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Preschoolers and technology : effects of computer use on the preschool child

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Preschoolers and technology : effects of computer use on the preschool child

Abstract

Computer technology was investigated to examine technology's role in the education of preschool children. A comprehensive review of published literature was performed to determine the effects technology has on the social, cognitive, and emotional development of preschoolers and the guidelines for using computer technology with young children. Computer technology, implemented into preexisting educational activities and curricula, can assist in developing social and cognitive skills in preschool-age children. Computers assist in a child's ability to scaffold information. Appropriate computer software encourages preschoolers to think and act independently. Software that focuses on drill-and-practice skills can be detrimental to the mental growth of young children and inhibit creativity.

**PRESCHOOLERS AND TECHNOLOGY:
EFFECTS OF COMPUTER USE ON THE PRESCHOOL CHILD**

**A Graduate Review
Submitted to the
Division of Educational Technology
Department of Curriculum and Instruction
in Partial Fulfillment
of the Requirements for the Degree
Master of Arts**

UNIVERSITY OF NORTHERN IOWA

by

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Abstract

Computer technology was investigated to examine technology's role in the education of preschool children. A comprehensive review of published literature was performed to determine the effects technology has on the social, cognitive, and emotional development of preschoolers and the guidelines for using computer technology with young children. Computer technology, implemented into pre-existing educational activities and curriculums, can assist in developing social and cognitive skills in preschool-age children. Computers assist in a child's ability to scaffold information. Appropriate computer software encourages preschoolers to think and act independently. Software that focuses on drill-and-practice skills can be detrimental to the mental growth of young children and inhibit creativity.

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Introduction

Technology is an integral part of a preschooler's routine. Preschoolers recognize and use forms of technology as part of their everyday activities. From the television to computers, preschoolers are in contact with what can be termed as an electronic playground. This playground is filled with sights, sounds and experiences that stimulate children in ways that need to be constantly evaluated. Children born after 1990 are now being described as the Clickerati generation (Harel, 1999b). These children have never known a world without computers. Technology has expanded the ways in which a child can learn. Today, preschoolers need to learn the three R's, as well as, "the three X's: eXploring [sic], eXpressing, and eXchanging ideas using digital media" (Harel, 1998, p. 1).

At preschool-age, most children develop the fine motor skills necessary to effectively operate a computer's components. They have a natural curiosity about the world around them and a desire to explore. The computer is a tool with which preschoolers can accomplish this task. Computer technology is becoming increasingly accessible for parents to purchase for their children to use at home. According to the United States Census Bureau's Population Survey, released in October 1997, over forty percent of children between the ages of three and five have a computer in their home. Nearly sixty percent of these children are using those computers (United States Census Bureau, 1997).

Between 1997 and 1998, sales of software for children aged four years or younger increased by almost twelve million dollars (Jabs, 1999). Of the top ten

selling software titles in 1999, four were merchandised for children starting at the age of four (PC Data, Inc., 2000). These sales are being fueled by the existing notion that children may be at a disadvantage if they are not using the computer by the time they begin kindergarten. This, coupled with society's increasing competitiveness, gives parents the idea that purchasing software for their children will give them an educational lead over other children (Elkind, 1987; O'Harrow, 1999).

Parents are deluged with software titles that promise to *Jump Start* or to *Leap Ahead* a child's education. Other software declares to promote learning through entertainment. This packaging of software as "edutainment" can be confusing and intimidating to even the most computer-literate parent. Many parents have not been educated with computers; therefore, they rely upon the manufacturer's product labeling to determine whether the software is appropriate for their child. Parents and teachers are being compelled to examine how to introduce this technology to effectively stimulate children's development.

The effects of technology on preschool children is an area that has not been sufficiently investigated. Empirical research studying the cognitive effects of computers on young children is scarce, while opinions on the subject abound. Most research that does exist contains some serious defects. It is difficult for the research to "distinguish [sic] the technology from other factors such as a child's developmental level, teacher's instructional style, influence of other children and whether the child uses computers at home" (Cuban, 1999, p. 4). Other research available exists from sources that stand to profit from favorable outcomes (Healy, 1998; Schulman, 1999).

