# Computer Education in Waldorf Schools[1]

*Charles Weems*

When and how should we teach our children about computers, so that they are prepared for the future?

Over the past decade, parents, educators, politicians, and others have been asking this question more frequently, with a growing sense of anxiety and urgency. Organizations such as the National Science Foundation and the Computer Science Teachers Association answer by proposing a program of computer education beginning in kindergarten. Their recommendations are based more on a philosophy that earlier is better, than on research into the effectiveness and developmental appropriateness of teaching computational thinking starting at age five.[2]

Because Waldorf education waits until adolescence to focus on technology,[3] it can seem by comparison to leave children less prepared. But precisely the opposite is true. Success in a time of social upheaval and rapid change depends more on capacities for imagination, creativity, flexibility, artistry, and a love of learning than on early development of abstract, logical, and analytical approaches to thinking or of specific technical skills.

In a world where technology fosters frequent interaction between disparate cultures, people need social and multilingual communication skills. The apparent anonymity of the internet, combined with how it enables governments and corporations to track our activities, demands a strong sense of morality and good judgment. And the passivity that can arise from meeting the world increasingly through a screen must be countered by a passion for real experiences and the courage to take action.

In Waldorf kindergartens, play builds imagination, creativity, and empathy for others. Art, languages, drama, and practical work in the elementary grades develop not only those skills but also moral and aesthetic senses. High school weaves judgment and volition into college or vocational preparation. Waldorf education is already working to prepare children to have the resilience and resourcefulness necessary to prosper in a culture that is growing more intertwined with technology.

Consider instead a question that is rarely asked: What is the harm in introducing computational thinking before adolescence? Education research typically works by testing a new technique on a group of children and measuring for improvement in performance. It is much harder to determine what might have been lost in exchange for this gain.

One obvious loss occurs when new material displaces existing activities. We know children are more flexible for acquiring skills in music, art, movement, and languages prior to adolescence. Diminishing these activities reduces the opportunity to make the most of the pre-adolescent period of development.

Some will argue that learning the use of technology is more important. For example, the Common Core State Standards recommend that handwriting be replaced with keyboarding after first grade. But we do not know the broader effects of reducing the time spent developing those fine motor skills. And what happens when we replace the individuation that a child experiences in creating a personal writing style with the uniformity of always seeing his or her words appear in a standard computer font?

A question even more difficult to assess asks whether training children to think rationally at an early age introduces other deficits to their development. What

---

1 Portions of this article have been previously published by *Renewal*; we are grateful to *Renewal's* editor and to the author for allowing us to publish a combined version of these previous publications.

2 Computational thinking is a problem-solving process that includes (but is not limited to) the following characteristics:

- Formulating problems in a way that enables us to use a computer and other tools to help solve them
- Logically organizing and analyzing data
- Representing data through abstractions such as models and simulations
- Automating solutions through algorithmic thinking (a series of ordered steps)
- Identifying, analyzing, and implementing possible solutions with the goal of achieving the most efficient and effective combination of steps and resources
- Generalizing and transferring this problem-solving process to a wide variety of problems

3 In this article, when the word "technology" is used by itself, it refers to technology in a broad sense, such as cars, TVs, drones, phones, refrigerators, energy production, genetic engineering, etc.; the term "digital technology" is used to refer to computers, tablets, phones, the internet, or anything else that manipulates digitized information.

subtle changes in psychology might result? In the collection of lectures titled *A Modern Art of Education*, Rudolf Steiner offers an example:

> When we train children intellectually before the age of four or five, they take something terrible into life: materialism. The more we raise children intellectually at such an early age, the more we create materialists for later life.[4]

By this, he means that they become less inclined to place a high value on immaterial aspects of life, such as ideals or the human spirit.

