Invitation to Learn – Integrating Maker Movement into Handicrafts

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Biography

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Abstract

Integrating the Maker Movement with Finnish handicrafts, including coding and computational thinking, will create multi-material, gender-blind, student-centered classes, where pupils design, manufacture, and evaluate his/her own work. In Finland, handicrafts is included in the curriculum as a compulsory subject from grades 1 to 7, and this research includes a first draft of curriculum for those grades. The next step will be encouraging these 'handicraft-makerspaces' with co-teachers and students.

Keywords: maker movement, handicrafts, basic education, innovating, creating, constructionism, lifelong learning

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Introduction

Students need to be prepared for a fast-moving digital world where they have the confidence and skills to not only use digital technologies, but to design and create digital systems. In Finland, handicraft curricula allows students to learn project planning, time management, experimenting, documenting and evaluating. Schools and makerspaces are the best places to prepare our students for digital-future. In Finland, due to handicraft, we have both the time and teachers to do that job. My question is: "Will integrating makerspace into handicraft classes prepare every student for 21st century skills?"

Literature review

What is handicraft in 21st century?

Finnish core curriculum is still mainly based on different subjects. Unlike many other countries in the world, in Finland handicraft is included in the curriculum and is taught as a compulsory subject from 1st to 7th grade. The essence of handicraft as a school subject is often misunderstood. It is not only about learning different techniques to make things, but it is knowing and understanding the whole process from brainstorming to evaluating.

In an article by University of Helsinki: Huotilainen, Seitamaa-Hakkarainen & Matinlauri, (2018) are highlighting that the focus is to teach students 21st century skills. Student-centered handicraft teaching and learning focuses on the student's own ideas, experimenting and documenting their process. The new curriculum also expects the pupil to plan and schedule his/her own work. According to Pe Tuikkala (2014) it is important to view crafts as a versatile subject that supports the learner's holistic development as well as their overall learning.

The versatility of Finnish teaching often attracts admiration abroad. After visiting Finnish handicraft classrooms, deputy Professor Paulo Blikstein from Stanford University, pioneer

of FabLabs, was so excited about the space and the facilities, that he brought sewing machines to makerspaces in Stanford. (Huotilainen et al., 2018). We have something very unique and the value of handicraft education should be acknowledged.

What and why of a makerspace?

A makerspace (also FabLab / Hackerspace / Techshop) is a collaborative workspace inside a school, library or separate public/private facility for making, learning, exploring and sharing, that uses high tech to no tech tools. These spaces are open to kids, adults, and entrepreneurs, and have a variety of maker equipment including 3D printers, laser cutters, Computer Numeric Control –machine (CNC), soldering irons and sewing machines. A makerspace however does not need to include all of these machines or even any of them to be considered a makerspace. Just simply cardboard, Legos and art supplies can be considered as makerspace toolery.

We have children who can use and consume technology. “Educational zombies with all of their technological skill residing in the swipe of an index finger.” (Roffey, Sverko & Therien, 2016, p. 5). The learning is through creation and demonstration of newly acquired skills: “embedding maker culture in [primary and secondary] education has made students active contributors to the knowledge ecosystem rather than merely participants and consumers of knowledge” (Freeman, Becker, & Cummins, 2017, p. 8).

Constructivist ideology to form a constructionist approach to education are the core of Makerspace. These ideas were first introduced by Jean Piaget and later developed by Seymour Papert. The main idea of constructionism is to have the learners create their own knowledge by creating and interacting with physical objects. This core can also be found in handicrafts.

By combining the makerspace and handicraft, we can move beyond consumption to creation. It is very important for decision makers to understand that by developing basic education in this direction, it is first of all a necessity, and secondly it is very easy to implement. In Finland, we already have the structure, the teachers and the learning environment for this.

What are the guidelines in the Finnish core curriculum?

The latest core curriculum for basic education (grades 1 – 9) in Finland was updated in 2014. These new regulations started in grades 1-6 in 2016. In 2019 the whole basic education field uses this curricula, which reflects today's society as well as the knowledge and skills needed in the future. Subjects are taught and studied based on the number of lessons specified in the distribution of lesson hours and the objectives set in the curriculum in all grades. Each subject is assessed every school year. There is also more focus on Information and Communication Technology (ICT) skills, well-being and daily life management in all subjects.

The new core curriculum places an emphasis on transversal competencies in instruction:

- thinking and learning to learn
- cultural competence, interaction and self-expression
- taking care of oneself and managing daily life
- multiliteracy
- ICT competence
- working life competence and entrepreneurship
- participation, involvement and building a sustainable future

A changing society demands more and more transversal skills and competencies. Therefore, it is important that each subject, including handicraft, promote transversal competencies.

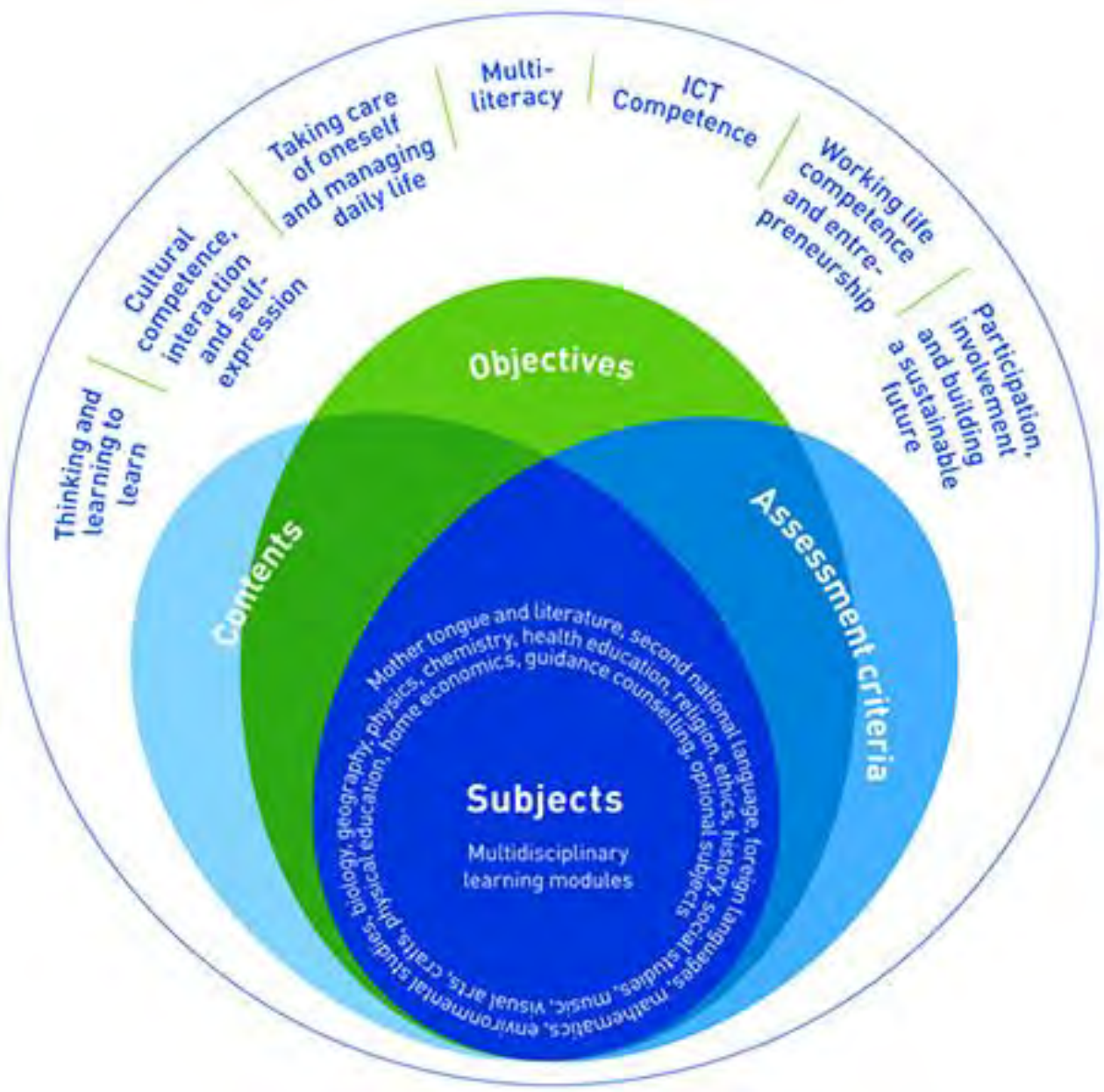

Figure 1: Transversal competences and subjects

Finnish National Agency for Education (EDUFI)

Discussion

In my analysis, I raise a few main points. I start with the changes in Finnish handicraft curriculum and the new opportunities brought by the change. The second thing I am dealing with is the Maker Culture and the origins of its development and manifestations in Phoenix, Arizona. Finally, I summarize the literature, my observations and research questions. In the discussion, I try to provide examples of both spatial planning and the implementation of a school-specific curriculum.

