Rousseau in the Heritage of Technology Education

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In the June 1762 issue of his literary journal, Melchior Grimm, one of Jean-Jacques Rousseau's former friends, poked fun at Rousseau's interests in a flying machine.

> At the same time, he was busy with a machine with which he intended to learn to fly; he stopped after some attempts which did not succeed; but he was never sufficiently disillusioned with his project to calmly admit it to be fanciful. Thus his friends, with some faith, can expect to see him someday gliding in the air (Tourneux, 1878, pp. 102-103; all translations from the French in this essay are by the author).

Grimm's remarks remained something of a mystery until 1910, when Pierre-Paul Plan published a recently discovered essay by Rousseau on his investigation into human flight (Plan, 1910). Rousseau's machine was mechanical in design. He was influenced by bird-type models and Borelli's seventeenth-century mechanical explanation of the human body. Rousseau summarized the relatively low strength/weight ratio of the human body compared to that of birds and acknowledged this as a major difficulty (Plan, 1910, p. 594). He also compared flying to being suspended under water, a fluid with similar qualities to air.

According to Rousseau, two key problems would have to be resolved: first, finding a body lighter than an equal body of air; and second, once aloft, figuring out how to keep from going further up and how to become heavy enough to descend (Plan, 1910, p. 596). Rousseau's approach to the problem demonstrates a propensity to experiment and to solve technical problems in a rational fashion. In addition, he was sensitive to social attitudes and Grimm's mockery, noting that "it is always the destiny of truth to be mocked" (Plan, 1910, p. 591).

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Rousseau, Industrial Arts, and Technology Education

Jean-Jacques Rousseau (1712-1778) is best known for his ideas on education, religion, politics, and social issues–not for building a flying machine. He is considered one of the most important figures in the history of education, including industrial and practical arts education.[1] But just how does Rousseau fit into the heritage of technology education? Indeed, how is the heritage of technology education different from that of industrial arts education? Why is so little known about Rousseau's flying machine and why was it rarely, if ever, referred to in the history of industrial arts education?

Rousseau's text on a flying machine was not an exposition of his educational ideas but of a systematic approach to solving a complex problem. That problem might fit into certain technology education programs today, but not into traditional industrial arts programs. The problem of flying required experimentation and systematic knowledge, and prompted reflection on the relationships between society and what we now call "technology." This essay shows that Rousseau modeled these interests in a way that would not be incompatible with ideas in technology education today. But first, the work of Rousseau needs to be placed briefly in the context of the history of education.

Rousseau, Education, and Society

In the history of education, Rousseau has usually been viewed as a precursor of human development theory. Sometimes he has also been considered an advocate of non-authoritarian pedagogy, with children selecting and solving problems in a non-directive environment. But Carbone (1985) was critical of this "enduring myth," noting that "there is actually scant justification in the *Emile* for heavy reliance on the desires and interests of students in the establishment of educational ends and means" (p. 408).

Bennett (1926), a very influential American historian of industrial education, emphasized the importance of Rousseau's recognition of the manual arts as a means of mental training and noted his influence on educators such as Basedow, Salzmann, Pestalozzi, and others (pp. 81; 85; 108). But Bennett did not go much beyond a discussion of the mechanical arts and trades in Rousseau's *Emile*.[2] Subsequent writing in the history of industrial arts varied little from Bennett's interpretation.

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[1] There is so much secondary literature on Rousseau that space allows only a few indications here. For example, see L'Aminot (1992) for different interpretations of Rousseau in the twentieth century. L'Aminot estimates about 15,000 books and articles on Rousseau since 1900. Rousseau's (1957) best known work on education was a sort of novel called *Emile*, published in 1762 during the period of his greatest literary productivity. For a broad interpretation of the genesis and writing of *Emile*, see Jimack (1960).

