" (p. 209). Inquiry learning can be successful at any grade level, in any content area. Students who participate in inquiry learning as individuals or as a group explore real-world problems, practice critical thinking, and develop practical solutions. Inquiry learning in a group has the additional advantages of considering diverse experiences and views, collaborative problem solving, and consensus building.

Inquiry learning makes possible a variety of positive learning experiences and outcomes. Inquiry increases students' interest, motivation, and engagement (Saunders-Stewart, et al., 2015; Suryono et al., 2023), and their use of metacognitive learning strategies (Kuisma, 2018). Student inquiry helps students to understand concepts they are studying (Suryono et al., 2023), develop problem-solving skills (Karamustafaoğlu & Pektas, 2023; Pill & SueSee, 2017; Suryono et al., 2023), and apply new knowledge (Saunders-Stewart, et al., 2015). Inquiry also promotes learning beyond traditional academics, including the development of critical thinking skills (Suryonoe et al., 2023; Lampert, 2006; Pill & SueSee, 2017) and creativity (Lampert, 2006; Thompson, 2017). Inquiry can help students develop voice and agency (Bronstein & Halvorsen, 2019) and provide students—including students from historically marginalized groups—a sense of empowerment (Domínquez, 2023; Ozer & Wright, 2012). Student inquiry helps learners develop collaborative skills (Suryono et al., 2023) to be practiced in positive student activism in school (Kirk, 2024) and the outside community (Beason-Manes, 2018; Bonati, 2018). One goal of such student activism can and should be the promotion of diversity, equity, and inclusion (Domínquez, 2023).

The Inquiry Learning Process

Many articles present different, *specific* steps in the inquiry learning process (Beason-Manes, 2018; Bonati, 2018; Callison & Baker, 2014; Fong & Slotta, 2018; Karamustafaoğlu & Pektas, 2023; Li et al., 2010; Luera, et al., 2003; Marshall & Horton, 2011; Pedaste et al., 2015; Sharples, et al., 2015; Wong, et al., 2022); however, the general inquiry process depicted in Figure 1 is fairly consistent across these articles.

Figure 1
The Inquiry Learning Process



Although this seems like a simple process, there are several important considerations for schools contemplating the adoption of inquiry learning. First, it is important to include stakeholders—district representatives, teachers, students' families, and other community members—in the adoption process from its earliest stages. Stakeholder participation should include both providing information about inquiry learning and its benefits to stakeholders as well as involving them in planning for the transition to inquiry learning. If there are nearby university faculty members skilled in inquiry learning and willing to assist, their inclusion in the adoption process would be valuable.

Teacher professional development in inquiry learning is essential, both prior to and during the early stages of implementation. For example, Chang and Wu (2015) found that a year-long professional development program helped teachers move from teacher-centered attitudes to the student-centered approach necessary for successful inquiry learning. The professional development also helped the teachers learn how to design, organize, and assess students' inquiry learning.

Students need to be oriented to inquiry learning and taught inquiry methods. Topics for inquiry learning need to be relevant and interesting to students, requiring the need for some level of student choice in learning content (Kirk, 2024; Kuisma, 2018; Ozer & Wright, 2012). Inquiry outside of the school is a powerful option (Karamustafaoğlu & Pektas, 2023). Student collaboration is an important component (KuKuisma, 2018). Opportunities for student creativity should be built into the inquiry process, and one way to accomplish this is to pose open-ended problems with alternative solutions (Lampert, 2006; Pill & SueSee, 2017). Flexibility regarding the inquiry process is essential (Calim & Bayram, 2025), and this includes allowing students to proceed at their own pace (Kuisma, 2018). In student inquiry, the teacher models inquiry learning and becomes a guide on the side for the students' exploration (Calim & Bayram, 2015).