The long history of the school as an institution as well as the previous curricula influence the direction of curriculum change. The new curriculum can be regarded as an update to the previous version rather than a completely new document. Previous emphasis, values and ideals can also be traced from a new document. In addition, older curricula may indirectly affect the broader social context in which the next curriculum is drawn. (Iversen, 2014)

During my long teaching career, I have experienced a number of curriculum changes. Especially the change in handicrafts has been significant. The core of the subject is making things by hand; the biggest change is how the different areas of the subject are emphasized. In the past, a very technique-oriented, and gender-biased way of thinking, has given way to a whole process (project planning, time management, experimenting, documenting and evaluating) way of thinking. At the same time, the subject has become more gender-blind.

The 2016 Finnish core curriculum abandoned the terms ‘technical’ and ‘textile’ work and replaced them with the multidisciplinary term ‘handicrafts’. These multi-material handicraft classes are implemented with a versatile combination of hard and soft craft materials. Ideally, teaching involves a student-centered problem-solving classroom, where the pupil designs, manufactures, and evaluates his or her own or group work.

Some of the teachers think that change in the handicraft curricula is underestimating the value of the subject and they are worried, that it narrows the pupils' technical skills. On the other hand, for some, the new curriculum opens the door to more comprehensive implementation of all aspects of the handicraft process. In active online conversations, I have found a clear support for both views and neither viewpoint can be considered wrong or right.

When you put your focus on project-based learning and problem solving, which are absolutely required in handicrafts, you provide opportunities for credible, lifetime, and authentic growth and development. Regardless of whether today's students work in technical careers, become doctors or politicians, or whatever they choose, we know that with the challenges their generation will face, they will be expected to be problem solvers. The World Economic Forum (2016) produced a report that predicted what the employment landscape would look like in 2020 based on responses from human resources and strategy officers from leading global employers. (Brejcha, 2018)

	Top 10 Skills Sought by Employers in 2015	**Top 10 Skills Employers Are Likely to Seek in 2020**	**Top 10 Skills Employers Are Likely to Seek in 2022**		**The top 5 soft skills of 2019, according to LinkedIn**
1.	Complex problem solving	Complex problem solving	**Analytical thinking and innovation**	1.	**Creativity**
2.	Coordinating with others	Critical thinking	**Active learning and learning strategies**	2.	Persuasion
3.	People management	**Creativity**	**Creativity**, originality and initiative	3.	Collaboration
4.	Critical thinking	People management*	**Technology design and programming**	4.	Adaptability
5.	Negotiation	Coordinating with others*	Critical thinking and analysis	5.	Time Management
6.	Quality control*	**Emotional intelligence**	Complex problem-solving	6.	Cloud computing
7.	Service orientation	Judgement and decision-making*	**Leadership and social influence**	7.	Artificial intelligence
8.	Judgement and decision-making	Service orientation*	Emotional intelligence	8.	Analytical reasoning
9.	Active listening*	Negotiation*	**Reasoning, problem-solving and ideation**	9.	People management
10.	**Creativity**	**Cognitive intelligence**	**Systems analysis and evaluation**	10.	UX Design

Figure 2. Skills sought by employers. Adapted from World Economic Forum (2016) and LinkedIn, 2019.
(Note. Skills emphasized in bold are new to 2020 / 2022, and skills marked with asterisks [*]

no longer appear in the Top 10 in 2020 / 2022. Blue part of the Figure 2 is from networking site LinkedIn, 2019's employers are looking for a combination of both hard and soft skills)

Coding literacy is becoming increasingly necessary across industries. Education systems are realizing there is a need to be prepared for a fast-moving digital world, where our children have the confidence and skills to not only use digital technologies, but to design and create digital systems. Maria Montessori said, "The hands are the instruments of man's intelligence." Nevertheless, intelligence is not only in the act of making, it is in extending one's own intelligence with interesting materials and tools. Our new 2016 curricula gives us a legitimized right to implement coding, 'makering' and digital thinking to handicraft teaching. A changing society demands more and more transversal skills and competencies. Therefore, it is also important that handicraft promote transversal competencies.

Here in Phoenix, Arizona, I have been working with second graders making puppets. They have been reading a story of cats and now they are rehearsing a play for their parents, using their handmade cats. I have not been able to see this kind of activity in other schools in the region. The teachers that I have had the opportunity to talk with, have told me that they very rarely can do anything else but to prepare students for standardized tests. Therefore, when given a chance, the children are very excited. Making something by yourself is a powerful and personal expression of intellect. It creates ownership, even when your product is not perfect. Making is about the act of creation with new or familiar materials. As a parent and handicrafts teacher, I know how children have always made things, but in recent years, their tool pallet and canvas have expanded remarkably.

When we allow children to play with their own ideas, experiment and take risks, we give them permission to trust themselves. They begin to see themselves as learners who have good ideas and can transform their own ideas into reality. (Martinez & Stager, 2013, p. 36) When we

acknowledge that there may be many right answers to a question, it gives children permission to feel safe while thinking and solving problems, not just when they answer correctly.

I became interested in Maker Culture, Maker Movement and Makerspaces in year 2015 when I was a team leader to handicraft teachers, and we were writing the new curricula for handicrafts. In a way, making and makerspaces have always existed. It is an inherent part of human nature to ideate, plan and create things with our hands and with tools. How did this phenomenon called the "maker movement" begin, and what is it all about?

Burke (2014) explains that while certain aspects of the maker movement such as hobbyists, arts and crafts groups, shop classes, practical education and science fairs have existed for ages, it was the launch of Make-magazine in 2005, and its published information about maker-related projects, that gave the *maker movement* its impetus. According to Martinez and Stager the Make-magazine "is the Gutenberg Bible of the burgeoning 'maker' community". The Makerspace also has its roots in the MIT's Fab Labs (Massachusetts Institute of Technology). In their book, *Invent to Learn*, Martinez and Stager (2013), share some powerful stories about the learning environment and collaborative culture that emerged from a MIT course, "*How to Make Almost Anything".*

Nowadays there are hundreds of Makerspaces throughout the world as the concept has gained popularity, "all of which operate with a common minimum equipment requirement and a shared mission" (Burke 2014, p. 14). The growing maker movement is promoting its value and the schools are building out or repurposing spaces for maker-centered activities. Across the country educators, policy-makers, and researchers alike are beginning to investigate the tools, tricks, and trends of the maker trade (Burke 2014).

One driver of this increased interest in makerspaces within the U.S., was President Obama's "Educate to Innovate" campaign in 2009. He promoted the value of making experiences:

"I want us all to think about new and creative ways to engage young people in science and engineering (…), encourage young people to create and build and invent - to be makers of things, not just consumers of things" (as cited in Sheridan et al., 2014, p. 506). The White House hosted its first Maker Faire in June 2014, after which followed the commitments of numerous large companies to support community based making activities (Bevan, Gutwill, Petrich & Wilkinson, 2014).

