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ABSTRACT

According to the American Association for Advancement of Sciences, the National Academy of Engineering, and the International Technology Education Association (ITEA) and its Technology for All Americans Project (TfAAP), technology education should begin in kindergarten. Educators in Taiwan have also advocated beginning technology education in kindergarten. The National Association for the Education of Young Children (NAEYC) has advocated developmentally appropriate practice in early childhood programs serving children from birth through age 8. National Taiwan Normal University has developed a developmentally appropriate technology education curriculum for use in the kindergarten affiliated with it. The curriculum was developed with consideration for the TfAAP's technological literacy standards and the NAEYC's guidelines for developmentally appropriate practice, as well as to foster children's socioeconomic, physical, and intellectual development. The principles underpinning the curriculum are illustrated by the topics and activities included in a thematic unit on cars. Other thematic units appropriate for a kindergarten-level technology class include light, rainbows, light and water, parks, trees, ponds, sand, human growth, dinosaurs, oceans, and trains. A list of the TfAAP's 20 technological literacy standards with benchmark topics for grades K-2 and the NAEYC's 10 guidelines for a developmentally appropriate curriculum are appended. (Contains 11 references.) (MN)

Running head: KINDERGARTENER'S TECHNOLOGY EDUCATION

Kindergartener's Technology Education in Taiwan

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Paper presented to
the Training Group in Industrial Technology Education, Sponsored by
the Japan International Cooperation Agency (JICA),
Aichi University of Education,
July 16, 2002

Abstract

It is advocated that technology education should begin in kindergarten. Firstly, this paper introduced three vital professional communities' perspectives on kindergartener's technology education and suggested that the 20 technological literacy standards with benchmarks for grades K-2, developed by the Technology for All Americans Project (TfAAP) of International Technology Education Association (ITEA), should be addressed in kindergartens. Secondly, incorporating technology education into kindergarten's thematic units was discussed. Finally, technology education incorporated into thematic units and run in the kindergarten affiliated to the National Taiwan Normal University (NTNU) was introduced. Hopefully, kindergartener's technology education in Taiwan will have a prosperous future because central government has made efforts to expand or encourage the offering of publicly- or privately-managed kindergartens for young children and the new national curriculum for grades 1-9 embraces Living Technology.

Kindergartener's Technology Education in Taiwan

Technology Education Should Begin in Kindergarten: From Three American Professional Communities' Perspectives

Technology education for all aims to foster everyone's technological literacy (TL), being able to use, manage and understand technology. Three vital American professional communities have argued why young children need TL and what they need as follows:

Science Professional Community's Perspective

The American Association for the Advancement of Science (AAAS) founded Project 2061 in 1985 to help all Americans become literate in science, mathematics, and technology. A main publication of Project 2061, "Benchmarks for Science Literacy," says:

> Young children are veteran technology users by the time they enter school. They ride in automobiles, use household utilities, operate wagons and bikes, use garden tools, help with the cooking, operate the television set, and so on. Children are also natural explorers and inventors, and they like to make things. School should give students many opportunities to examine the properties of materials, to use tools, and to design and build things. Activities should focus on problems and needs in and around the school that interest the children and that can be addressed feasibly and safely. (AAAS, 1993)

The AAAS (1993) advocates that the task in kindergarten through grade 2 is to begin to channel the students' inventive energy, to increase their purposeful use of tools, and—in the process—broaden their understanding of what constitutes a tool (a container, paper and pencil, camera, magnifier, etc.). Design and technology (D&T) activities can be used to introduce students to measurement tools and techniques in a natural and meaningful manner. It is expected by the AAAS that by the end of the 2nd grade, students should know that: (1) Tools are used to do things better or more easily and to do some things that could not otherwise be done at all. In technology, tools are used to observe, measure, and make things; and (2) When trying to build something or to get something to work better, it usually helps to follow directions if there are any or to ask someone who has done it before for suggestions.

Engineering Professional Community's Perspective

A new report from the National Academy of Engineering (NAE) and the National Research Council, entitled "Technically Speaking: Why All Americans Need to Know More About Technology," points out that "Boosting technological literacy would have a number of benefits, including helping to ensure that decisions made by citizens, business and government leaders, and others are well-reasoned. In addition, a more technologically savvy population would be better prepared to enter today's high-tech workplace and participate in public debates about technology. More widespread literacy in this area also could help alleviate disparities in Internet access, the so-called "digital divide." The report says, "Learning about technology should begin in kindergarten, and its connection with all subjects should be emphasized throughout a student's education." (NAE, 2002; The National Academies, 2002). This report also suggests that "Schools should ensure that teachers specializing in technology follow standards issued by the International Technology Education Association (ITEA)."