Many communities and families are not familiar with inquiry learning. Also, as Stitzlein (2025) points out, some conservative families, special interest groups, and politicians have become strongly opposed to students raising questions, considering controversial issues, engaging in debates, and service learning. These critics tend to support "new 'back to basics' and classical curricula" (p. 47). This trend means that schools considering the adoption of student inquiry need to take a cautious approach. Additionally, Chowdhury (2016) found that teachers face several professional challenges with implementing student inquiry. These include a lack of adequate knowledge about inquiry learning, time constraints, concern about how students will respond to inquiry learning, the need to meet curriculum standards, and a perception of inadequate tools for assessing the effects of student inquiry. Teacher concerns about such challenges are another reason for gradual implementation of inquiry learning in schools and communities. This will allow teachers to incrementally develop the knowledge, skills, and confidence to facilitate student success with inquiry learning. Gradual implementation, if it leads to improved student learning at the various stages of implementation, will also help to allay family and community concerns about the nature and effects of student inquiry.

The rest of this article will describe what I call a developmental approach to inquiry learning. This approach involves three broad areas: learning level, curriculum level, and learning locale. A developmental approach to *learning level* involves gradually moving from analytic to applied to

activist inquiry. *Curriculum level* would expand over time from discipline-based to interdisciplinary to transdisciplinary inquiry. *Locale* would always include school-based inquiry, but community-based and remote inquiry would be gradually added. In the discussion of the developmental approach below, I will include several examples of inquiry learning, both to illustrate what such learning looks like and to demonstrate that it can be highly successful.

Learning Levels. In *analytic learning*, students may choose a topic to analyze, or different groups may choose from several subtopics within a broad topic. Students ask a question about their topic, then plan and conduct an inquiry intended to answer that question. Students typically examine a variety of information and views on the topic, draw conclusions, and share their analysis with others. A key aspect in analysis is determining the legitimacy of sources and validity of information examined. In *applied learning*, students engage in analysis but go beyond analysis to apply knowledge, skills, or dispositions in their learning to complete a meaningful project. *Activist learning* involves both analysis and application as students identify and attempt to solve a real-world problem inside or outside the school.

Analytic Learning. Students can develop analytic skills by examining a problem or issue, story or belief, process or product, location or event, technology or natural phenomena, document or artifact, relationship or conflict. In addition to helping the student reach immediate learning goals, the analytic skills developed can be used for other types of learning. For example, in our modern world the ability to analyze social media is essential. As Alvermann (2017) argues, "Developing a critical awareness of what differentiates 'fake news' from what is considered factual is foundational to later teachings" (p. 337), and students can develop such awareness by analyzing and comparing fake and real news found on various types of social media.

Share et al. (2007) describe a variety of activities to develop students' media literacy, including one for differentiating generalizations from stereotypes. The specific focus of this lesson is gender stereotyping. After learning the difference between generalization and stereotype, students develop generalizations specific to males and females, then convert some of those generalizations to stereotypes. Students then cut out pictures of males and females from magazines and create two collages, one with pictures of females and the other with pictures of males. Based on the collages, students create Venn diagrams to illustrate the similarities and differences in how females and males are portrayed. Using the collages and Venn diagram, students write generalizations and stereotypes about females and males. Students share the sentences they created, examine the values communicated by generalizations and stereotypes, and consider the role of media in originating or sustaining stereotyping.

Project Wild's *Oh, Deer!* is a popular activity developed by the Association of Fish & Wildlife Agencies (n.d.) that focuses on the relationship between an animal's habitat and its survival. In this activity, students assume roles of deer and components of the deer habitat—food, water, and shelter—with approximately the same number of students in each of the four groups. The deer start out behind a line on one side of a large area, and students representing food, water, and shelter stand together behind another line 10-20 yards from the deer line. In each of 10–15 rounds, students in the role of deer run after and "capture" food, water, or shelter and take them behind the deer line. Deer who capture food, water, or shelter successfully "reproduce" for the next round. Deer who do not capture food, water, or shelter die and become one of the habitat

components in the next round. The teacher records the number of living deer at the beginning and end of each round. After the last round, students create line graphs of the changes in deer population from round to round and discuss what they learned from the activity, including animals' habitats and survival needs, fluctuation of animal populations, and how ecological systems evolve.

In an extension of the *Oh, Deer!* activity described by Wong et al. (2022), after completing the activity, students watch videos and review articles on the issue of building drainage systems and reducing green spaces to protect from floods caused by hurricanes versus the need to preserve wetlands. The students then engage in small-group discussions, considering the strengths and weaknesses of arguments on both sides of the issue. Individual students then write individual responses to the issue, in which they assess the arguments shared in the small-group discussions.