Steiner also claims that waiting to introduce intellectual thinking until a later stage of development is actually more effective:

> Although it is necessary, especially today, for people to be completely awake in later life, it is equally necessary to let children live in their gentle dreamy experiences as long as possible ... if you allow the organism to be strengthened without intellectualism, children will move into the necessary intellectualism in the proper way.[5]

Steiner goes on to say that forcing young children to use intellectual thought too soon is like giving them an inner beating. It can engender resistance to taking it up in later studies. No student should arrive in high school with a preformed self-image that "I'm bad in math and science." But that is often what we see resulting from well-intentioned efforts to teach those subjects to young children in an intellectual manner.

Regarding children in ages nine through twelve, Steiner says:

> Nothing is more harmful to children than definitions and sharply contoured ideas, because they lack the quality of growth. ... A child must be given flexible concepts—ideas whose form constantly changes as they mature.[6]

The problem Steiner identifies in teaching elementary age students in terms of facts, data, and set processes is that they learn rigidity in their thinking and come to desire simple answers, rather than gain confidence in working flexibly with living and evolving concepts.

Expressing a view similar to what the well-known pioneer in the field of child development, Jean Piaget (1896–1980), described in his formal operational stage, Steiner says that, "before the age of twelve, children do not understand cause and effect" but that "through coercion," they can be forced to "take it in." He says that the effect of such premature instruction is like "swallowing a stone."[7] Needless to say, computational (algorithmic) thinking is largely based on cause and effect.

Empirical evaluation of the pros and cons of early vs. delayed instruction in computational thinking is nearly impossible. It would require a long-term study on a large population of students with a carefully designed assessment. Parents and teachers do not want to wait the decades such a study would take. There is a sense of crisis that demands immediate action. The easy fix that was opted for is to start requiring computer use in kindergarten, as recommended by the Common Core.

However, Waldorf education has nearly a century of experience with teaching children in a manner that accounts for their development. That's a long-term experiment we can analyze in retrospect. The most recent survey undertaken by the Research Institute for Waldorf Education (RIWE) of Waldorf high school graduates is documented in the survey's report, *Into the World: How Waldorf Graduates Fare After High School,* written by Ilan Safit and Douglas Gerwin (Waldorf Publications, 2020). Although the full pool of graduates surveyed includes graduates from 1990 to 2017, it separately reports statistics related to college for graduates from 2011 to 2017. The survey compared the majors studied in college by Waldorf high school graduates to those reported by the National Association of Independent Schools (NAIS) and found that Waldorf graduates are just as likely to study science and engineering (STEM) subjects as graduates of other independent schools.[8]

In the following table, taken from *Into the World*, we can further compare these findings to the majors for all college graduates in 2011 to 2017 as reported by the National Center for Education Statistics (NCES),[9] where we see that Waldorf and NAIS students go into STEM fields at more than an eleven percent higher rate than the national average. Clearly, a curriculum that delays rigorous, intellectual science education until high school has not deterred graduates from pursuing such careers. Indeed, it seems to have had just the opposite effect.

4 Rudolf Steiner, *A Modern Art of Education* (Great Barrington, MA: SteinerBooks, 2004), 103.

5 Steiner, *A Modern Art of Education*, 131.

6 Steiner, *A Modern Art of Education*, 151.

7 Steiner, *A Modern Art of Education*, 158.

8 Ilan Safit and Douglas Gerwin, *Into the World: How Waldorf Graduates Fare After High School* (Hudson, NY: Waldorf Publications at the Research Institute for Waldorf Education, 2020), 32.

| College Majors 2011 – 2017 | RIWE Report | | NCES |
|---|---|---|---|
| | Waldorf | NAIS | All Graduates |
| Arts and Humanities | 28.0% | 19.2% | 17.8% |
| Social and Behavioral Sciences | 23.5% | 22.6% | 16.5% |
| STEM: Natural Science, Engineering, Math | 22.2% | 23.0% | 18.1% |
| Total Sciences (above two rows) | 45.7% | 45.6% | 34.6% |
| Business and Accounting | 4.6% | 10.3% | 21.3% |
| Health Related | 6.8% | 5.2% | 10.9% |
| Education | 3.3% | 2.3% | 5.1% |
| Other | 8.0% | 14.7% | 10.4% |