Technology Professional Community's Perspective

The ITEA and its Technology for All Americans Project (TfAAP) have developed and released "Standards for Technological Literacy: Content for the Study of Technology," which focuses on 20 standards that every student in grades K-12 (ages 5-18) should know and be able to do in order to be technologically literate. The standards cover five core areas: the nature of technology, technology and society, design, abilities for a technological world, and the designed world (ITEA, 2002; Gorham, 2001). The ITEA-TfAAP's 20 technological literacy standards with benchmarks topics for grades K-2 are listed in Appendix 1.

Thematic Approach Has Enough Scope to Incorporate Technology Education in Kindergarten

Many young children are not at home anymore. The percentage of children 3-6 years of age enrolled in childcare or kindergarten in each country has increased. As shown in Figure 1, childcare and kindergarten are two legal parallel tracks for preschoolers but only kindergarten is in the formal educational system. Most kindergartens in Taiwan are private while public kindergartens are normally affiliated with elementary schools. Pupils aged 4-6 are admitted for 1-2 years of kindergarten. In school years 1976-2000, the number of kindergarteners as a share of the population increased from 7.3% to 10.9%. The growth rate of kindergarten in Taiwan is shown in Figure 2. In school years 1976-2000, the number of teachers, schools and students increased 540.9%, 404.9%, and 200.3%, respectively.

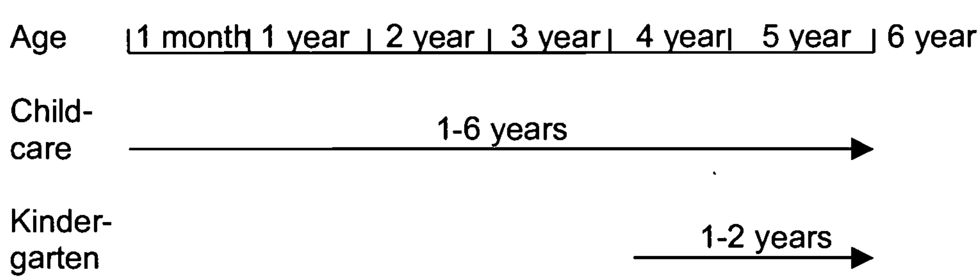

Figure 1. Childcare centers and kindergartens are two parallel tracks for preschoolers in Taiwan.

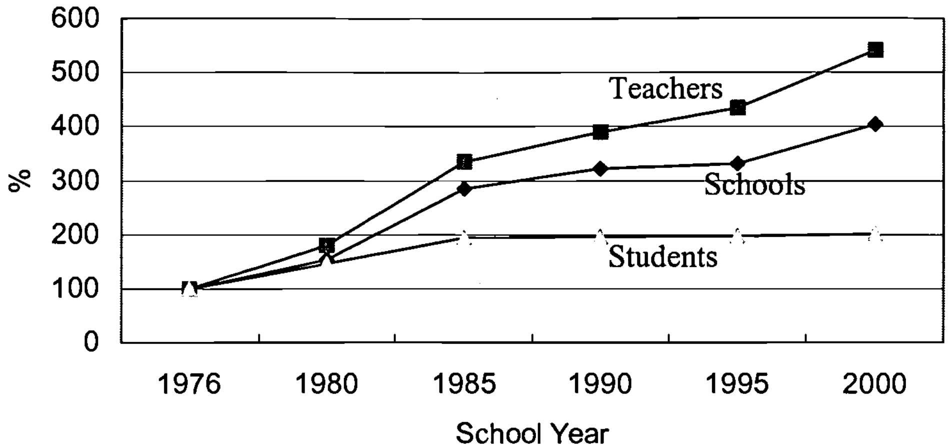

Figure 2. The growth rate of preschool education in Taiwan.
Note: School Year 1976 = 100%.
Source: MOE, 2001, p. 11.