Conclusions

In Finland, we are in a strange situation, we are afraid that decision makers are underestimating the value of handicrafts. Yet, all around the world Makerspaces are beginning to seed and take root within the educational soil of many institutions. Only time will reveal the kind of growth that Makerspaces will experience in the future. When you do something yourself, the thing that changes most profoundly is you. Even if the object of the lesson is not to program a computer but make a puppet. The object is to empower children to use their brains and anything they could to put their hand on, to solve any problem. This type of focused education opens students to explore new topics and subjects, and it allows different learning techniques to be promoted. Creativity in Makerspace promotes innovative thinking in students. To allow them to collaborate and to make things within a single space (Burke, 2014). As Peppler and Bender (2013), explain, "a hallmark of the maker movement is its do-it-yourself (or do-it-with-others) mindset that brings together individuals around a range of activities." (p.67)

I recommend integrating makerspace into handicraft classes to prepare every student for 21st century skills. I will create a first draft of a working curricula for grades 1-7 by combining makerspace-ideology and the essence of handicrafts. Students can learn coding and computational thinking in this 'handicraft-makerspaces'. We need to have a joint knowledge of what we should teach in class every year. I will include my co-teachers into development of curricula. In the table (Appendix A) I am giving one option on how teachers can find a solution for teaching and how

every student can have the same access to learn different educational content. Teacher resources including evaluation, teacher instructions and pictures of existing Makerspaces can be found in Appendix B-K.

Action Plan (Invitation to Learn)

Note: Sharing (Blue), Implementing (Green), Sharing the Material in School (Yellow) and Evaluating (Purple)

What **Steps/Strategies**	**Who is responsible**	**Timeline** **When & How long**	**Resources** **Money, Staff, Materials**	**Evaluation** **How will you know it is completed?**
Share Inquiry Project with my principal	Myself	First month – May / June	Appointment time Copies of materials	Date of meeting
Schedule date for Learning Environment Expert Teachers Presentation	Myself	Before August	Appointment	Date on calendar
Presentation / Meeting with architects, request of feedback for project	Myself	Before August	Appointment	Date of Meeting and feedback given
Conduct training for the co-teachers in my school	Myself	August / September at the beginning of school year 2019-20	Time, location, materials, snacks, survey	Training is completed. End of training discussion to gather feedback on training and strategies
Conduct training for the co-teachers in my city / for teachers from other cities	Myself	Before Autumn break	Time, location, materials, snacks, survey	Training is completed. End of training discussion to gather feedback on training and strategies
Share ideas and online-curricula materials with colleagues	Myself	August	Appointment, Time, Digital materials, Lunch or coffee	Date of meeting
Implementing strategies with students	Myself	August/ September	Time, Copies of materials, Digital materials	Dates of implementing
Improved material based on own experiences and feedback from students, teachers and from learning environment group	Myself	April – May 2020	Time, Copies of materials, Digital materials	Improved material ready

Feedback from students	Myself, students,	August/ September (during implementing and after)	Time	Feedback received

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Makerspace toolery:

All the types of computer-driven tools that create things by cutting material away are called **digital fabrication tools**.

3D printer; building up material in layers to create an object (3D printing)

Laser cutter; cutting material away, the computer controls the cutter to precisely cut your parts

Computer Numeric Control -machine(CNC);
cutting material away, the computer controls the cutter to precisely cut your parts

Soldering iron;
A hand tool used in soldering. It supplies heat to melt solder so that it can flow into the joint between two workpieces.

Sewing machine;
A machine used to sew fabric and other materials together with thread – can be computer-driven.

Simple supplies can be considered as makerspace toolery:
Cardboard
Legos
Art supplies

List of the Appendix:

Appendix If - Makerspace in Arizona Science Center - Wood Shop (2) in Makerspace / Arizona Science Center
Appendix Ig - Makerspace in Arizona Science Center - Storage system in Makerspace / Arizona Science Center
Appendix Ih - Makerspace in Arizona Science Center - Some creations in Makerspace / Arizona Science Center

Appendix K - Makerspace in Arizona State University (Farmer Building) – Different things in Makerspace in ASU

Appendix Aa – First Draft of Curricula for Grades 1 – 7

Perustekniikat							
Luokka-aste	Ideointi	Suunnittelu	Kovat materiaalit	Pehmeät materiaalit	Dokumentointi	Reflektointi/Arviointi	Maker
1. luokka	Sadut ja tarinat	Opettajan ideoima pohja	naulaaminen / sahaaminen / liimaaminen	käsin ompelu, saksilla leikkaaminen	Piirtäen / Kuvattuna / Videoituna (sähköinen alusta)	Kertoen / nauhoitettuna/ videoituna / (sähköinen alusta)	Lego
2. luokka	Itse keksityt tarinat	Oppilaan suunnittelema pohja / piirros / sähköinen piirtopöytä (iPad-pro)	hiominen kuumaliima	virkkaus /paksut langat ja isot koukut / kaavan käyttö / koneompelun alkeet	Piirtäen / Kuvattuna / Videoituna (sähköinen alusta)	Kertoen / nauhoitettuna/ videoituna / Kirjoitettuna (sähköinen alusta)	BeeBot
3. luokka	Pelit ja leikit	Mahdollinen verkkomateriaali	suoraan sahaaminen suorakulman käyttö / viivan mukaan sahaaminen / lehtisaha / akkuporakone	koneompelu virkkausta / kiinteäsilmukka	Piirtäen / Kuvattuna / Videoituna / Kirjoitettuna (sähköinen alusta)	Kertoen / Nauhoitettuna / Videoituna / Kirjoitettuna (sähköinen alusta)	Makey Makey
4. luokka	Maailman ihmeet	Valmiit, yksinkertaisen suunnitteluohjelmat	pylväsporakone / käsihöylä /pintakäsittely	koneompelua / neulonnan perusteet	Sähköiset välineet	Sähköiset alustat	Makey Makey
5. luokka	Muuttunut maailma / lapsen ja leikin historia	Valmiit, yksinkertaisen suunnitteluohjelmat	metallin leikkaaminen metallin muokkaaminen	virkkaus kavennukset ja levennykset / koneompelu sauma /päärme	Sähköiset välineet	Sähköiset alustat	Microcontrollers Arduino / Gemma
6. luokka	Omien mieltymysten huomioiminen	Valmiit suunnitteluohjelmat / 3D -mahdollisuus	puusorvi / pistehitsaus	neulonta levennykset ja kavennukset / koneompelu	Sähköiset välineet	Sähköiset alustat	Microcontrollers Arduino / Flora
7. luokka	Oman projekti -> lähtökohta muokataan ryhmän tarpeet huomioiden	Suunnitteluohjelmat / valmiit pohjat / omat ideat / 3D / Laser- & vinyylileikkuri /	metallin pakottaminen	joustavat materiaalit	Sähköiset välineet	Sähköiset alustat	Microcontrollers Raspberry Pi / Lilypad

Appendix Ab - First Draft of Curricula for Grades 1 – 7 with Active Links

LK	Ideointi	Suunnittelu	Kovat materiaalit	Pehmeät materiaalit	Dokumentointi	Reflektointi / Arviointi	Maker tehtävät!	Työideoita
1.	Tarina idean lähteenä	Viirupöllö 1-7 lk	Naulaaminen Sahaaminen Liimaaminen	Käsin ompelu: * Solmu langanpäähän * Ompeleen päättely	Oppilas piirtää / sarjakuva	**A:** Arviointi oppimisen aikana Voidaan käyttää koko ABC-aineistoa	Lego elokuva https://www.youtube.com/watch?v=sq4ztDnK4ZI	
2.	Oman tarinan kirjoittaminen	Viirupöllö 1-7 lk		Virkkauksen alkeet Huovutettu pöllö	Piirtäen ja kirjoittaen	**B:** Arviointi 1-9. luokilla Voidaan käyttää koko ABC-aineistoa	BeeBot https://www.youtube.com/watch?v=Y6hhSNXXUOA	
3.	Pelit ja leikit	Oma peli_toteutussuunnitelma		Koneompelu, sauma ja huolittelu	Kuvaten, piirtäen ja kirjoittaen	Voidaan käyttää koko ABC-aineistoa	Makey Makey https://www.youtube.com/watch?v=EWPKJF5enkk	
4.	Maailman ihmeet	Kokonaisen prosessin vaiheet_mallitaulukko		Koneompelu, sauma ja huolittelu	Kuvat, piirrokset, kirjoitus ja videointi	Voidaan käyttää koko ABC-aineistoa	Makey Makey https://www.youtube.com/watch?v=rfQqh7iCcOU	Hedelmäpussi *Yksinkertainen malli *koristeltu
5.	Leikin historia	Tangram		Koneompelu, ompeleiden säätö	Kuvat, piirrokset, kirjoitus ja videointi	Voidaan käyttää koko ABC-aineistoa	Arduino Gemma https://www.youtube.com/watch?v=uOepNMAYLyI Arduino Uno https://www.youtube.com/watch?v=I37nWdxrWNE	Kuljetin: *vanhoista tekstiileistä tehty kassi Hedelmäpussi *Yksinkertainen malli *koristeltu
6.	Omat ideat suunnittelussa	Artikkeli_taitava tekijä		Koneompelu Pfaff Koneompelu, ompeleiden säätö	Kuvat, piirrokset, kirjoitus, videointi ja työidean jakaminen verkossa	Voidaan käyttää koko ABC-aineistoa	Arduino Flora https://www.youtube.com/watch?v=eGtGoPhjmcc	
7.	Yhteinen tiimiprojekti	Neulontaa_raksahommia ja käsillä tekemistä -blogi		Laserleikkaus Koneompelu Pfaff * Erilaiset saumurit * Erilaiset saumuriompeleet Ompelemine n saumurilla * Saumurilla ompelun kikkoja	Kuvat, piirrokset, kirjoitus, videointi ja työideoiden jakaminen verkossa	**C:** Itsearviointimateriaali Voidaan käyttää koko ABC-aineistoa	Raspberry Pi https://www.youtube.com/watch?v=QwrKlyC2kdM Lilipad https://www.youtube.com/watch?v=2HOF0zKKSG0	Neulonnan harjoitus: planeetta Maa-neuletyöhön Suunnittele toiselle_opasvideo