This review will examine the following questions: What is the role of computer technology in the education of preschoolers? What effect does technology have on the emotional, social and cognitive development of preschoolers? What learning skills can preschoolers acquire through the use of computer technology? What are the guidelines for the use of computers with preschoolers? What are the guidelines for choosing software that is challenging and interactive for preschoolers?

In researching these questions, information was gathered to examine both sides of this issue. One perspective is that computer use by preschool children may be harmful to their cognitive development. The other viewpoint believes that the computer is a useful tool for the education of young children. Due to the conflicting viewpoints and the evidence of increasing sales of computer programs geared towards preschool children, an analysis of the current information is deemed relevant for examination.

The scope of the review was limited to sources that provided information that specifically pertaining to preschool children. Preschoolers, in the breadth of this review, are defined as children between the ages of three and five years old, who have not yet started attending kindergarten. This age group was selected due to the significant cognitive, emotional, and social developments that occur during this period in a child's growth. The results of this review may be important to parents and educators who want to know the parameters of selecting appropriate uses for computer technology for preschool children.

Methodology

The method enlisted to identify sources was to research books, magazines, newspapers and journal articles. Some of these materials were found on the World Wide Web. On account of the perpetually changing environment of technology, preference was given to sources from the last ten years. Information prior to that time frame did not include some of the newer technologies, such as compact disc software.

The sources were selected because they offered information specifically related to the education of preschool-age children. Research concerning older, school-age children cannot be applied towards the education of a preschool-age child.

Preschoolers have their own unique characteristics and developmental stages. Since most of a preschooler's time is spent in the home environment, preference was focused on information dealing with children and computers at home. Research that dealt with children in a preschool setting was examined for content that could be applied in a home-based situation.

Information was evaluated in regard to its relevance to the questions posed by this review. The information was limited to facts involving computer uses and software. The internet and its effect or other forms of technology, such as digital cameras and writing tablets was not a source of focus of this paper. These areas were not focused, on primarily due to the lack of information and research involving these forms of technology and preschoolers.

Analysis and Discussion

Role of Computer Technology

Computer technology's role in the education of preschoolers is a controversial subject. Debate exists on whether computers should be introduced to young children and if computers are introduced, at what age. A focus of the debate is on the merits of using technology with young children. Some researchers (e.g., Elkind, 1987; Healy, 1998) feel that using computers with preschoolers can affect their physical and mental development. Other researchers argue that computers can enhance learning through a constructivist or constructionist approach (e.g., Haughland & Wright, 1997; Papert, 1996; Wright & Shade, 1994).

In reviewing the literature on technology and young children, educational psychologists appear to be the major opponents to the use of technology with preschoolers. Psychologists question the use of computers with young children on the merits that parents are using computers as a competitive measure. The theory is that if a child uses the computer, the computer will advance their learning skills ahead of other children. These attitudes are then transferred to the child and can be detrimental to their development. "The immature human brain neither needs nor profits from attempts to 'jump start' it" (Healy, 1998, p. 241).

A child does not need to be rushed into learning. At the preschool-age, children have an inborn ability towards cognitive development. Psychologists are also concerned that some parents, whether they realize it or not, affiliate the use of

computers and owning a computer as a status symbol (Elkind, 1987). Owning a computer is equated with wearing designer label clothes.

Psychologists also question whether the computer inhibits the way children relate with other people. Children tend to interact with the computer much in the same way as they interact with others. Children who are introverted and tend to think things through in their head, will immerse themselves in the computer and therefore further isolate themselves from others (Elkind, 1987). Children who spend too much time in front of the computer may develop difficulty in listening and expressing themselves (Healy, 1998).

To counteract the adverse affects of computer use, some researchers recommend that seven years old is soon enough to introduce the computer to children (Healy, 1998). The idea is that introducing the computer too early is more detrimental to a child than introducing it too late. In her research, Healy (1998) suggests that a child needs to understand the cause and effect relationship of the mouse and what happens on the computer screen before he or she begins to use the computer. Before the age of seven, children think in terms of concrete ideas, as children grow they develop more abstract ways of looking at the world around them.

Another claim is that children under the age of seven develop cognitive skills only through the manipulation of materials with their hands (Wright & Shade, 1994). The computer is then viewed as an isolation object that deters from the basic elements of touching and feeling. Papert (1996) argues that the question of what age a child should use computers is a badly formed one. "There can be no answer because a

computer is not a thing with one use” (Papert, 1996, p. 98). The most effective types of computer use allow a child to control the technology rather than the technology controlling the child.

