Benefits of Making in Elementary and Ways to Address Potential Challenges

Aspects of Learning Unique to Making &/or PBL/DBL	**Making Supports these 21st C Skills**	**Challenges of Implementing in a K-5 School Environment**	**Potential Solutions to Challenges**
Makers choose their own projects by defining the problem they want to solve or artifact they want to create..	Self-directed learning; critical thinking, problem solving, planning	Students may not have any idea of the time/skills/materials they need for their project.. Proposed projects may cover topics outside required curriculum areas. Can be difficult for teachers to assess widely varying projects.	Teachers help students set realistic goals & interim milestones based on available time, skills & materials.(Vongkulluksn,et.al., 2018) Create a prompt or set parameters that enable the project to fulfill curriculum requirements. Create a flexible rubric.The Digital Harbor Foundation Blueprint website is a good resource (Dellosso, 2016).
Projects often lead to cross-discipline learning & discovery.	Creativity, problem solving, deep learning	Aspects of student's project may be outside the teacher's area of expertise/comfort zone & difficult to support.	Enlist parents, other teachers or specialists to mentor or consult. Encourage students to use online resources.
Students share ideas and expertise with each other. Often work in teams on projects	Collaboration	Students can get distracted, can be disruptive. With group projects, work can end up unevenly distributed.	Set guidelines for behavior & group interaction. Make these part of the rubric. Use a tool such as Common Sense Media's Group Work Roles Worksheet.
Students create an artifact that can be shared with others & as a way to assess whether they solved their stated problem.	Self-assessment, peer assessment, collaboration	Feelings can get hurt. Students can be hard on themselves or alternatively, not hard enough.	Give examples & structure appropriate peer feedback. Refer to rubric. Allow flexibility in interpretation - e.g., student may not have solved the problem outright but they have gone as far as they could in the time allotted.
Iteration is expected.	Flexibility, perseverance, problem solving	Time is always an issue. Students can get discouraged when their artifact doesn't look/operate as they had envisioned.	Give as much time as possible. "Sufficient time must be provided...to think..plan, execute, debug,change course, expand and edit...projects" (Martinez & Stager, 2013). Be clear with students they aren't expected to get it right the 1st time (Vongkulluksn,et.al., 2018).
Students learn & apply digital skills to solve their problem.		Typical maker tools such as 3D printers, laser & vinyl cutters, robots, microprocessor boards, coding, video production, & rendering software can be challenging to learn; some equipment requires constant supervision.	PD for classroom teachers & access to tech specialists. Encourage students to help each other if they have developed certain tech skills. Assign small, thematic projects to enable students to gain basic proficiency with maker tools **prior** to the large project. (Worsley & Blikstein, 2013).

Resources

Dellosso, S. (2016). Maker project rubric. *Digital Harbor Foundation*. Retrieved from: https://blueprint.digitalharbor.org/maker-project-rubric/

Group work roles to promote shared ownership. *Common Sense Media.org* Retrieved on 1/19/19 from: https://d1e2bohyu2u2w9.cloudfront.net/sites/default/files/tlr-asset/document-group-work-roles-4.pdf

Martinez, S., & Stager, Gary. (2013). What makes a good project?. In *Invent to learn : Making, tinkering, and engineering in the classroom* (pp. 57-67). Torrance, CA: Constructing Modern Knowledge Press.

Vongkulluksn, V.W., Matewos, A.M., Sinatra, G.M., & Marsh, J.A. (2018). Motivational factors in makerspaces: a mixed methods study of elementary school students' situational interest, self-efficacy, and achievement emotions. *International Journal of STEM Education*, *5*(43) Retrieved from: https://stemeducationjournal.springeropen.com/articles/10.1186/s40594-018-0129-0

Worsley, M. & Blikstein, P. (2013). Designing for diversely motivated learners. Paper Presented at the Digital Fabrication and Making In Education Workshop at the 2013 Interactive Design for Children Conference (IDC 2013). New York, NY. Retreived from: https://www.marceloworsley.com/papers/dfm_idc_2013.pdf