Student analysis of primary sources in an American history class was studied by Nelson (2016). For each lesson, students were first provided historical background knowledge through traditional teaching methods. Student analysis of an historical event or period was focused on a central historical question. Students analyzed two to five primary sources with multiple and sometimes conflicting perspectives in their effort to answer the central question. In a subsequent class discussion, students shared their conclusions and supported those conclusions with material from the primary sources. Based on a variety of data (e.g., pre- and post-surveys, teacher observations, pre- and post-tests, daily student self-reports), Nelson (2016) concluded that the student analysis of primary sources improved students' engagement, achievement, and attitudes toward learning history.

Applied Learning. In applied learning, students create or invent something, solve a relevant problem, simulate an event or process, conduct a novel experiment, synthesize ideas, develop a model, or build something complex. Although it includes analysis, applied learning is more complex and tends to take more time than analytic learning, thus many schools and teachers may wish to experience success in facilitating analytic learning before moving to applied learning.

Discussing what they call inquiry math, Chapko and Buchko (2004) argue that "society, career fields, and technological advances mandate that students possess math knowledge beyond basic computational skills," and "students learn math skills most effectively when they are taught as relevant lessons based on real-life situations" (p. 32). The process of inquiry math begins with students being assigned a relevant problem and then breaking into pairs or groups to solve the problem. Students share ideas for solving the problem, question and correct each other, and work together to find a solution. Next, in a whole-class discussion, students share their strategies for solving the problem, with some students learning more effective strategies then the ones they had used in pairs or groups (Chapko & Buchko, 2004).

An example of applied learning described by Rearden & Bertling (2019) involved an elementary art teacher asking her students to choose a local species of fish and to create art projects (e.g., paper-mâché sculptures, air-dry clay sculptures, other media) that illustrated the physical adaptations of the chosen fish species to the local environment. Benefits of the project included students' interest and enthusiasm, environmental awareness, and pride as artists. Another applied activity in the teaching of art described by Lampert (2006) begins with students reviewing self-

portraits of multiple artists presented in a variety of genres (e.g., painting, photography, sculpting). Students then select the visual media they wish to use for their own self-portrait. The student self-portrait becomes a problem to solve through reflection on and application of ideas gathered in the review and discussion of the artists' self-portraits.

Activist Learning. In activist learning, which includes analysis and application, students work for significant change within or beyond the school. Such change could be educational, social, cultural, political, environmental, or economic. In activist learning, students integrate academics and real-world action to foster positive relationships, promote democracy, and improve the life of humans and other living things. Although activist learning is a higher form of learning than analysis or application as described above, given its novelty and the political situations in many communities, some schools may want to consider demonstrating student achievement based on analysis and application before initiating activist learning.

Beason-Manes (2018) described gifted students at a middle school forming teams that engaged in community activism. The teams identified a community problem and worked with community organizations to research the problem, design an action plan, and implement the plan. The 6th grade team worked to procure internet access for students who needed it. The 7th grade team addressed the problem of distracted driving in the community. One 8th grade team focused on financial guidance to underserved members of the community. A second 8th grade team sought to curb the use of plastic in cafeterias. At the end of the semester, students shared their action research with families during an evening session.

A high school "Cookbook Project," recounted by Bonati (2018), involved high school students in a media arts class and students in a life skills special education class working together. The students assessed community needs, and based on that assessment, decided to create a photo cookbook for use by both adults with dementia and schools. The students first identified media arts and individualized education plan (IEP) goals the project would meet. After inviting and confirming participation by community partners, the students explored possible recipes, and then voted on what would be included in the cookbook. The life skills students shopped in grocery stores for the recipes and modeled preparing the food while the media arts students took and edited photos, designed the cookbook, and created an accompanying DVD. The students presented 100 copies of the cookbook to life skills programs at other schools and to facilities for adults with dementia, engaged in a cooking demonstration at a neighboring school, presented on their project at a school board meeting, and joined their parents in a breakfast celebration of the project.