The research available on computers and young children is based primarily on the interpretations of the studies of Swiss psychologist, Jean Piaget. Piaget believed that the “long-range goal of education was autonomy” (Wright & Shade, 1994, p. 14). Depending on how the researchers construe Piaget’s work, determines the direction of their arguments about using computers with young children.

The interpretation of Piaget’s findings suggest that children construct their ideas through the manipulation of concrete materials. Taken literally, this means that a child only develops cognitively when manipulating materials with their hands. Others who interpret Piaget’s work feel that to a child, what is concrete or real to them can vary in nature. Computer representations of objects on a computer screen, for instance, can seem as concrete to them as the actual object itself (Wright & Shade, 1994). The child uses a process of “adaptive thought and action” (Elkind, 1987, p. 91). Children are able to internalize their mental actions and then act upon them in the real world. As Piaget (1976, p. 335) wrote, “...knowledge does not proceed from the subject or from the object, but from the interaction between the two...”

While researchers disagree on computer technology’s role in the education of preschoolers, the fact remains that the technology exists and it is the way in which it is used that will determine its position in early childhood education. Researchers agree that the computer should be viewed as another tool, but one that should be

monitored. Just as teachers must examine how materials, such as books or blocks, are used in their classrooms, computer technology must also be reviewed to determine its appropriateness to the learning situation (Wright & Shade, 1994).

The computer is now a part of everyday life for a preschooler much in the same way the television is. If we ignore the technology, we are dismissing its importance in the scheme of a preschooler's life (Wright & Shade, 1994). By implementing technology into early childhood programs, it reinforces the notion that technological skills are expected and "socially desirable" (Wright & Shade, 1994, p.29). Therefore, in taking into account the various viewpoints, the role of computer technology in a preschooler's education is as a tool to augment real-life (concrete) events and experiences from which a child can build and form learning skills (opportunities).

A computer can enable a preschool child to assimilate a range of visual and auditory experiences. The question that remains is whether these experiences assist in the emotional, social and cognitive development of the child. The remainder of this review will focus on how to implement technology to achieve positive effects on the development of young children.

Effects on Development

The type of computer experiences, rather than the computer itself, influence whether computers will enhance or inhibit development (Haughland & Shade, 1997). Computers can promote the development of physical, social and cognitive skills. For preschoolers, the most effective types of computer software enlist a constructivist

approach to learning. Constructivism is the belief or theory that children learn best by doing. “Children learn best by creating rather than passively absorbing facts” (Woody, 1999).

The theory of constructivism was expanded upon by the work of Papert (1993, 1996). Papert created the term “constructionism”. Constructionism is based on the theory of constructivism, but attaches importance to the product being produced, as well as the mental process involved in producing the product (Papert, 1993).

Constructionism is the idea that the “most learning is produced by the least teaching” (Papert, 1993, p. 139). Instructionism is the idea that learning will be improved if the instruction is improved. Constructionist software enables the computer to have an active rather than a passive use. Active computer use allows a child to distinguish relationships between objects on the computer screen. Constructionism supports concrete ideas and meaning. The computer program stimulates the child’s ability to establish meaning. Most important, in the constructionist view, the child is able to control the technology. By controlling the technology, a child is an active learner not a reactor (Haughland & Shade, 1997; Wright & Shade, 1994).

Constructionism stems from the belief that as a child gains knowledge they will use that knowledge to gain even more knowledge (Papert, 1993). The child constructs ideas in their mind and builds upon them. Technology assists in this process by providing a framework for the child to build upon. A child learns a skill,

develops it, and then builds upon the skill. “If children want to learn something, and have the opportunity to learn it in use, they do so even if the teaching is poor” (Papert, 1993, p. 140). The teacher in this situation plays a minor role in the instruction.