As illustrated in Figure 3, the Kindergarten program advocates development of the whole child--socio-emotionally, physically and intellectually through appropriate curriculum and instruction. Seedfeldt (1989) says, "A good kindergarten curriculum is like a ballet between a sensitive adult and enthusiastic children. Both in control, both respond, and both take cues from one another." (p. 12) The National Association for the Education of Young Children (NAEYC) has advocated the Developmentally Appropriate Practice (DAP) in early childhood programs serving children from birth through age 8 (Bredekamp, 1987). The DAP approach, which addresses two dimensions—age appropriateness and individual appropriateness, is widespread. The ten guidelines for DAP's curriculum are listed in Appendix 2. According to the guidelines, it is apparent that the goals and content of technology education advocated earlier may be infused in DAP's curriculum. Compatible with DAP, thematic teaching and learning is grounded in the notion that children learn best when things make sense. Thematic units are a multifaceted method of planning and a dynamic process which together have a broad enough scope to incorporate many areas of study and essential learnings, including technological literacy (Vardell, 1998).

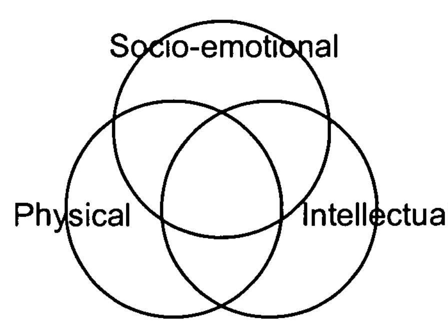

Figure 3. Three aspects of development of a whole-child.

Saskatchewan Education for Kindergarteners (1994) points out the following steps for planning and carrying out a theme:

1. Choose a theme based on what the children are interested in and familiar with in their daily lives.
2. Research the theme topic.
3. Involve students and colleagues in plans.
4. Divide the theme into sub-themes or topics.
5. Determine the learning objectives for kindergarteners.
6. Determine appropriate learning activities and organize them.
7. Plan other instructional approaches, keeping a balance of group and individual, and active and quiet activities.
8. Plan methods of assessing students and self.
9. Gather appropriate resources to support the theme.
10. Plan methods for communicating with and involving parents/caregivers and community members.
11. Create a thematic learning environment.
12. Participate in the theme as a learning facilitator. Demonstrate sincere interest in acquiring new information and ideas.
13. Include some theme-related and some non-theme-related activities in daily plans.
14. Observe students and assess their involvement.
15. Adapt activities to accommodate students' needs, interests and abilities.
16. Evaluate theme effectiveness for the improvement of future planning.

Themes should always begin with and build upon what the children are interested in and familiar with in their daily lives. The duration of a theme should be determined by the enthusiasm of the kindergarteners. Themes normally last from a week to a month. Saskatchewan Education (1994) presents a some-three-week sample theme entitled "Modes of Transportation," which at least comprises the following two objectives tightly related to technological literacy: (1) to participate in activities designed to improve motor skills, and (2) to acquire concepts and information that lead to the attainment of the life skills that are necessary to function independently. The sample theme shows that there are many ways to explore the modes of transportation. Teachers are encouraged to adapt according to the materials available, the community, the needs of the students and their own teaching styles. For example, teachers could introduce the theme by having a bicycle or dog sled in the classroom, by taking an outing to a train station, or by examining a canoe or snowmobile or any other suitable means of transportation (Saskatchewan Education, 1994).

It should be noted that both technology and engineering aim to turn imagination into reality. Both fields have a confluence area. Some kindergartens offer their students "engineering education" to enhance kindergarteners' technological literacy. For example, in the state of Massachusetts, where engineering is part of the curriculum in several schools selected by the state to participate in a pilot program. The program pioneer, Ioannis Miaoulism, who is also an American Society of Mechanical Engineers (ASME) member and the dean of engineering at Tufts University, advocates that engineering education begin at the kindergarten level. He said, "Technological literacy is no luxury — it's now basic." Miaoulis was concerned that since technology education had become somewhat of a backwater in many schools, identified with industrial arts and relegated to a dusty shop somewhere in the basement, his participation was "a great opportunity to shift the field closer to engineering, to focus on learning about technology and about the integration of science and design." (Baumgartner, 2001)

In Taiwan, kindergartens more or less provide their students opportunities to learn technological literacy from thematic units. Kindergarteners not only learn technological literacy from kindergartens, but also from other channels such as family mentoring, technology-related museums, TV programs, toys, etc.

