An introduction to makerspace

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Abstract

Maker education is a term coined by Dale Dougherty in 2013. It is inspired from 'learning by doing' where the child is the centre of the teaching-learning process. Retention is best when the child gets involved in the activities. Every child should be encouraged to create something on his own. Maker Education motivates the learners & is a powerful learning force which has been recognised as a potent learning opportunity. Learning in school remains controlled by traditional pedagogies & curriculum which are opposed to the way of learning in makerspaces. Makerspaces are places where a child is encouraged to create something on his own. So, the introduction of the maker movement in schools can be an opportunity for the teachers & students to break away from the traditional teaching- learning process. The present article focuses on the need of makerspaces in schools to give a boost to the innovative & creative skills of the students through maker education.

Keywords: makerspace, maker education, experiential learning, STEAM

1. Introduction

The best way to keep the students physically and mentally active in the classroom is to let them make something on their own. It develops their curiosity and arouses interest in the learning process. The students learn freely when given a chance to do a task by themselves. The 21st century skills require the students to learn by doing (either individually or in groups). It allows learning through the projects, where students collaborate with each other and create things by trial and error method. It facilitates active learning. The present educational requirement encourages higher order learning skills. The aim is not just higher academic records that depend on memorization but to promote higher forms of thinking such as analysing and creating. This has made the need for doing and learning, which in turn, has given a boost to the maker movement.

2. Maker education

Maker Education is an approach to problem-based and project-based learning that relies upon hands-on, often collaborative, learning experiences as a method for solving authentic problems. People who participate in making call themselves 'makers' and develop their projects in 'makerspaces'.

- "Makers are people who create things instead of just using them."
- Since long, schools have valued only knowledge/memory based learning & undervalued learning with one's hands. The maker movement requires us to value learning with the head, heart, and hands equally (cognitive, affective and psychomotor domains of learning).
- "We are born makers. We move what we are learning, from our heads, through our hearts to our hands.'' Brene Brown
- Maker education involves using hands-on project to encourage learning.
- "Maker education is a fun and engaging way for students to build skills they need to succeed today: creative problem-solving, collaboration as they make with others, and the ability to prototype fail and keep trying. It's proof that learning can and should be fun." Raechel French, K-12 Education Planner at the DLR Group.

The following figure shows the stages of making

Fig 1: Stages of making

The students, under the guidance of their teacher try to create something on their own.

- "The role of the teacher is to create the conditions for invention rather than provide ready-made knowledge."

Seymour papert

The students of maker education, construct new knowledge from their previous experiences with the help of books, websites or suggestions from classmates. It reflects a more active form of thinking.

3. Makerspace

A makerspace (Also called hackerspace, hackspace, and fablab) is a place where students create, invent, explore and discover. The goal is to allow students to make themselves inventors & creators by using raw materials, tools, technology and imagination.

- "To define a school makerspace by its purpose and simplest of terms, it is a place where young people have an opportunity to explore their own interests; learn to use tools and materials, both physical and virtual; and develop creative projects." **-**

Laura flemming worlds of making

In a 'makerspace', there is no need for expensive hardware; most of the schools cannot afford expensive materials. But to make something you can start with simple materials such as cardboard, fabrics, old telephone wire, tennis balls, nuts and bolts, paint, woodblocks, rubber bands, straws, magnets, scissors, batteries, buttons, bottle caps, string, clay, construction paper, broken toys, popsicle sticks, tape, etc.

- "Makerspaces come in all shapes and sizes, but they all serve as a gathering point for tools, projects, mentors and expertise. A collection of tools does not define a makerspace. Rather, we define it by what it enables: making." - Makerspace Playbook School Edition 2013

The makerspace is inspired by reusing old or unused materials and making 'Best out of Waste' materials and SUPW (Socially useful productive work). It also increases the students awareness of scientific advancements and develop a scientific outlook. Students, here, get an opportunity to learn things from getting direct hands-on experience.
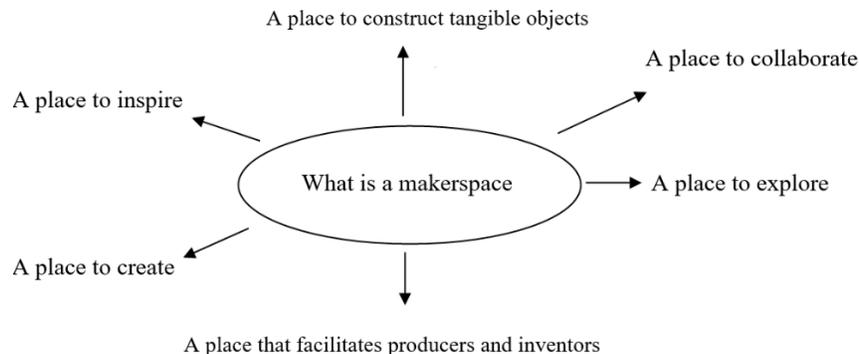
4. Experiential learning

The makers education relates to the principles and learning activities of experiential learning. Experiential learning was developed by David Kolb, drawing heavily on the work of John Dewey, Kurt Lewin, and Jean Piaget. It engages students in critical thinking, problem solving, and decision making as students get an opportunity to learn from direct experience. Students learn better when they get first-hand experience. The recall value in such a situation is more. The experiential learning cycle (fig. 2) is effective in teaching higher-order thinking skills.