After considering several potential foci for their inquiry, students at an urban high school chose to focus on assisting teachers to improve student engagement (Ozer & Wright, 2012). Following training in communication, team building, and research skills, one group of students designed and conducted surveys and interviews on teachers' best practices for student engagement. The students then conducted a professional development session for teachers in which they shared their research results and placed teachers in small groups to review the data and discuss future actions. A new cohort of students was trained in observation and conferencing skills, and they conducted individual pre-observation conferences, classroom observations, and post-observation conferences with teachers, providing positive feedback. Outcomes of this student inquiry

included increased diversity of student input, enhanced student roles, data-informed student-educator dialogue, and more collegial student-teacher interactions. Additional outcomes were increased educator perceptions of student potential for contributing to improved teaching; student learning of research, communication, and presentation skills; increased student understanding of the power of alliance building; and convergence of student and educator goals for student growth.

Curriculum Levels. The curriculum at most schools is *discipline based*, which can create barriers to many types of student inquiry, especially at the high school level. Nevertheless, there are myriad inquiry projects that students can engage in within each of the disciplines. Another level of curriculum is *interdisciplinary* that "integrates two or more disciplines through an explicit focus on blending the disciplines and integrating the contributions of several disciplines to explore and understand a thematic unit" (Warkentien et al., 2022, pp. I-10). The broadest level of curriculum is *transdisciplinary*, which "begins with the issue or problem and, through the process of problem solving, engages the disciplines as needed to reach a solution to a complex issue" (Warkentien et al., 2022, pp. I-10).

Disciplinary Curriculum. In inquiry learning within a discipline, students are given choices of questions to ask, plans to find answers to those questions, and ways to monitor their progress and assess their learning. The questions the students ask and inquiry they carry out relate not only to the discipline but also to the student's real world, making their inquiry interesting and motivating them to learn. Inquiry learning within a discipline typically is collaborative, with democratic decision making and peer assistance throughout the learning process. The teacher's role shifts from subject-matter expert to co-investigator and facilitator.

According to Pill and SueSee (2017), when engaged in inquiry during physical education, "students can be taught to analyze the logic of questions, synthesize knowledge to create new and novel solutions, and assess the value or utility of information" (p. 49). Examples of questions for younger students to initiate student inquiry suggested by Lynott & Bittner (2019) include:

- What movement increases your heart rate more: walking for three minutes or jumping rope for three minutes?
- What object can you throw farther?
- What types of movements make you flex your biceps? (p. 34)

Students create a hypothesis indicating a potential answer to the question, test the hypothesis (through research, physical activity, observations) draw conclusions, and share those conclusions (Lynott & Bittner, 2019). Inquiry in physical education can assist students to develop critical thinking, creativity, and problem-solving skills (Pill & SueSee, 2017).

A middle school geography unit described by Kuisma (2018) is another example of discipline-based student inquiry. Pairs of students chose a European country for their inquiry. Students first wrote what they knew about their chosen country, what questions about the country they wished to explore, and a plan for answering those questions. As the students conducted their projects, new questions arose that they added to their inquiries. One product of each inquiry was a set of student-created maps that depicted geographic characteristics of the country under study. Another

product was digital games about the chosen country designed by students to assist other students to learn about the chosen country. A "tourism fair" at the end of the unit allowed the students to teach other students about the country they had investigated.

Nikki Railton (2015), an English teacher in an inner-city school, describes how she substituted a requirement that students read a novel with an assignment that each student identify an oral folk tale that they believed defined their culture. The students analyzed their folk tales and their cultural heritage as revealed by those stories. Later, the students were asked to "update" their stories to make them more relevant to their current lives. Railton (2015) concluded that the telling and sharing of stories increased her students' cultural understanding while developing their inquiry and analysis skills.

Interdisciplinary Curriculum. In interdisciplinary curriculum, students learn and use related content from two or more disciplines to solve a problem, answer a question, or address an issue that is common to the integrated disciplines. The focus is on both the relevant content from each discipline involved and the relationship of those different content areas to each other and the unit topic.

An example of interdisciplinary curriculum studied by An and colleagues (2014) involved a third-grade teacher who designed and taught lessons integrating mathematics and music. In these lessons, students used musical instruments (e.g., drums, handbells, keyboards, musical sticks) as manipulatives to learn math. Music composition and music playing were integrated into the mathematics lessons.