Technology Education in the Kindergarten Affiliated with NTNU

This author received her bachelor's and master's degrees from the Department of Home Economics Education, National Taiwan Normal University (NTNU), which offers early childhood education (ECE) program. There is a kindergarten, founded in 1959 and affiliated with NTNU (afterwards, called NTNU kindergarten), to serve young children and provide the students in ECE program opportunities of practicum. The NTNU kindergarten is a typical kindergarten in Taiwan, so its technology education will be introduced as follows.

Having nine classes, the NTNU kindergarten has adopted thematic approach. Each semester, lasting about 18 weeks, runs 1-2 thematic unit(s), such as light, rainbows, light & water, parks, trees, ponds, sand, human growth, dinosaurs, doll houses, flour, oceans, and trains, which is/are selected from kindergarteners' daily lives. Technological literacy, including appropriate information and communication technology (ICT), is more or less incorporated in every unit. For example, energy, lighting, heating, man-made lights are often the subtopics of the theme Light.

Cars is also a theme often selected. Figure 4 presents a topics/activities mapping of the cars theme, which was experienced by a mixed-age class from March 1 to May 15, 1999.

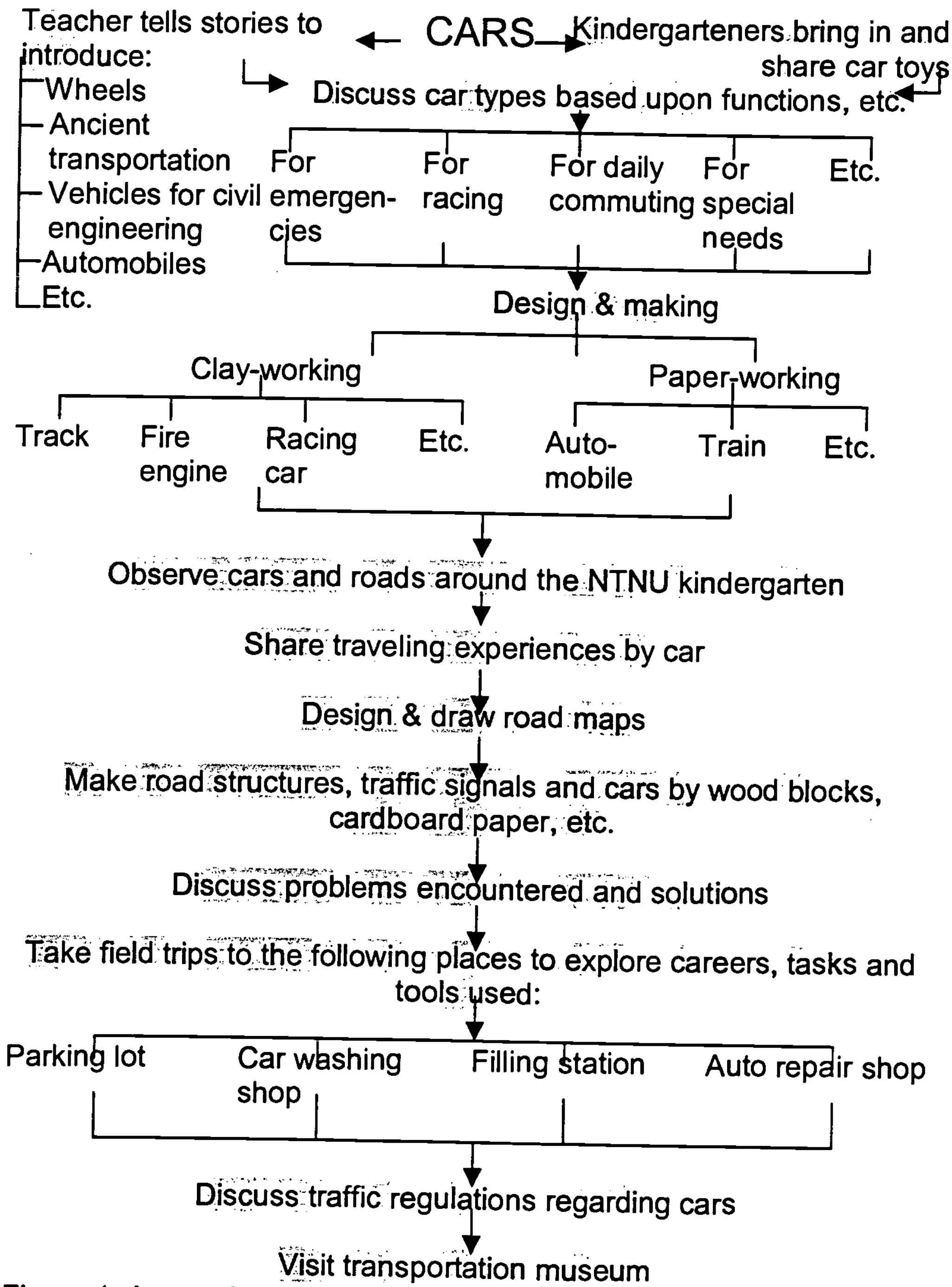

Figure 4. A mapping of theme "Cars".