Cognitivist software converts the child into a passive user of the technology. Young children subjected to high levels of instruction lose their sense of autonomy and tend to rely heavily on adults for direction (Elkind, 1987). The child uses the technology without comprehending its implications. Drill and practice software is a member of this type of programmed learning. These types of programs may lead to “shallow processing” (Healy, 1998, p. 143). The computer controls the outcomes rather than the child and can inhibit a child’s creativity. Researchers (Haughland & Wright, 1997) found a 50 percent decline in creativity scores when children used drill and practice software three times a week for one hour per day. Diminishing a child’s creativity places the child at risk for “negative attitudes and failure without reasonable justification” (Elkind, 1987, p. 89).

Another primary benefit of the use of computers by preschoolers is the ability of computers to allow for scaffolding of information. “The scaffolding effect of developmental software helps to make children’s learning possible” (Haughland & Wright, 1997). By scaffolding, children are able to master tasks without having the normal prerequisite skills. A child that is able to recognize letters, but not able to write them, can use the keyboard to select the letters. With interactive stories, children who can not read still have the ability to enjoy the story. This type of

interactive software encourages children to begin associating words to objects.

Scaffolding, when present in computer aided instruction, can increase language-related cognitive skills in preschoolers (Chute & Miksad, 1997).

Learning Skills

Computer use by preschoolers has shown an increase in social skills among preschoolers. Computer programs can promote conversation and creative play (NAEYC, 1996b). Researchers (e.g. NAEYC, 1996b; Jabs, 1999; Wright & Shade, 1994) have found that preschoolers are more likely to engage in conversation when they are at the computer than when they are playing with blocks or coloring. While participating in other classroom activities, such as dramatic play, children who are socially outgoing tend to dominate (Riley, 1993).

In early childhood classrooms, preschoolers approach the use of computers as a social activity (Wright & Shade, 1994). At school and at home, preschoolers will communicate with their peers, siblings and parents over what actions to take. They will share ideas on how to perform tasks on the computer and will instruct each other on how to perform those tasks. In order for the “full effects of constructionist learning to take root” (Harel, 1999a, p.2), the creation process and end result must be shared. Sharing ideas with others integrates learning and opens up dialogue that can also enhance the growth of new ideas. This form of peer teaching enlists preschoolers in developing socioemotional skills (Wright & Shade, 1994).

Technology has the ability to act as a tutor, meeting preschoolers’ individual learning styles and assisting them to think independently (NAEYC, 1996b). The use

of computer technology fosters an environment in which a child can explore objects and ideas that help them make sense out of the world around them (Wright & Shade, 1994). This process involves identifying shapes, colors and how things work together. The computer allows children to explore and discover solutions to problems. Problem-solving abilities have been shown to be enhanced through computer use (NAEYC, 1996b).

Young children can also improve their hand-eye coordination through the use of the computer mouse and keyboard (Jennings, 1999). Movements with the keyboard and mouse must be precise in order to produce desired results.

Technology allows opportunities for parents and children to share experiences (NAEYC, 1996b). If the software can be individualized to meet the variety of children's learning abilities, motivation will be improved (Healy, 1998). Children learn through repetition. The computer allows for skills to be repeated until the desired result occurs without losing patience with the child. This component can aid children with learning disabilities (Jennings, 1999). In a world where technology appears in almost every facet of life, by using computers, preschoolers can gain confidence in their ability to control technology (Jabs, 1999).

Computer Use Guidelines

The computer, like any other learning tool, can be used in ways that are appropriate and in ways that are developmentally inappropriate (NAEYC, 1996b). When the technology is used in ways that are deemed inappropriate, habits may form that interfere with learning (Healy, 1998). In the preschool setting, software should

be integrated into the curriculum. Computers should not replace or disrupt existing program routines (NAEYC, 1996b). At home and at school, activities should occupy computer use that seek to provide meaning and follow-up (Healy, 1998). Real-life experiences assist in providing context to the virtual experiences of the computer.

Children who control their own computer use view their experiences as play. If the child is told what to do, then the action becomes work (Wright & Shade 1994). Children learn best when they are involved in playful exploration (Harel, 1999a). The primary component in choosing to use the computer with preschoolers is to ask what task is to be learned and whether the computer best accomplishes the task.