Appendix B – Evaluation in Handicraft

KS 1.-2. lk Arvioinnin kohde	1	2	3	4 Hyvä osaaminen 2.lk päättyessä	5	6
Käsityöprosessi: Ideointi ja suunnittelu T1,T2,T3	Yritän tehdä suunnitelman piirtämällä, muovailemalla tai rakentamalla. Tarvitsen apua.	Piirrän, muovailen tai rakennan suunnitelman työstäni.	Piirrän, muovailen tai rakennan suunnitelman työstäni ja osaan täydentää suunnitelmaani.	Teen kuvallisen, muovaillun tai rakennetun suunnitelman annettujen ohjeiden mukaan.	Teen itsenäisesti kuvallisen, muovaillun tai rakennetun suunnitelman ohjeiden mukaan.	Teen itsenäisesti kuvallisen, muovaillun tai rakennetun suunnitelman ja esittelen suunnitelmani.
	Suunnitelman aloittaminen on hankalaa mutta pääsen alkuun opettajan ohjauksella. Suunnitelmastani ei saa selvää.	Hahmottelen, muovailen, rakennan tai piirrän vain opettajan avulla. suunnitelmani kaipaa kovasti täydennystä.	Suunnittelen vain helpoimman mallin. Hahmottelen, muovailen, rakennan tai piirrän osin opettajan avulla enkä piirrä tarkasti.	Teen suunnitelman, josta käy ilmi, millaisen työn haluan valmistaa. Hahmottelen, muovailen, rakennan tai piirrän mukaan yksityiskohtia tuotteesta.		Teen suunnitelman, joka on omaperäinen. Suunnitelmani perusteella kuka tahansa osaa valmistaa työni loppuun.
Kokeilu, tekeminen ja välineet T1,T2,T3	Yritän kokeilla eri materiaaleja, välineitä ja tekniikoita.	Kokeilen eri materiaaleja välineitä ja tekniikoita. Tarvitsen apua.		Kokeilen aktiivisesti ja oikein eri materiaaleja, välineitä ja tekniikoita.		Käytän luovasti erilaisia materiaaleja, välineitä ja tekniikoita.
Turvallinen työskentely käsityön luokissa T3,T4	Olen ymmärtänyt turvallisuusohjeet ja pyrin noudattamaan niitä aina.			Työskentelen käsityön luokissa turvallisesti.		Ohjaan muitakin työskentelemään luokassa turvallisesti.
Dokumentointi ja TVT taidot T2	Harjoittelen ottamaan kuvan tekemästäni työstä, tarvitsen paljon tukea.	Otan kuvan tekemästäni työstä ja sen työvaiheista tuetusti.	Otan kuvan tekemästäni työstä ja sen työvaiheista.	Otan kuvan tekemästäni työstä ja harjoittelen tallentamaan kuvaa.	Otan kuvia työstäni ja sen vaiheista sekä tallennan ne.	Otan itsenäisesti kuvia työstäni ja sen vaiheista sekä tallennan kuvat.
Itse- ja vertaisarviointi T2,T5	Yritän tehdä arviointia ohjatusti.			Harjoittelen oman työni arviointia sekä kannustavaa palautteen antamista.		Arvostan ja arvioin omaa työtäni ja annan kannustavaa palautetta toisille.

KS 3.-6.lk Arvioinnin kohde	1	2	3	4 Hyvä osaaminen 6. lk päättyessä	5	6
Suunnittelutaidot T2,T6 Käsityöprosessi	Yritän opettajan avulla toteuttaa kokonaisen Käsityöprosessin. Tarvitsen paljon tukea.	Toteutan opettajan avulla kokonaisen käsityöprosessin	Toteutan itsenäisesti osia annetusta käsityöprosessista.	Toteutan kokonaisen käsityöprosessin.	Toteutan kokonaisen käsityöprosessin eri vaiheet arvioiden toteutustani jatkuvasti.	Toteutan kokonaisen käsityöprosessin monet eri vaiheet itsenäisesti ja toteutuksen on monipuolinen ja laadukas.
	Yritän käyttää TVT-taitoja käsityön suunnittelussa, valmistuksessa tai dokumentoinnissa. Tarvitsen paljon tukea.		Käytän tuetusti joitakin TVT-taitoja käsityön suunnittelussa, valmistuksessa tai dokumentoinnissa.	Käytän TVT-taitoja ohjatusti käsityön suunnittelussa, valmistuksessa ja dokumentoinnista.	Käytän TVT-taitoja itsenäisesti käsityön suunnittelussa, valmistuksessa ja dokumentoinnissa.	Käytän TVT-taitoja luovasti käsityön suunnittelussa, valmistuksessa ja dokumentoinnissa.
Tiedot ja taidot T4	Yritän tuetusti valita ja yhdistää eri materiaaleja ja valmistustekniikoita	Valitsen ja yhdistän ohjatusti eri materiaaleja ja valmistustekniikoita.		Valitsen, yhdistän ja käytän tarkoituksenmukaisesti eri materiaaleja ja valmistustekniikoita.		Valitsen, yhdistän ja käytän luovasti eri materiaaleja ja valmistustekniikoita.
	Olen tutustunut käsityön käsitteisiin.	Käytän ohjatusti käsityön käsitteitä.	Yritän käyttää käsityön käsitteitä.	Tunnen ja osaan käyttää käsityön käsitteitä.		Käytän monipuolisesti käsityön käsitteitä.
Työskentelyn taidot T3, T5	Ryhdyn työskentelemään vasta kun opettaja pyytää. En muista työn tavoitetta.	Ymmärrän tavoitteen, mutta tarvitsen usein apua opettajalta työn etenemiseen.	Yritän tehdä töitä tavoitteen mukaisesti, mutta tarvitsen vielä vähän opettajan apua työn etenemiseen.	Otan vastuuta omasta työskentelystäni ja toimin tavoitteellisesti. Tarvitsen vielä opettajan tukea työn etenemiseen.	Työskentelen itsenäisesti ja oma-aloitteisesti.	Työskentelen itsenäisesti ja osaan hyödyntää erilaisia työskentelyvaihtoehtoja työn tekemiseen.
	Olen tutustunut opettajan avulla työvälineisiin, koneisiin ja laitteisiin.	Harjoittelen opettajan ohjaamana käyttämään työvälineitä, koneita ja laitteita.	Käytän opettajan avustamana työvälineitä, koneita ja laitteita.	Käytän asianmukaisia työvälineitä, koneita ja laitteita oikein, turvallisesti ja tarkoituksenmukaisesti.	Sovellan työskentelyssäni työvälineitä, koneita ja laitteita oikein, turvallisesti ja asianmukaisesti.	Käytän luovasti ja itsenäisesti valikoiden erityövälineitä, koneita ja laitteita turvallisesti ja asianmukaisesti.
	Olen tutustunut opettajan ohjauksessa yksinkertaisen ja arkipäivään liittyvien laitteiden toimintaperiaatteisiin.			Kuvaan yksinkertaisten ja arkipäivään liittyvien laitteiden toimintaperiaatteita.		Ymmärrän yksinkertaisten ja arkipäivään liittyvien laitteiden toimintaperiaatteita.
	Teen tuetusti omaan tai yhteiseen suunnitelmaan perustuvan tuotteen tai teoksen.	Teen ohjatusti omaan tai yhteiseen suunnitelmaan perustuvan tuotteen tai teoksen.	Valmistan osittain itsenäisesti oman tai yhteiseen suunnitelmaan perustuvan tuotteen tai teoksen.	Valmistan osittain itsenäisesti oman tai yhteiseen suunnitelmaan perustuvan tuotteen tai teoksen, jossa on huomioitu esteettisyys ja toimivuus.	Valmistan itsenäisesti oman tai yhteiseen suunnitelmaan perustuvan tuotteen tai teoksen, jossa on huomioitu esteettisyys ja toimivuus.	Valmistan itsenäisesti oman tai yhteiseen suunnitelmaan perustuvan tuotteen tai teoksen, jossa on huomioitu luovuus, esteettisyys ja toimivuus.
Kasvamisen taidot ja käsityöprosessin arviointi T7,T8	Olen tutustunut oman ja toisen työn ja työskentelyn arviointiin.	Harjoittelen ohjatusti oman työn ja työskentelyn arviointia.	Osallistun toisten työn ja työskentelyn arviointiin ja vertaispalautteen antamiseen.	Osallistun rakentavasti oman ja toisten työn ja työskentelyn arviointiin ja vertaispalautteen antamiseen.		Osallistun aktiivisesti oman ja toisten työn ja työskentelyn arviointiin ja vertaispalautteen antamiseen. Palautteeni rakentavaa.
	Tutustun kulutus-ja tuotantotapojen vaikutuksiin oman tuotteeni elinkaaressa			Selitän, miten kulutus- ja tuotantotavat vaikuttavat oman tuotteeni elinkaareen.	Tarkastelen kriittisesti kulutus- ja tuotantotapojen vaikutusta tuotteiden elinkaareen.	Otan omassa työskentelyssäni huomioon kulutus- ja tuotantotapojen vaikutuksen tuotteen elinkaareen.