> The students were provided with pre-composed musical pieces, which they used to learn mathematics by investigating some of the fundamental components of musical theory. Students had multiple opportunities to share their emergent knowledge of mathematics concepts with their classmates, often during music-themed small group activities. (p. 6)

The researchers found that the group of students in the interdisciplinary math and music class improved significantly on a test of math dispositions while a comparison group that received traditional math instruction did not.

Bronstein and Halvorsen (2019) describe application of the *Read. Inquire. Write*. program to the integration of history and writing at the middle school level. Students are assigned a question about a historical or social issue and then analyze readings from different sources reflecting different viewpoints on the issue. The students then engage in three types of writing. First, they provide an argument for an interpretation upon which they agree. Second, they critique an interpretation upon which they disagree. Third, they write a counterargument, which includes both arguing for an agreed-upon interpretation and rebutting other interpretations for which they disagree. The student writings can be in the form of emails, letters, and written speeches and are most effective when written for real-world audiences. Finally, the students reflect on their performance and improvement goals.

STEM is a popular model for integrating science, technology, engineering, and math. Chang and Wu (2015) describe how STEM students in a vocational high school used the inquiry process to

develop an "intelligent robot." First, to engage and motivate students, they were asked to build a paper robot and reflect on questions concerning the control of an intelligent robot. Next students read and discussed literature on building intelligent robots, including information from across the STEM disciplines. Students then organized the information they had gathered and designed a tentative plan for building the robot. The plan was proposed by the students and approved by the teacher, and groups then constructed their robots, experimented with the robots, and recorded the results of their experiments. Finally, the students prepared a group report on the effectiveness of their work and proposed improvements in the construction process. Groups shared and discussed their reports with the entire class, and through whole-class discussion, the students selected the best process for constructing an intelligent robot.

Transdisciplinary Curriculum. Transdisciplinary curriculum is defined by Levin and Nevo (2009) as "free from the constraints of subject-matter boundaries and…therefore life-centered, contextual, and practically limitless" (p. 442). Bertling and associates (2024) explain, "Transdisciplinary inquiry is founded on the premise that problems can transcend disciplinary boundaries through their broadness and complexity, and that for inquiry to address these problems effectively, it, too must surpass disciplinary boundaries" (p. 2). It is not that transdisciplinary curriculum ignores the disciplines; rather, the teacher and students start with a real-world problem or issue and draw on knowledge, skills, and methods from various disciplines that are relevant to addressing the problem or issue. The teacher and students also may draw on sources beyond the disciplines to assist the transdisciplinary inquiry, such as community members, outside experts, or data from external sources.

Given the typical structure of public-school systems in the U.S., a fully transdisciplinary curriculum is not an immediate option for most schools. However, there are ways that schools can experiment with transdisciplinary inquiry, such as occasional special units, after-school and weekend programs, student clubs, and open periods during the school day. Another possibility is for selected schools to receive waivers from required state and district curricula, develop inquiry-based transdisciplinary curricula, and participate in research on the long-term effects of those curricula. Success with such experiments can pave the way toward political and public acceptance of inquiry-based transdisciplinary curriculum. School participation in such experimental programs can be justified by the fact that we already have examples—at all school levels and with varied student populations—of teacher and student success with the transdisciplinary approach.

Transdisciplinary curriculum in an elementary school, described by Levin and Nevo (2009), involved teachers collaborating with students to plan transdisciplinary units. Students selected specific concepts and issues to explore within each unit. For example, the unit on *boundaries* included inquiry on "equality, difference, racism, nationalism, friendship, tolerance, concession, love, and so on" (p. 445). In their inquiries, students explored a variety of information sources from inside and outside the school, including readings, communication with experts, and field trips. Students shared their inquiry in a variety of ways, including art, written statements, concept maps, role plays, student-created models, and group and class discussions. Students' culminating experience was an individual or group research project presented to the class or school.

Bertling and associates (2024) researched middle school students drawing on STEAM curricula (science, technology, engineering, art, and math) to research and illustrate local water quality issues. The students both tested local water samples and analyzed previously gathered data on local water quality, then used data visualization techniques to illustrate their findings. Students used a variety of art media to illustrate water quality, including papier-mâché sculptures, collages, and displays of objects found in the water. The researchers discovered that students expanded their concept of data visualizations, were better able to create and interpret such visualizations, and believed they were better able to use data visualizations to address community problems.