Introducing technology to preschoolers consists of four roles that the parent or teacher assumes. These four roles are: instructor, coach, model and critic (Davis & Shade, 1994). When introducing computers to young children, the parent or teacher first takes on the role of an instructor. This is the most active phase of involvement. The child at this stage becomes comfortable with the computer and how it works. Parents and teachers should explain how the computer works by teaching the terms of the different parts of the computer and their relationship to each other (Borgh, 1993). Children should learn how to handle the disks and how to start their programs. This stage assists in developing children's "procedural knowledge" (Healy, 1998, p. 139) or children's ability to learn how to do something.

The space where the computer is used needs to be organized to conform to the size of child using it. At home, the computer should be placed in a central location so a parent can see what the child is doing. Placing two chairs by the computer can

assist in making computer use a social experience for the child and parent (Healy, 1998). At school, the computer is best utilized when it is also in a central location rather than in a computer lab. The computer should be where children can converse with each other at the workstation, as well as, with other students who may come to comment on what the children are doing at the computer (Wright & Shade, 1994).

After introducing the basics of the computer, the next stage in the process is as a coach. This approach focuses the instruction on the learner. The child begins to have control of the situation and is able to independently operate the technology. The parent or teacher provides support to the child only when needed. To help develop conceptual knowledge, coaches may stop the software program occasionally to ask what the child is doing and why (Healy, 1998; Pruett, 1999). By stopping and asking questions the child is challenged to explain what he or she is doing.

The important issue is that the child learns the process, as well as the outcome. It is important to reach a goal (outcome), but equally important to understand the way the child achieved the outcome (process). At this stage, the children begin to gain conceptual knowledge when they are able to interpret and explain the reason behind making choices. This helps to reinforce the skills being learned.

These skills allude to the findings of Piaget. A child knows what he wants to do with an object and can do it. If the child is unable accomplish the task, then he can see why immediately (Piaget, 1976). This is the reason why impulsive clicking by the

child should be discouraged (Jennings, 1999). Clicking erratically harms the ability to process the flow of information on the screen.

When acting as a coach, a parent or teacher needs to encourage a child to think visually by having him or her describe what he or she is going to do before he or she does it. For example, if a child is using a paint program, have the child explain what the picture is going to look like before the child draws it (Healy, 1998). In programs like this, try to avoid having the child use clip art images. Clip art discourages original thought and action. "We must make sure that computer use includes the important step of requiring children to 'elaborate' their knowledge - thinking aloud, questioning, communicating ideas or creating some kind of original representation about what they are learning" (Healy, 1998, p. 141).

Children will duplicate their use of computers after their parents and teachers; therefore, another role a parent or teacher assumes is that of a model (Davis & Shade, 1994). Preschoolers realize using the computer is important because people important to them are using the computer (National Education Association Today, 1997). However, unless parents and teachers have the knowledge and ability to use computers, they are not in a position to conceptualize how they can help children learn (Papert, 1996).

Software Guidelines

Before the technology is even introduced, parents and teachers must take on the task of critic. Choosing software that is developmentally appropriate is the key to successfully introducing software to young children. "The effectiveness of

computer learning depends critically on the quality of the software, the amount of time children work with the software and the way in which they use it (Wright & Shade, 1994, p.33).

Haughland and Wright (1997) developed ten criteria to evaluate software.

These ten criteria provide the framework for the following guidelines. The first criterion involves the issue of age-appropriateness. Software should be developmentally in tune with the child's age and abilities. Choosing age-appropriate software assists in deterring anxiety in young children (Healy, 1998). Parents and teachers should preview software at the store or at a friend's home to determine its appropriateness. While a child may be able to give some basis to a software's worth, the fact that the child enjoys the software does not indicate that it is beneficial to them. The edutainment value of software can be misleading. "Saying that a program addresses a particular intelligence is not the same as saying that the program offers an opportunity to enhance that intelligence (Wright & Shade, 1994, p. 10).

The next issue involves the control. Papert (1996) encourages parents and teachers to ask the question: "Is the toy running the child or the child running the toy?" (p. 55). Children should be able to set their own pace to the program and should be able to leave the program when they want. The NAEYC (1996a) further recommends that children should be able to control the level of difficulty, pace and the direction of the software. The level of difficulty should start at the basics and then increase in difficulty as the child's skills increase.