Appendix C – Task for Students

Task

Name:

Explain your experience with this project. Had you ever made something like this before, how did you get started, how long did you work on it?

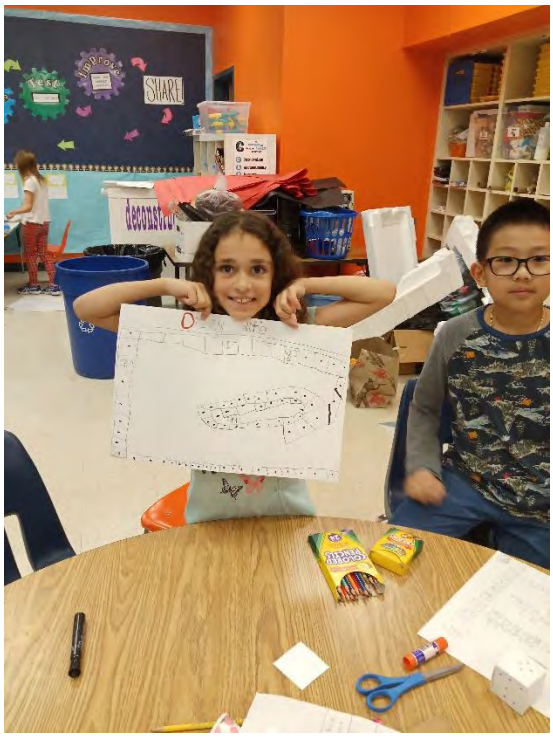
How can the skills you learned, be used later in your life?

Additional information? Is there anything else you want us to know about your project?

Appendix D – Some Instructions for Teachers

Appendix E – Some Instructions for Teachers

Appendix Fa - Makerspace pictures from Kyrene de los Cerritos

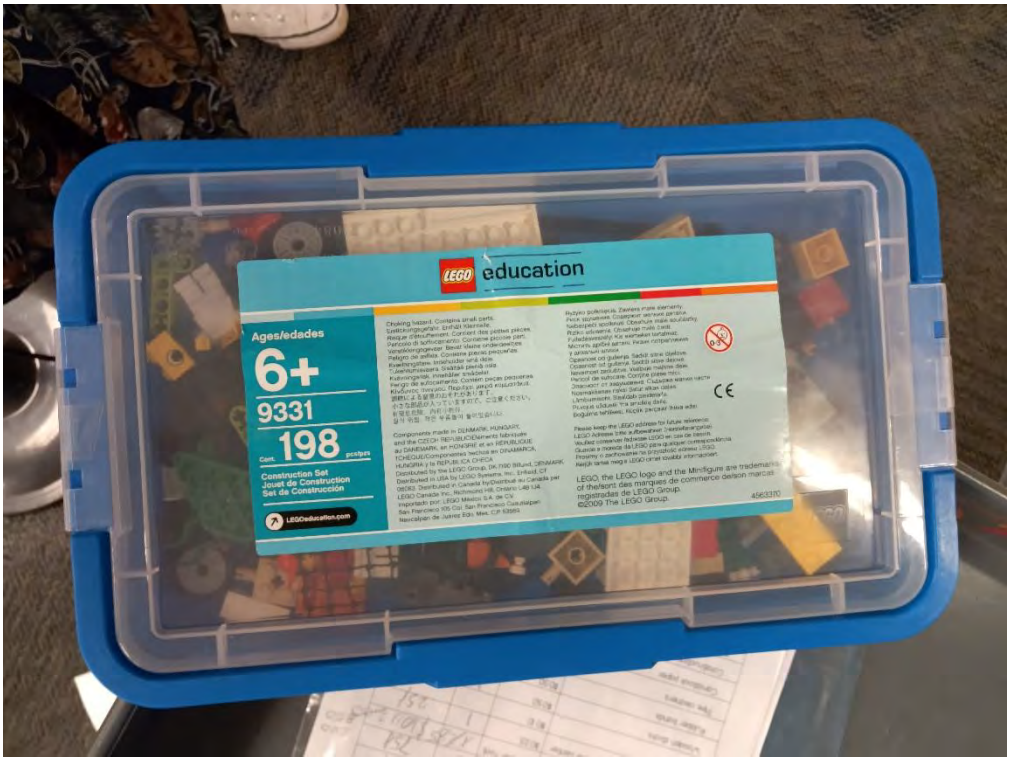


Makerspace pictures from Kyrene de los Cerritos - General view over the Makerspace with students

Appendix Fb - Makerspace pictures from Kyrene de los Cerritos

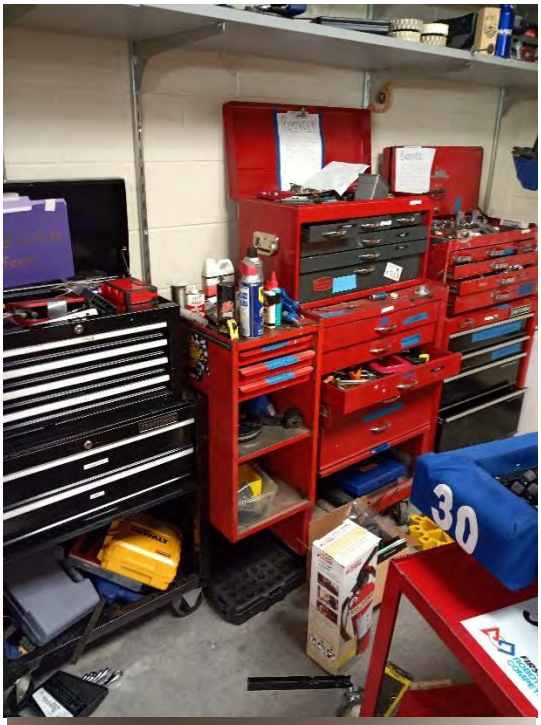
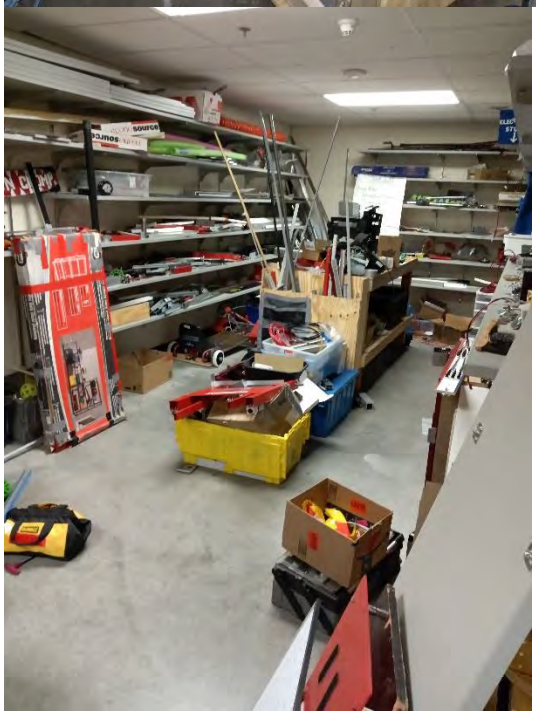
Makerspace pictures from Kyrene de los Cerritos - General view over the Makerspace