[2] Limiting this discussion to Rousseau's writing on teaching the mechanical arts might have resulted in a focus on *Emile* as did Bennett (1926). But Rousseau turned 50 years old in 1762 when *Emile* was published. Rousseau's interest in the mechanical arts, systematic knowledge, and experimentation long preceded the publication of *Emile* but there is less known about Rousseau's

Rousseau's belief that manipulative and perceptual skills are essential to mental development can still be controversial in education today, though not in technology education. But within technology education, there are unresolved issues related to the ideas of Rousseau. Some of these issues arise in controversies among different philosophies of curricular design. For example, Zuga (1993) acknowledged Rousseau's contribution to human development theories in her discussion of the tension between social efficiency, human development, and social meliorist tendencies in technology education. Rousseau's ideas have indeed been influential for human development theories, but taken as a whole his work does not fit neatly within the boundaries of contemporary categories. [48] To understand this requires some historical context.

Rousseau wrote during the Enlightenment period. [48] All kinds of issues in religion, philosophy, politics, and economics were being reexamined in light of "reason." Education became an especially popular topic following the work of Rousseau. French guilds (including guild education in the arts and crafts) were under intense scrutiny and were abolished during the French Revolution. The demise of the guilds was promoted through liberal economic ideas that favored

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early life. Boyd (1963) noted in 1911 that the "right method of approach to his [Rousseau's] theory of education is not through the *Emile* but through his whole social philosophy" (p. vi). Given the broader scope of technology education and its emphasis on understanding social context, Boyd's interpretative view now seems more appropriate than Bennett's more limited focus on the mechanical arts.

[3] Rousseau's work is often ambiguous and difficult to interpret. Scholars sometimes talk about different Rousseaus, for example, Rousseau before and after 1756 when he left Paris; Rousseau the writer; Rousseau the man; and Rousseau writing about himself. When Rousseau made his radical decision to leave the city life of Paris in 1756 and lead a simple life in the country, he claimed that this type of life also better suited his nature. Still, his departure was also a rejection of many of the aspects of the lifestyle he had experienced in the city, and his friends found this hard to accept. The isolation, his own poor health, and the incredulity of his friends all contributed to the notoriety of this break with high society.

In later life, Rousseau wrote his autobiography, the *Confessions*, in which many comments, dates, or recollections conflict with other historical evidence, such as his vast correspondence, that of his friends and acquaintances, and an important work of self-evaluation called *Rousseau Judge of Jean-Jacques* (Rousseau, 1959, Vol. 1). As a result, some critics claim that Rousseau was constructing a sort of myth of himself, often emphasizing his worst and best sides. Nevertheless, his book *Confessions* is still considered an important source for information about his experiences at a younger age.

[4] For a general overview of eighteenth-century Europe, see Woloch, 1982; for an overview of eighteenth-century French education, see Chartier, Julia, & Compère, 1976; for an overview of early technical education in France, see Artz, 1966; and for an assessment of the limits of Enlightenment reform, see Chisick, 1981. For the most part, classical education was scholastic in orientation and limited to the wealthy. Only a few schools even taught about such things as the "new" natural sciences. The mechanical arts were taught either in the urban regulated craft corporations through apprenticeship or in less regulated conditions in rural areas or small towns. In any case, in France, the mechanical arts were generally taught as vocational training.

freer trade and access to technical knowledge. France was already a world leader in systematic engineering and scientific education in schools, a trend that continued during and after the Revolution.

During the Enlightenment, Diderot (Diderot & d'Alembert, 1751-1772), the French Academy of Sciences, and others published extensive, systematic texts on science and the mechanical arts. These texts were conceptual precursors of modern texts that now serve as systematic knowledge bases for organizing "academic rationalist" and "technical" curriculum designs. Today curriculum designs based on such systematic organization of content are often considered representatives of "social efficiency" theory. But in the context of eighteenth-century France, these early technical texts could be considered "social meliorist" because many authors sought to change or improve existing society. (See Zuga, 1993 for a discussion of social efficiency and social meliorism in technology education.)

Early in his professional life, Rousseau contributed to one of these attempts to systematize knowledge, Diderot's *Encyclopédie*. Later he became an outspoken critic of high society and its arts and sciences to the extent that they contributed to a world of luxury and hypocrisy repulsive to him.[5] But Rousseau recognized that the mechanical arts included the techniques that people used to solve problems of practical importance to their basic well-being. As an advocate of simple living, Rousseau promoted teaching techniques to solve life's basic material problems, to become self-reliant, and to understand the common person.