Clear and simple instructions, either verbal or visual, assist in allowing preschoolers to perform tasks independently. Other technical features should be considered such as whether the program can print and save work. The program should function quickly and effectively. It should be non-violent in nature and stress cooperation. Other considerations when examining software include avoiding gender and racial biases. Parents and teachers need to be aware of software that may attempt to sell or endorse a particular product.

Software that motivates by discovery rather than drilling skills is the most beneficial. Discovery encourages exploration and building upon ideas. The software should enable children to extract and understand what they are learning (Healy, 1998). The focus of the activity should reflect the process more than the product. Preschoolers possess natural, in-born motivation. This motivation can be capitalized upon by emphasizing mastery goals rather than software that is reward driven (Healy, 1998). Mastery goals stress to trying a task until it is successfully completed rather than moving on to the next step or phase.

Another criterion of software is whether the software acts as a microworld. A microworld creates a realistic facsimile of an event, such as a circus. The child may not physically be able to go to the circus, but can experience a reasonable facsimile of the event (Jennings, 1999). It is important that the software shows objects in a realistic proportion to each other. For example, the elephants at the circus should appear larger than the tigers. Through software, children can view transformations

that they may not normally be able to see (Haughland & Wright, 1997). The growth of flower is an example of a transformation.

Conclusions and Recommendations

Conclusions

The use of computers by preschool children has sparked a debate that will likely continue as new and even more advanced technologies emerge. The current research available does not provide indisputable support for using computers with preschool-age children. The argument for computer use by preschoolers would be strengthened by more extensive research supporting the theory that computers enhance preschoolers' cognitive development (Chute & Miksad, 1997).

More empirical research is needed studying the cognitive effects of computer technology on the development of preschoolers. Research is also needed to determine whether computer technology actually helps or hinders the development of children at this young age. When children reach preschool age, they are at a critical time in their cognitive development. All methods and tools should be examined for their educational benefits before deciding on whether or not to use computer technology.

Computers and preschoolers is a subject that cannot be ignored in our world of increasing technological advances. Due to the cognitive abilities that develop during the preschool years, the effect of computer use on preschool age children needs to be constantly examined. The use of computers is too diverse to judge its use as primarily appropriate or inappropriate. Careful examination into the types of

software and the amount of time a child spends on the computer needs to be maintained by parents and teachers in order that a child may deem the full benefit of computer technology.

Preschoolers can gain significant cognitive benefit from using computers.

Computers assist in a child's ability to scaffold information. We need to further examine the question of whether the computer can provide a better mode of learning skills than are currently being formed by other methods.

Successful implementation of computer technology depends on asking the following questions: What will the child accomplish by using the technology? How is the technology going to help accomplish the task? Is the computer the best method to accomplish the task? When considering the education of preschoolers, it is important to consider that the "best multimedia, interactive environment is the real world" (Healy, 1998, p. 242). By integrating curriculums and real-life experiences with computer software, preschoolers will receive the positive developmental benefits of using computer technology.

Recommendations

It is the recommendation of this review that the following conditions apply to the use of computer technology and preschoolers:

1. The American Academy of Pediatrics (1998) recommends that time at the computer and television should be limited to an hour per day for preschoolers.

Excessive time spent on the computer may lead to health and attention problems for young children (Healy, 1998).

2. Computer workstations should conform to the size of young children and placed in areas that are in plain view of supervising adults.
3. Placing two chairs at computer workstations will encourage communication between peers and parents.
4. To help build procedural knowledge, teach children how the computer works and how to handle disks.
5. Computers should not be used as a substitute for manipulatives, but rather as a supplement to learning by integrating them into the curriculum and by providing meaningful real-life experiences.
6. To counteract any negative effects of using the computer, special attention needs to be placed on the selection of computer software. Computer software should be chosen that builds upon a child's knowledge by encouraging the child to perform tasks independently.
7. When selecting software, choose software that reflects the child's current state of development, her learning style, and the software's ease of use.
8. The edutainment value of software needs to be diminished in choosing software. The focus should be on the merits and consequences of using the technology, rather than on the entertainment value of the software. While software that entertains may also educate, it should not be the primary consideration when evaluating its effectiveness.

9. Software should be interactive rather than reactive. Drill and practice software, which inhibits a child's creativity, should be used in moderation or not at all with young children.

10. When using computers with preschool children, remember that the learning process involved in using the technology is as developmentally important as the outcome.

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