A high school in New York City described by Hantzopoulos (2011) was home to a diverse student population, including students who did not feel their needs had been met at schools they previously attended. The school received a waiver from high-stakes achievement testing. The inquiry-based curriculum focused on critical peace education and included classes on peace and social justice specifically related to the students' cultures, interests, and questions. Teachers assisted students with carrying out inquiries on self-selected topics, and students then presented their projects to panels of educators and outside experts. Rather than using textbooks in their inquiries, students relied on a variety of media and information to explore their topics. These inquiries helped students to critique dominant views and understand the world, as well as their purpose in the world, in new ways.

A variety of school structures interfaced with and supported the school's transdisciplinary curriculum. The school operated under democratic governance, with staff, students, and families involved in decisions about school policies and practices. Classes were heterogeneous. Teachers shared workspace with students in a large room called Prep Central, where members of the school community engaged in social and intellectual discourse. Daily advisory periods provided students with opportunities to discuss personal issues, receive academic assistance, enhance leadership skills, and develop community. Weekly, whole-school Town Meetings, often with guest speakers, provided opportunities for students and teachers to discuss personal, school, and world issues. The Fairness Committee followed the principles of restorative justice as students and teachers discussed violations of school values and how to address such violations. Hantzopoulos (2011) concluded that these supportive school structures are essential for the success of a transdisciplinary peace education curriculum. The school she reported on had much higher graduation and college acceptance rates than the average rates for the city.

Learning Locales. Potential learning locales can be classified as the school, community, and remote. Our experience with COVID-19 affirms the need for PreK-12 teachers and students to come together in person at school. However, by extending inquiry learning to the community and remote levels, students are given the opportunity to relate and apply their learning to the world beyond the school.

School Level. School-based learning includes learning that takes place in the classroom, throughout the school building, and on the grounds surrounding the school. Technology within the classroom and the classroom itself can become integral aspects of the inquiry process. For example, in a "Common Knowledge" design described by Fong and Slotta (2018), the ecosystem of insects, including their food sources, was simulated on the classroom's walls. The digital

ecosystem allowed elementary students to investigate insects' habitats, the insects themselves, insect life cycles, the food web within the ecosystem, and organism populations. Students also were able to study manipulation of the insects' habitat in response to environmental pressures. Students shared notes on their inquiry on digital tablets and on the classroom's common wall, forming a community knowledge base.

An example of schoolwide inquiry learning studied by Kirk (2024) involved Year 6 students at an elementary school in Melbourne conducting inquiry on microbial loads in the air throughout their school building. Small groups of students used agar plates to test 22 locations in the school. The students discovered a high microbial load in a lost property box, indicating a health risk for the school community. Next, the students explored potential inhibitors of microbial growth, tested each of those possible inhibitors, and shared results and recommendations for minimizing health risks. The students' recommendations were adopted by the school. Data on the project gathered by Kirk included lesson videos, student and teacher artifacts, and interviews. Kirk concluded that the student inquiry resulted in increased student voice and agency.

Garden-based learning (GBL) includes students creating, caring for, and observing gardens in schools and on school grounds. Student inquiry on gardens can increase students' intrinsic motivation through "observing the fruits, vegetables, or animals or through activities within the garden that may carry historical, social, or cultural significance for students" (Riggs & Lee, 2022, p. 216). GBL also can increase students' environmental awareness and commitment to preserving the environment. Riggs and Lee (2022) surveyed K-12 science teachers throughout the St. Louis Metro Area and found that, compared to teachers who did not teach with GBL, teachers who taught with GBL perceived their students to have higher science self-perceptions and higher science engagement.

Community Level. Community-based inquiry learning involves learning that extends to students' homes, neighborhoods, and the larger community served by the school. Such inquiry could include student exploration of local institutions, cultural groups, or natural habitats in or near the community. In an example of the latter, Black elementary students in a Michigan community that had experienced large-scale water shut offs completed a socio-scientific unit on water and water justice (Davis & Schaeffer, 2019). The unit was intended to teach students traditional content about water's properties, its relationship with the human body, and lead poisoning as well as water injustice and the need for reform. Students reviewed a report on the Flint water crisis, engaged in dialogue on the Flint crisis, and designed information posters on the water crisis that were displayed on the school wall. Students then studied about the extensive water shut offs in their local community and debated whether water was a human right. In the last part of the unit, students made a field trip to the local river to collect water samples, engaged with water justice activists, and produced a short film on the local water supply. As a result of the unit, the students began to view water justice as a sociopolitical issue, different water crises as part of a systemic problem, and water as a human right.