My personal experience with teaching computer science in a Waldorf high school since 2002 tells me that our students are more than able to learn binary arithmetic, digital logic, and programming. Although many of these students later major in college subjects other than computer science, a surprising number pick up software and web development skills along the way and are quite fluent with technology. This anecdotal experience is further supported by the RIWE study, which found that 5% of Waldorf graduates are working in computer science related jobs,[9] and compares favorably with the NCES statistic of 3.1% for graduates in general.[10]

Because many Waldorf schools end in eighth grade, however, it is easy to perceive Waldorf education as being opposed to computers. Again, that is far from the truth. Steiner was very insistent that, once children enter adolescence, Waldorf curricula should focus on technology:

> People are surrounded by inventions of the human mind, but have no contact at all with them. It is the beginning of an antisocial life simply to accept inventions of the human mind without at least understanding them in a general way... When children are fourteen or fifteen years of age, we must focus our energy on connecting children with the inventions of the human mind. This helps them understand and find their place in society.[11]

Prior to that age, students should be working on developing their other capacities so they can approach technology from a strong foundation. Steiner explains, "The main thing is to enable young adults to find their place in the world with real confidence in their own powers of discernment. Thus, they will sense their real humanity, because their education has been completely human."[12]

If students enter adolescence with a strong sense of self, they are better prepared to study digital technology objectively. It can then be approached as a tool, like any other, with capabilities and limitations that can be understood. With discernment, it is possible to see through the hyperbole that often surrounds new technologies to grasp the reality of their effects.

Does this mean that children should be kept in a bubble with respect to computer technology until they are teens? Of course not. Waldorf education at all ages must work with the real world, and computers are a significant part of modern reality. High school is merely the stage in which it is most effective to focus directly on what computers are, how they work, why they behave as they do, and their effects on humanity.

9 Safit and Gerwin, *Into the World,* Table 4.12, p. 48.

10 National Center for Education Statistics, 2018 Tables and Figures, Table 322.10: *Bachelor's degrees conferred by postsecondary institutions, by field of study: Selected years, 1970- 71 through 2016-17* (2011 - 2017 subset). Online: https://nces.ed.gov/programs/digest/d18/tables/dt18_322.10.asp (retrieved 2/23/2020).

11 Steiner, *A Modern Art of Education*, 158.

12 Steiner, *A Modern Art of Education*, 190.

In a lecture about children in the first four grades Steiner writes:[13]

> There is no desire on our part to deride technical innovations, but we should be able to keep our eyes open to what they do to us, and we should find ways to compensate for any harmful effects. Such matters are especially important to teachers, because they have to relate education to ordinary life. What we do at school and with children is not the only thing that matters. The most important thing is that school and everything related to education must relate to life in the fullest sense. This implies that those who choose to be educators must be familiar with events in the larger world; they must know and recognize life in its widest context.

Thus, Steiner calls upon elementary school teachers to be completely familiar with the technology of their times. But notice that he doesn't say they must bring technology into the classroom. Later in that same lecture, he says:

> With the change of teeth children enter a new relationship to the world. As the life of their own soul gradually emerges, which they now experience in its own right, they must first meet the world supported through an experience of authority. At this stage, educators represent the larger world, and children have to meet it through the eyes of their teachers.

It is not that the children should be immersed in technology, but that the teachers should be, so they can bring it to the children with appropriate compensation for their stage of development. But what does that mean? Steiner tells us that the teachers must understand the technology of their time so they can give the children the necessary strength of will and moral clarity to work with it in freedom, rather than becoming enslaved or addicted to it.

For the Waldorf movement, then, it is imperative in each era to ensure that teachers are fully cognizant of the challenges that the dominant technologies will present to the children as they grow up. Out of that knowledge, the faculty must reflect on the curriculum and change it as needed so it ensures that children can meet those challenges while remaining fully human. For example, with respect to digital technology, teachers should understand what it is at a fundamental level, the essentials of how it works, why it manifests as it does in our lives, and how it can affect us psychologically and as a society.