Appendix Fc - Makerspace pictures from Kyrene de los Cerritos



Makerspace pictures from Kyrene de los Cerritos - Legos

Appendix Ga - Makerspace in Chaparral High School


Learning environment

Appendix Gb - Makerspace in Chaparral High School

Robot and prototype of solar cooker / oven.

Machinery 1

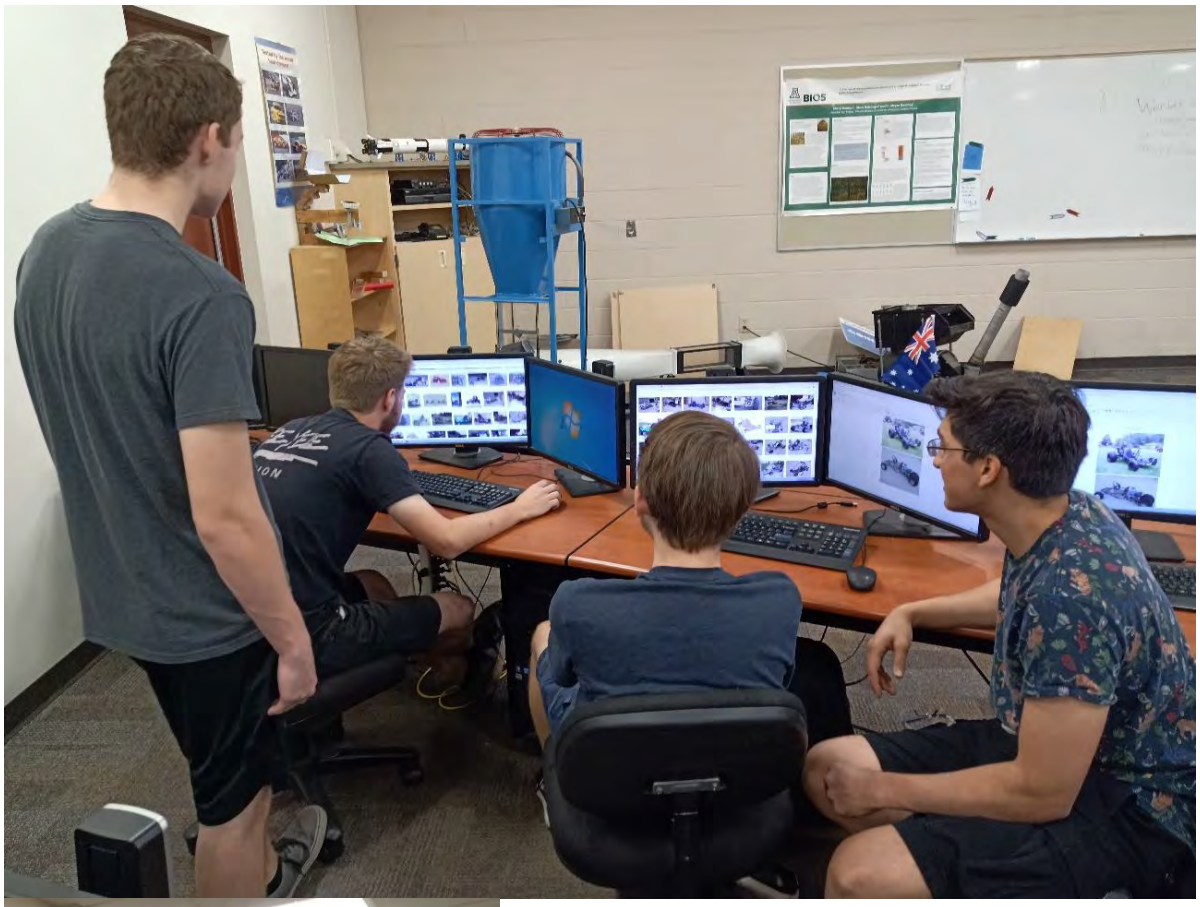
Appendix Gd - Makerspace in Chaparral High School

Machinery 2

Appendix Ge - Makerspace in Chaparral High School

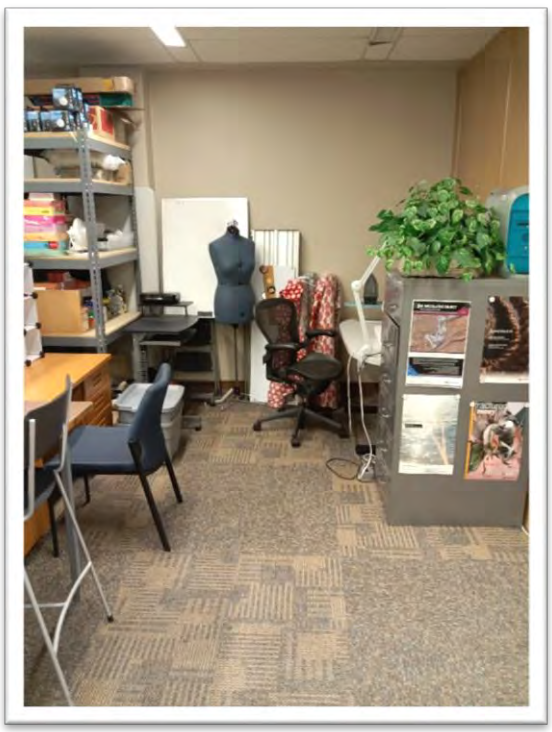
Machinery 3

Appendix Gf - Makerspace in Chaparral High School



Students concentrating on their projects

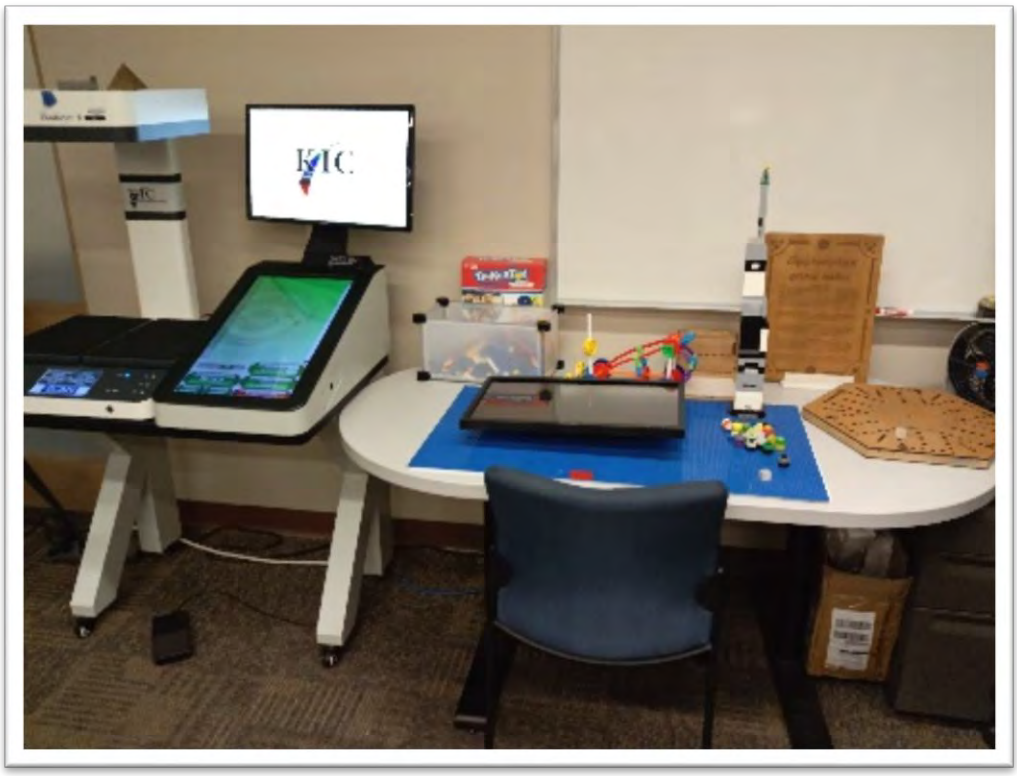
Appendix Ha - Makerspace in Hayden Library