Elementary student inquiry in another socio-scientific project studied by Herman and colleagues (2023) was carried out in an after-school program in which students explored the human impact on the local Missouri River, an endangered species in the river, and how scientists investigated such issues. Students used a reading, diagrams, photos, and discussion to learn about the

Missouri River, the pallid sturgeon's habitat and its ways of adapting to its habitat, and how human activity (e.g., building channels and dams) had caused the sturgeon population to decline. Students also explored and compared two alternative proposals by scientists on how to recover the sturgeon: chutes or interception habitats. The next step in the unit was a field trip to the Missouri River where students took a guided boat tour and visited four field stations to learn more about efforts to recover the sturgeon and scientists' research on recovery efforts. The field trip also included a session with fishery biologists where students learned about and practiced scientific methods for studying sturgeon. In the final phase of the unit, students worked in teams to develop an argument in support of one of two ways scientists have proposed for recovering the sturgeon. The students were asked to include historical, social, scientific, and economic components in each argument, and to consider the perspectives of different stakeholders. Each team presented its argument to a panel of neutral peers, and the panel selected the best argument. The students then engaged in a discussion of the process in which they participated and how their perspectives had changed. Herman and colleagues reported that, compared to students who did not participate in the program, participating students expressed more advanced views concerning research on socio-scientific issues involving the Missouri River.

Wright and associates (2021) studied the use of camera traps throughout a school district to take photos of local wildlife for use in middle school ecology lessons. The photographs were intended to help students explore local food webs, study energy transfer, compare wildlife in different areas, and investigate human impacts on wildlife habitats. Wright and associates studied the program through observations, interviews, and artifact review, and discovered that some teachers fully implemented the program while others did not. The "implementers" shared two important characteristics: they perceived the use of data from the camera traps to be aligned with academic standards, and they possessed the agency to revise the curriculum to include use of the photos. The students of implementers "studied local wildlife, collaborated with other teachers and wildlife experts, participated in experiential lessons, made interdisciplinary connections, and included community engagement experiences" (pp. 1528-1529).

A Philadelphia high school that focused on peace and social justice, described by Seif (2009), placed a heavy emphasis on community service integrated with inquiry. A few examples of projects shared by the author include "learning about and working with elderly people, helping homeless people, or exploring ways to aid people with mental illness. Journal writing and self-reflection are integral parts of these lessons and projects" (par. 14). A multidisciplinary graduation project combined service to address a real-world problem with a research paper; the completed project was presented to a panel of teachers and community members.

Remote Level. Remote inquiry learning includes learning that takes place at the regional, state, national, or global level. Technology makes such learning more possible and inviting but does not rule out other forms of remote inquiry. Karamustafaoğlu and Pektas (2023) describe a unit of instruction in which high school students traveled to a nature camp where they designed, developed, and tested rockets. Questions students were asked to conduct on inquiry included:

- How do you design a rocket? (How would you design the nose and fixed fins?)
- How do you decide where the rocket's center of gravity should be?
- How do you calculate the altitude of your rocket?

- What kind of rescue method would you develop to prevent your rocket from falling to the ground and getting damaged? (p. 7657)

The students learned about criteria for designing a rocket, drew their rockets, and used a 3-D printer to turn their drawings into three-dimensional rockets. The student rockets were discussed and evaluated based on the criteria listed above and problems encountered. Karamustafaoğlu and Pektas found that the project improved students STEM awareness, creative problem solving, collaboration, and productivity.

The potential of technology for remote student inquiry is almost limitless. For example, Mott (2011) points out that when students are studying a novel that involves a historical or modern location, web-based technology often allows students to view that location, become familiar with its landmarks and people, or read about events that have taken place there. Web sites often include photographs, maps, videos, and guided tours that can help students better understand places and cultures described in novels.