- "For the things we have to learn before we can do them, we learn by doing them." Aristotle
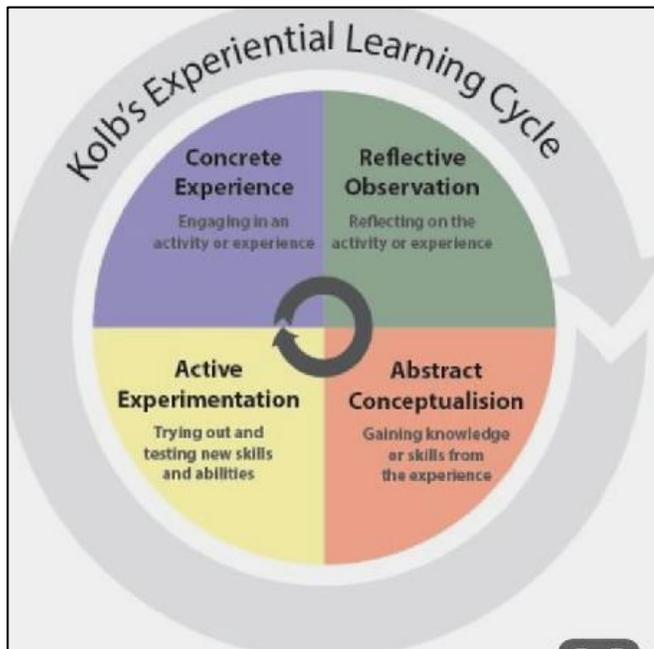

Fig 2: Kolb's experiential learning cycle

5. STEAM

The STEAM (Science, Technology, Engineering, Arts & Mathematics)activities emphasizes 21st century competencies, and combine them with real world or project based learning to develop skills for collaboration, questioning, creativity, problem-solving and critical thinking. The rise of makerspaces in schools, libraries, and community centres and the popularity of experiential learning give us an opportunity to use higher order cognitive skills and solve meaningful problems.

- "STEAM is an educational approach to learning that uses science, technology, engineering, the arts & mathematics as access points for guiding student inquiry, dialogue& critical thinking." -Susan Riley (Arts Integration Specialist)

  The STEAM process involves skills essential in maker education- Investigate, discover, connect, create and reflect.

Fig 3: The STEAM process

6. Need and importance of makerspace

Makerspaces are a necessity because they develop the required STEAM skills for students in the 21st century. Aside from STEAM, makerspaces also tend to be areas for collaboration, critical thinking, and creativity – skills used by all students in the world. There is a need for students to get engaged in makerspaces because:-

1. It accelerates the creative process.
2. It encourages to try, fail and try again.
3. It creates connection with real life.
4. It improves self esteem.
5. It enables to construct one's own knowledge.
6. It gives value to manual labour.
7. It encourages invention.
8. It helps students to experiment freely.
9. It develops innate skills.
10. It gives wings to one's imagination.
11. It is active and engaging.
12. It boosts meta-cognition.

Projects can be wide-ranging and based on numerous topics such as weather, medicine, crime science investigation, space, environment, social issues, economics, animals, and energy.

7. Features of makerspace

A STEM or STEAM makerspace should include the following:
- Small and large tools
- Technology (voice, data, and video outlets, data drops, Wi-Fi, laptops, printers)
- High-amp electricity
- Large, flexible storage spaces for materials
- Display cases for small models and fabrications

- Sound isolation for mitigating or dampening sounds
- Flexible, durable, and mobile furnishings for a variety of instructional groupings
- Surfaces that are easy to clean including polished concrete floors with drains
- Multiple double-bowl sinks with hot water and clay traps
- Mobile walls to create small-group learning spaces
- Glass walls to increase visibility and ensure safety
- Operable windows for direct sunlight and fresh air
- Double doors to move large equipment through
- Mobile work tables, seating options, casework and shelves (Kerriane Wolf, 2016)

8. Obstacles to makerspace
- Lack of funds.
- Lack of space.
- Lack of administration support.
- Lack of interest among teachers.
- Lack of assistance from various other professionals.

9. Conclusion
Thus, from the above discussion, we can conclude that the maker movement has come here to stay. It gives an impetus to student's learning. It also helps to impart innovative and application-based learning. The growing awareness for hands-on learning, has made the maker education rely on the higher order thinking skills. Education in such a way can truly bring out the best in child. It encourages innovation and creativity of the learners which is essential to bring about a change in their personality where knowledge is not only gained but also created.

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