The compulsory education in Taiwan lasts nine years—grades 1-9. In recent years, Taiwan's government has made efforts to expand or encourage the offering of publicly- or privately-managed kindergartens for young children. It is expected that most preschoolers will receive at least one year of kindergarten before entering elementary schools in the near future. In addition, the new national curriculum for grades 1-9, which took into effect in 2001, explicitly embraces Living Technology. Because almost all public kindergartens are affiliated with elementary schools, it is expected that kindergartener's technology education in Taiwan will have a prosperous future.

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Appendix 1. The ITEA-TfAAP's 20 Technological Literacy Standards with Benchmarks Topics for Grades K-2

Standards	Benchmarks Topics for Grades K-2
1.The Characteristics and Scope of Technology	1.1 Natural world and human-made world 1.2 People and technology
2.The Core Concepts of Technology	2.1 Systems 2.2 Resources 2.3 Processes
3.The Relationships Among Technologies and the Connections Between Technology and Other Fields	3.1 Connections between technology and other subjects
4.The Cultural, Social, Economic, and Political Effects of Technology	4.1 Helpful or Harmful
5.The Effects of Technology on the Environment	5.1 Reuse and/or recycling of materials
6.The Role of Society in the Development and Use of Technology	6.1 Needs and wants of individuals
7.The Influence of Technology on History	7.1 Ways people have lived and worked
8.The Attributes of Design	8.1 Everyone can design 8.2 Design is a creative process
9.Engineering Design	9.1 Engineering design process 9.2 Expressing design ideas to others
10.The Role of Troubleshooting, Research and Development, Invention and Innovation, and Experimentation in Problem Solving	10.1 Asking questions and making observations 10.2 All products need to be maintained
11.Apply the Design process	11.1 Solve problems through design 11.2 Build Something 11.3 Investigate how things are made
12.Use and maintain technological Products and Systems	12.1 Discover how things work 12.2 Use tools correctly and safely 12.3 Recognize and use everyday symbols
13.Assess the Impact of Products and Systems	13.1 Collect information about everyday products 13.2 Determine the qualities of a product

14.Medical Technologies	14.1 Vaccinations 14.2 Medicine 14.3 Products to take care of people and their belongings
15.Agricultural and Related Biotechnologies	15.1 Technologies in agriculture 15.2 Tools and materials for use in ecosystems
16.Energy and Power Technologies	16.1 Energy comes in many forms 16.2 Energy should not be wasted
17.Information and Communication Technologies	17.1 Information 17.2 Communication 17.3 Symbols
18.Transportation Technologies	18.1 Transportation system 18.2 Individuals and goods 18.3 Care of transportation products and systems
19.Manufacturing Technologies	19.1 Manufacturing systems 19.2 Design of products
20.Construction Technologies	20.1 Different types of buildings 20.2 How parts of buildings fit

Source: ITEA, 2000, pp. 211-214.

Appendix 2. The NAEYC's Ten Guidelines for DAP's Curriculum

1. Developmentally appropriate curriculum provides for all areas of a child's development: physical, emotional, social, and cognitive through an integrated approach.
2. Appropriate curriculum planning is based on teachers' observations and recordings of each child's special interests and developmental progress.
3. Curriculum planning emphasizes learning as an interactive process. Teachers prepare the environment for children to learn through active exploration and interaction with adults, other children, and materials.
4. Learning activities and materials should be concrete, real, and relevant to the lives of young children.
5. Programs provide for a wide range of developmental interests and abilities than the chronological age range of the group would suggest. Adults are prepared to meet the needs of children who exhibit unusual interests and skills outside the normal developmental range.
6. Teachers provide a variety of activities and materials: teachers increase the difficulty, complexity, and challenge of an activity as children are involved with it and as children develop understanding and skills.
7. Adults provide opportunities for children to choose from among a variety of activities, materials, and equipment; and time to explore through active involvement. Adults facilitate children's engagement with materials and activities and extend the child's learning by asking questions or making suggestions that stimulate children's thinking.
8. Multicultural and nonsexist experiences, materials, and equipment should be provided for children of all ages.
9. Adults provide a balance of rest and active movement for children throughout the program day.
10. Outdoor experiences should be provided for children of all ages.