Sewing space

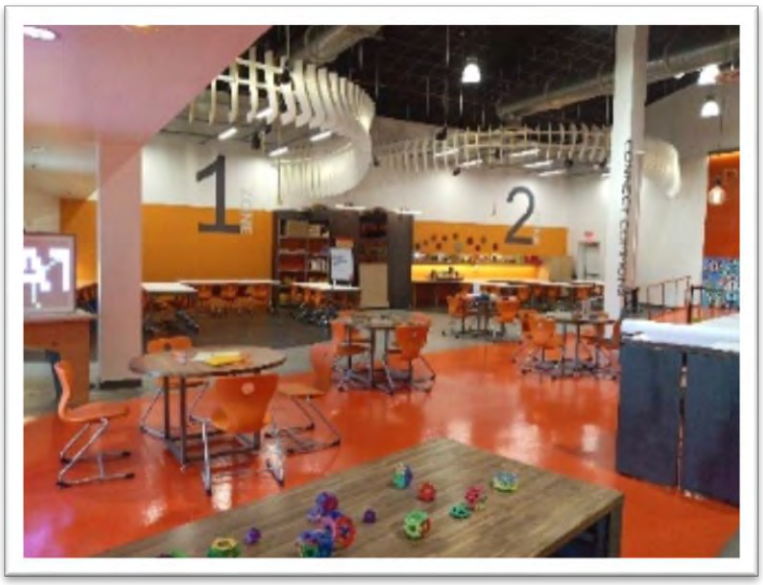
Appendix Hb - Makerspace in Hayden Library

Appendix Hc - Makerspace in Hayden Library



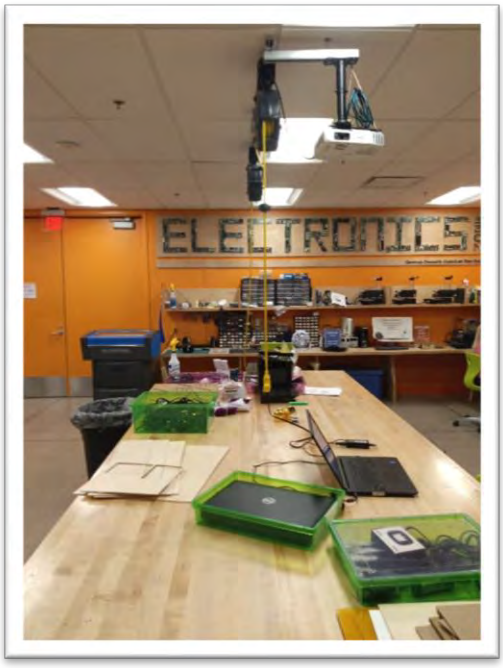
Film studio and vinyl cutter

Appendix Ia - Makerspace in Arizona Science Center



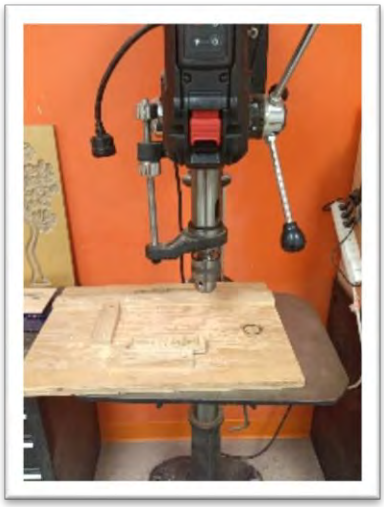
General view over the space

Appendix Ib - Makerspace in Arizona Science Center



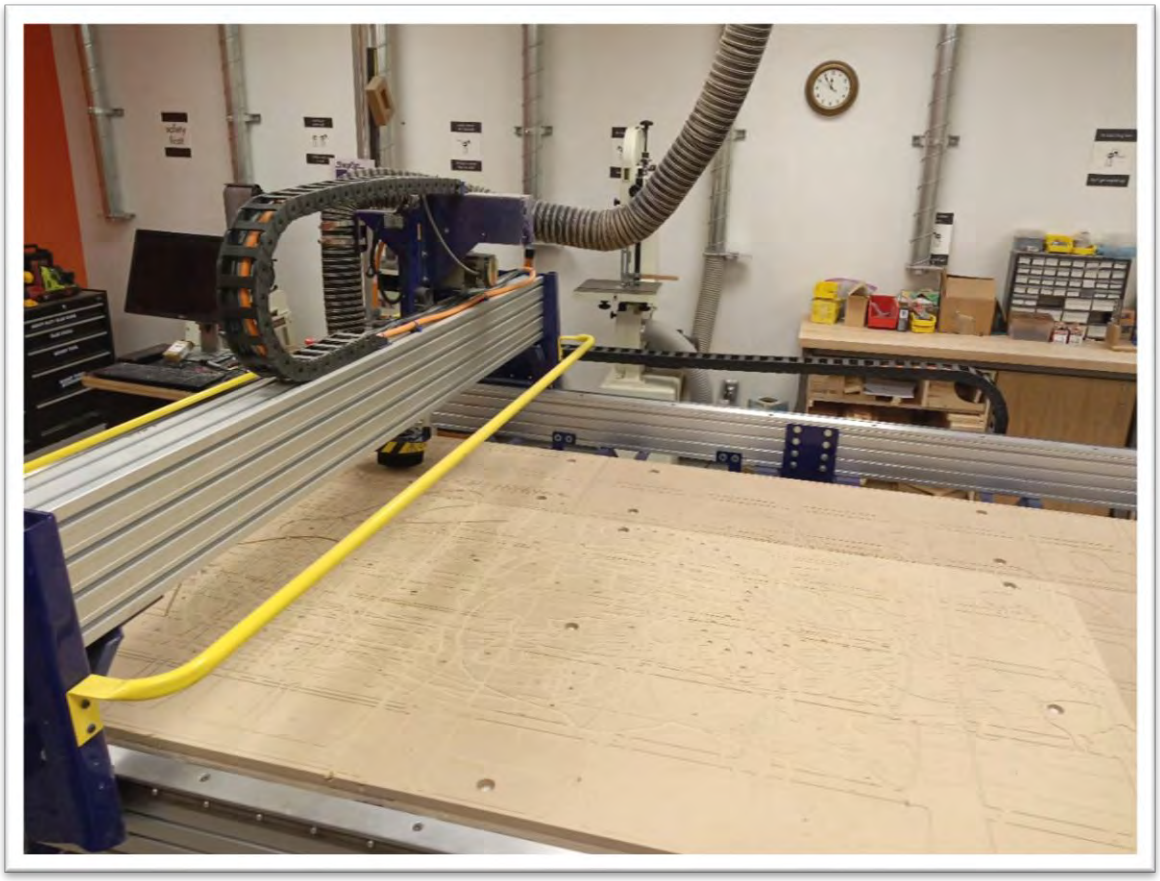
The electronics area in Makerspace / Arizona Science Center