In the elementary years, children look to the teacher as an authority who brings the world into the classroom. Many parents also look to the teacher for guidance with respect to computer use. For these reasons, teachers should be as knowledgeable regarding digital technology and social media as they are about other subjects.

Today's children will face modern challenges such as cyberbullying, internet addiction, violations of privacy, online fraud, and many others. Awareness of how personal interactions and experiences of the world are shifting to virtual forms can shape a teacher's efforts to guide social situations and create community.

In the early grades, the choices of fairy tales and fables may shift to offer examples of characters who are faced with moral choices more akin to what arises from online communication, where one's words can take on a life of their own beyond what was intended, and where people may not be who they seem. Recognizing the sensory bias that may arise from using flat screens with a limited color palette that is always luminous, teachers may have to make a conscious decision to incorporate more experiences with sculpture, a richer range of color work, and more encounters with color and form in the world of nature.

Clearly, a curriculum that delays rigorous, intellectual science education until high school has not deterred graduates from pursuing such careers. Indeed, it seems to have had just the opposite effect.

In upper grades, teachers may rethink their choices of class plays to let children explore feelings of isolation, or having lies spread about them in social networks. In the study of modern history, students may research biographies of people who influenced the rise of technology and the moral arcs of these historical figures. Or they may look at social changes that have happened since the development of the internet.

Faculty may also want to explore appropriate ways of introducing technology in the upper grades. For example,

13 Rudolf Steiner, "Children From the Seventh to the Tenth Year," GA 303, S-4708, appears as Chapter 9, in *Soul Economy: Body, Soul, and Spirit in Waldorf Education* (Anthroposophic Press, 2003).

using cell phone cameras to intensively explore the qualities and creation of beautifully composed, artistic images, as an antidote to the egotism of selfies and compulsive posting on social media. Another possibility calls for putting more emphasis on learning to dress a loom to weave an intricate pattern, because it involves the kind of problem solving used in programming. If no programming is taught at the school, a course offering may include a class for programming robots using one of the graphical blocks languages, since the concrete actions of a robot in three-dimension space are more directly relatable to such a program than the screen displays produced by a textual program. Team projects may grow in importance to foster greater collaborative social skills.

These examples should not be taken as recommendations. They are merely meant to illustrate what could result from faculty in the elementary grades taking up the study of technology of our era and working out of an anthroposophical understanding of the human being to develop their work in response. It should be remembered that Steiner was well aware of how technology would shape civilization, and thus the Waldorf curriculum was designed to support children toward freedom in that context. Therefore, much of the study may simply serve to bring existing curricular wisdom into awareness with respect to the modern context, enabling teachers to hold it more appropriately. Waldorf teachers know that it is not the content of a fable, but how the teacher imagines it within, that most deeply affects the second grader. Such study also enables teachers to explain the relevance of the curriculum to parents and visitors.

With respect to younger children, in the same lecture series cited above,[14] Steiner tells us:

> Children take in all that we do, such as the ways that we act or move. They are equally susceptible to our feelings and thoughts. They imitate us, and even if this is not outwardly noticeable, they nevertheless do this by developing tendencies for imitation that, through their organic soul forces, they press down into the physical organism. Therefore, education during these first two and a half years should be confined to the self-education of the adults in charge, who should think, feel, and act in a way that, when perceived by children, will cause them no harm. Fundamentally, the stage of imitation continues until the change of teeth, and thus children will be strongly influenced by their environment later on as well.

Combined with the need for Waldorf teachers to fully embrace the real world, Steiner is implying that young children know how an early childhood teacher feels with respect to the technologies that surround them. A child will take in those feelings at a deep level that has ramifications for later life.