Source: Bredekamp, 1987, pp. 3-8.

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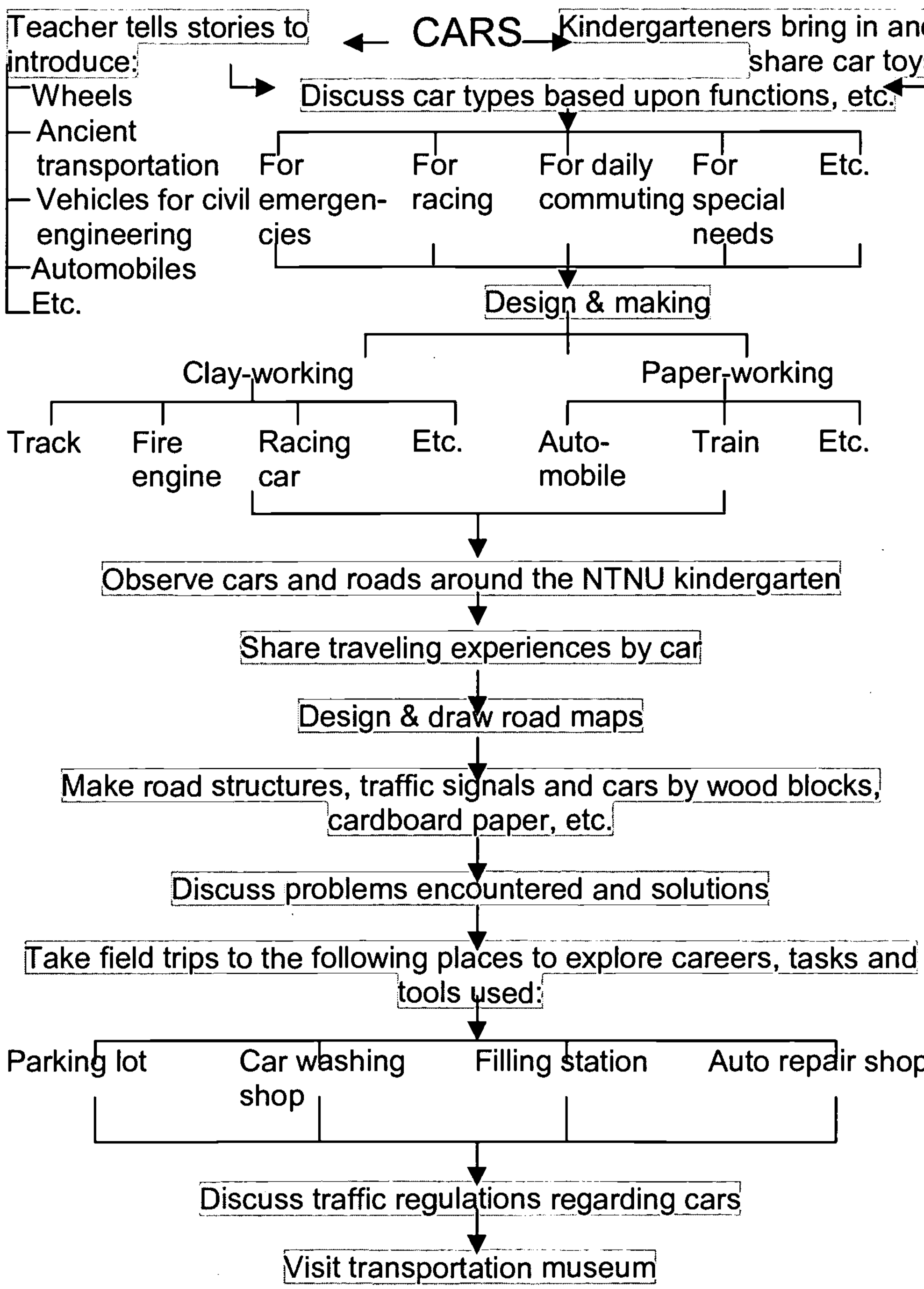

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