Appendix Ic - Makerspace in Arizona Science Center



Machinery 1: Makerspace / Arizona Science Center

Appendix Id - Makerspace in Arizona Science Center

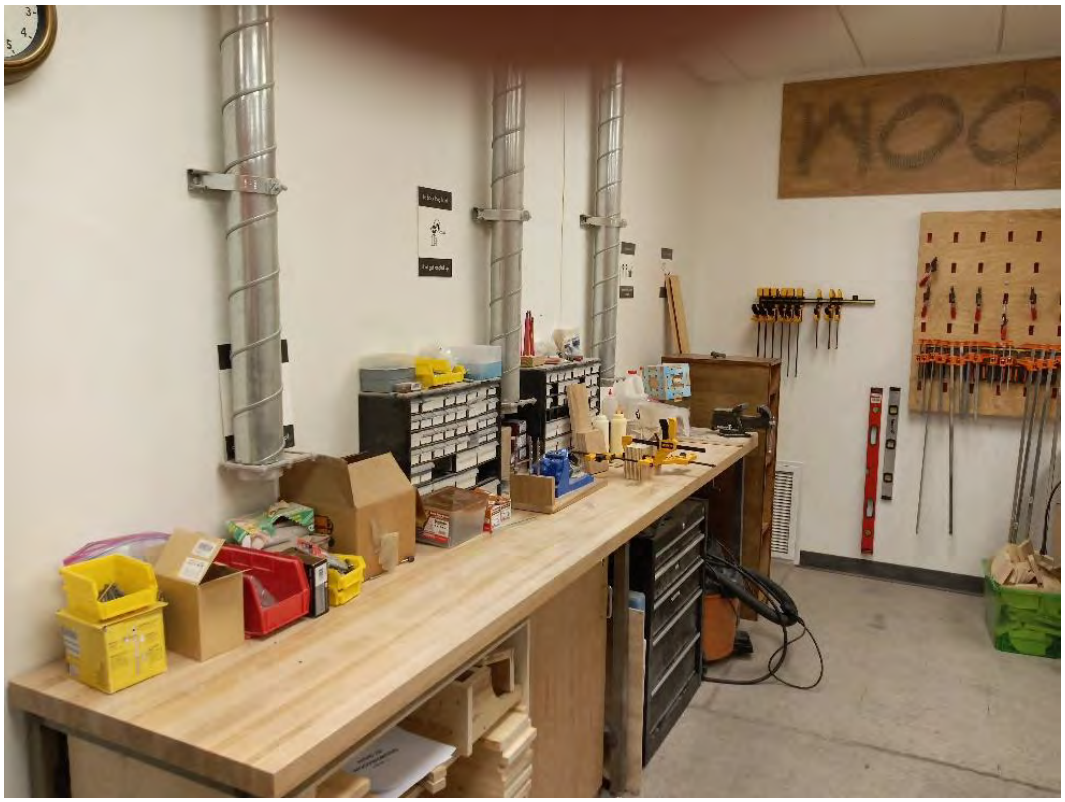


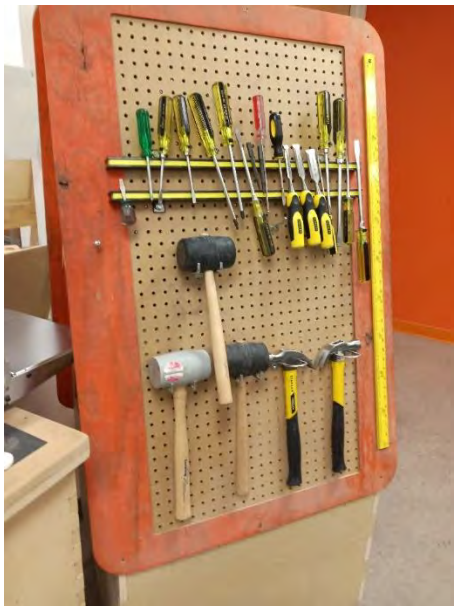
Machinery 2: Makerspace / Arizona Science Center

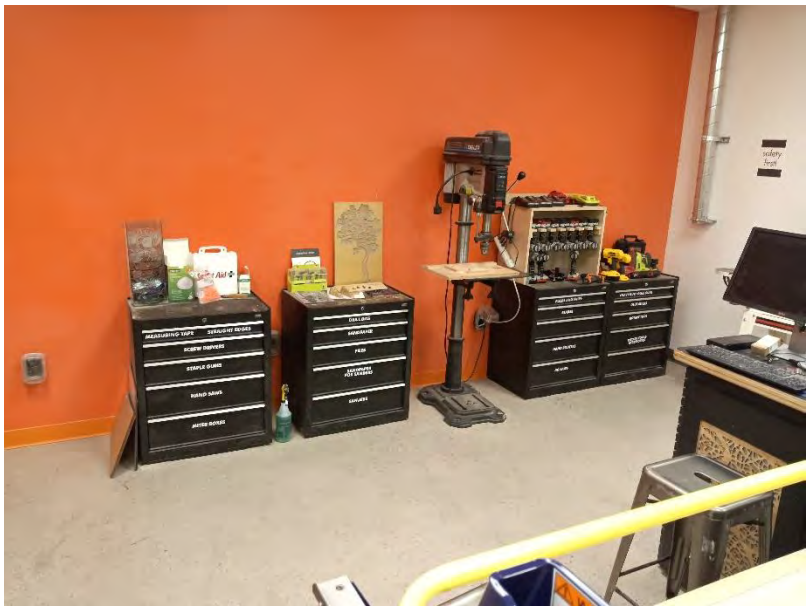
Appendix Ie - Makerspace in Arizona Science Center

Wood Shop (1) in Makerspace / Arizona Science Center

Appendix If - Makerspace in Arizona Science Center







Wood Shop (2) in Makerspace / Arizona Science Center

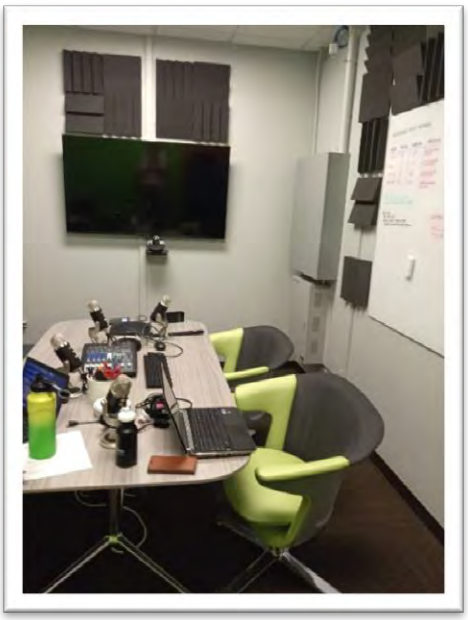
Appendix Ig - Makerspace in Arizona Science Center

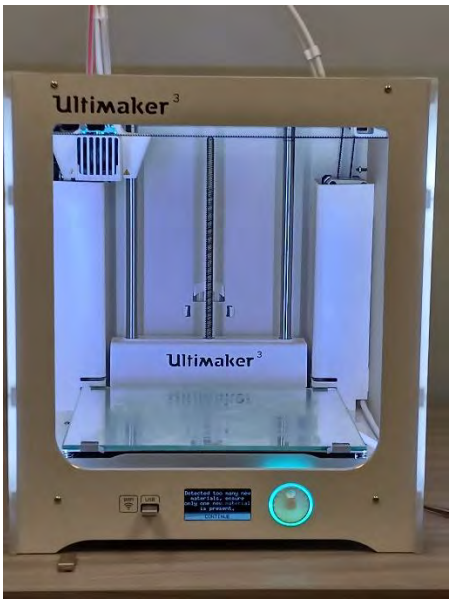
Storage system in Makerspace / Arizona Science Center

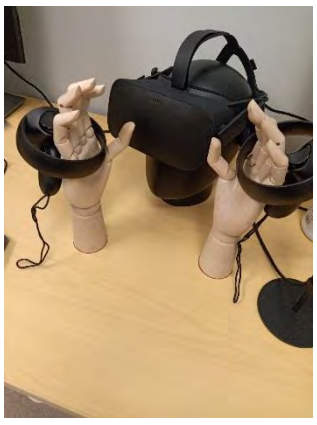
Appendix Ih - Makerspace in Arizona Science Center

Some creations in Makerspace / Arizona Science Center

Appendix K - Makerspace in Arizona State University (Farmer Building)







Different things in Makerspace at ASU