It is thus important for the teacher to be able to stand before the child as an example of a human being who masters technology. That does not mean just being a competent user. Again, the teacher should grasp the underlying nature of the technology to have clarity regarding its effects. Of greater importance, however, is contemplative work that enables the teachers to meet the technology on a daily basis in a manner that actually reinforces their inner humanity.

Waldorf education at all ages must work with the real world, and computers are a significant part of modern reality.

As early childhood teachers know, in kindergarten, children are naturally imitative of the adults around them. They learn fundamental lessons about computers from observing how we interact with them. Children know that adults sometimes need to use cell phones or computers. They should see how we decide when that is appropriate and understand what we use them for.

For example, they might be aware that the kindergarten teacher always turns off her phone before the students arrive because she wants to be wholly attentive to them. But one day, she might say, “Children, I need to keep my phone on because my daughter is about to have a baby, and I don’t want to miss that call.” The children will then understand that the teacher has consciously made this choice for an important reason.

On the other hand, seeing people spending large amounts of time interacting silently with a screen while ignoring others around them tells young children that this is a socially acceptable behavior. Hearing adults express a lack of understanding of technology also makes it seem impossible to grasp. However, if teachers and parents model mastery and understanding of these devices, then children will develop a sense that human beings control the technological devices rather than

14 Rudolf Steiner, "Children Before the Seventh Year," GA 303, S-4706, appears as Chapter 7, in *Soul Economy: Body, Soul, and Spirit in Waldorf Education* (Anthroposophic Press, 2003).

being controlled by them. Helping parents to develop awareness of how they use technology around their young children, and sharing contemplative practices for coping with technology becomes another aspect of the work of the teacher.

When a Waldorf school extends into the high school years, technology education can, of course, be more direct. Even then, it is still essential that elementary and early childhood teachers, and high school teachers in other disciplines, understand how their role in preparing young human beings for life in a technological world was set out by Steiner as an essential aspect of Waldorf education. Teachers should appreciate how there are necessary deeds in this regard, at every stage of development.

There is so much to be done in the preschool, elementary, and middle school years to help children prepare to enter a world of ubiquitous digital technology. Learning computational thinking can wait for the developmental stage in which abstraction and symbolic reasoning come naturally.

Does Waldorf education really need to change? Absolutely. A living form of education must continually evolve. But as Steiner so often indicated, the approach begins with inner work. Teachers owe it to the children to educate themselves about this aspect of the world, take it into their meditative lives, discuss it with colleagues and parents, and then bring it intentionally to their teaching in the context of each developmental stage. For Waldorf education to be relevant to the 21st century in a spiritual sense, we need to work together, help each other to gain the necessary knowledge and find the intuitive insights to guide our work.

Parents can join in this effort by deepening their understanding and reflecting on their own relationships to technology, and by engaging each other and the teachers in conversations about what they hope their children will come to value most as they grow up and become computer users.

Steiner identifies the deeper goal of this education, saying, "The real aim of Waldorf schools is to raise free human beings who can direct their own lives."[15]

The question is not when computer education should happen. It already begins shortly after birth, and will inevitably occur as children encounter the world. The question is how we will shape their education to enable them to work with technology in freedom.

15 Steiner, *A Modern Art of Education*, 191.

**Charles Weems, PhD.** *Charles (Chip) Weems holds a PhD in computer science. He is a founding teacher at Hartsbrook High School, where he has taught earth science, computer science, and photography for 18 years. During that time, he created a developmentally-based, four-year high school computer science curriculum, which was published in* Renewal *and the* Research Bulletin*. He is currently advising multiple schools on its implementation. At the AWSNA national conference, he has given workshops on teaching computer science, overcoming genus in the internet age, and the spirit of photography. He is a member of the Association for Computing Machinery, the Institute of Electrical and Electronics Engineers, the Anthroposophical Society, and the Pedagogical Section. He has co-authored 28 introductory computer science textbooks, has over 40 years of university teaching experience, and is a professor of computer science at U. Mass Amherst, where he also received the University Distinguished Teaching Award.*