In a creative case of remote inquiry described by Masterson (2018), 14–16-year-old students in secondary foreign language classrooms in Ireland and Germany paired up to co-construct their life stories. First, each partner wrote their autobiography in their native language. Next, partners interviewed each other, and based on the interviews, the partners wrote each other's biographies. Each student then compared the biography they had written with the autobiography their partner had written. Finally, each student created a Venn diagram illustrating similarities and difference between their autobiography and the biography that had been written about them and reflected on the differences between the two writings, including any "surprising, pleasant, or uncomfortable discoveries" (p. 345). This project helped students to develop a greater sense of self-understanding and cultural awareness.

Connections

The different categories of inquiry learning and levels within each category depicted in Table 1 all are connected. Regarding the *learning levels*, analysis is necessary for application and application is necessary for activist learning. As one moves through the *curriculum levels*, additional connections are present. Neither interdisciplinary inquiry nor transdisciplinary inquiry ignores the disciplines, although they often go beyond them. Interdisciplinary inquiry addresses learning goals across particular disciplines. Transdisciplinary inquiry is primarily focused on its own learning goals but utilizes various disciplines to help students reach those goals. Finally, concerning *leaning locales*, inquiry learning that takes place in the community or at remote locations is connected to the school, where such learning is planned, facilitated, analyzed, and assessed.

Table 1
Categories of Inquiry Learning

	ENTRY LEVEL	INTERMEDIATE LEVEL	ADVANCED LEVEL
LEARNING	**Analytic** Students examine a problem, issue, story, belief, process, product, location, event, technology, natural phenomenon, document, artifact, relationship, or conflict.	**Applied** Students create, invent, problem solve, simulate an event or process, conduct a novel experiment, synthesize ideas, develop a model, or build something complex.	**Activist** Students work for significant educational, social, cultural, political, environmental, or economic change. Students integrate academic and real-world action to foster positive relationships, promote democracy, and improve life.
CURRCULUM	**Disciplinary** Within a single discipline, students are given choices of questions to ask, plans to find answers, and ways to monitor their progress and assess their learning. Inquiry relates to both the discipline and the real world and is collaborative and democratic.	**Interdisciplinary** Students learn and use content from two or more disciplines to solve a problem, answer a question, or address an issue that is common to the integrated disciplines.	**Transdisciplinary** Students *start* with a real-world problem or issue and draw on relevant knowledge, skills, and methods from disciplines relevant to addressing the problem or issue. The teacher and students may draw on other sources, such as community members, outside experts, and external data.
LOCALE	**School** Learning in the classroom, other parts of the school building, or grounds surrounding the school.	**Community** Learning that extends to students' homes, neighborhoods, or the larger community served by the school. Such learning could include exploration of local institutions, cultural groups, or natural habitats.	**Remote** Learning that extends to the regional, state, national, or global level. Such learning is often facilitated by technology.

Any of the three levels of inquiry learning (analytic, applied, activist) can be carried out at any of the three levels of curriculum (disciplinary, interdisciplinary, transdisciplinary) or any of the three locales (school, community, remote). However, there are usually wider possibilities for analytic, applied, or activist inquiry at the interdisciplinary level, and still wider possibilities at the transdisciplinary level. Also, there are often more options for analytic, applied, or activist inquiry at the community level or—provided resources for distance learning are available—at remote locations highly relevant to leaning goals.

Conclusion

Although the power of inquiry to promote student learning is firmly established, we need more research on how PreK-12 inquiry learning effects adults and society. Inquiry skills and dispositions hopefully assist graduates to succeed in postsecondary education and their careers. A great deal of PreK-12 inquiry learning is collaborative, and the diversity of ideas, mutual assistance, and dialogue that are part of collaborative inquiry may lead to more positive relationships in adulthood. On the societal level, if authentic inquiry continues into adulthood, citizens should be less likely to fall victim to misinformation and disinformation, more likely to support equity and justice, and positively contribute to a vibrant democracy. The potential of inquiry learning certainly is strong enough to expand its use in our schools and conduct research on its long-term effects. One line of research could focus on comparing the quality of inquiry learning in students' PreK-12 education to graduates' use of authentic inquiry in adulthood and the effects of such inquiry on their personal wellbeing, social relationships, and commitment to democracy. Such research could make significant contributions to both PreK-12 education and the future of our society.

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