This essay goes beyond Rousseau's writing on the mechanical arts and represents Rousseau in light of his broader interests as they relate to the heritage of technology education. These interests will be elaborated in the following three sections: (a) experimentation, (b) systematic knowledge, and (c) the relationships among education, mechanical arts, and society.

Rousseau and Experimentation

Jean-Jacques Rousseau was not French; he was a citizen of Geneva, a small independent city on the borders of eastern France and the center of Calvinism. He must have learned to read from his father because he wrote about the two of

[5]Today the term "technology," like the term "mechanical arts" in the eighteenth century, can be used to refer to either the collective technical forces in society or the small, incremental activities in which we as individuals engage in daily to construct or reconstruct our world. This distinction aids understanding of Rousseau's criticism of the arts, sciences, and social progress. The distinction is also important in the history and philosophy of technology today; people often feel a loss of control over technology considered collectively while they feel they have a sense of control over their own daily involvement in technological processes. See Schmidt and Miller (1980) for an essay on Rousseau and technology, where technology is considered primarily as a collective technical and economic force. See Galliani (1989) for a detailed discussion of Rousseau and luxury, a highly controversial subject of the time.

them reading novels left by his mother who died in childbirth (Rousseau, 1926, Vol. 1, pp. 12-13). These years of living and reading with his father came to an abrupt end due to his father's expulsion from Geneva after a brawl with an officer. Jean-Jacques was then supported by his uncle Bernard, an engineer.

For two years Rousseau lived with a cousin at the home of their tutor in a small village; these two years were to be the time of his only formal classical instruction. The young Jean-Jacques was a bit of a problem-solver, however. He enjoyed telling of his experience as a child civil engineer (Rousseau, 1926, Vol. 1, p. 31-35). The tutor, Mr. Lambercier, once planted a walnut tree to shade his terrace; in fun, Jean-Jacques and his cousin planted a willow and then proceeded to construct an underground conduit to water it from the other tree. The aqueduct was successful and Mr. Lambercier discovered and destroyed it, but later the two boys heard him roaring with laughter as he told his wife about the "aqueduct."

Later, he was exposed to drawing and the elements of Euclid during the lessons of his cousin who was being prepared for engineering. According to Jean-Jacques' *Confessions*, he and his cousin made cages, flutes, kites, drums, houses, popguns, crossbows, watches, and puppets (Rousseau, 1926, Vol. 1, p. 36). He remembers damaging his grandfather's tools trying to make imitations of his watches. Although Rousseau's unstructured childhood education is well known, it is sometimes forgotten that he built all kinds of devices which required experimentation and technical skills.

At age 13, his elders settled on his vocation; he would be an engraver, a trade that he did not really mind except for the brutality of his master (Rousseau, 1926, Vol. 1, p. 43). His "act of apprenticeship" (dated 26 April 1725) was to serve under Abel Ducommun, master engraver in Geneva. He served about three years out of his five-year apprenticeship contract; the official acknowledgment of his desertion was dated 30 March 1728 (Rousseau, 1959, Vol. 1, pp. 1209-1211). This was a period of turmoil, leading to his decision to leave Geneva. At age sixteen, Rousseau began his travels after his decision to remain locked out of the Geneva city walls during one of his nocturnal ramblings around the countryside with his friends. For a long time he moved around, at times working in paid positions, for example, as tutor and ambassador's assistant in Venice.

It was probably as a tutor that Rousseau first began to reflect seriously on pedagogy, because he left two brief manuscripts on the subject. They are significant in that they both suggest that some of Rousseau's ideas expressed in *Emile* about 25 years later were already in the process of formation. His emphasis on moral behavior was already present but he also stressed that learning should be amusing and fun. The environment should include "scraps of paper, a little drawing, music, instruments, a prism, a microscope, a magnifying glass, a barometer, a wind machine, a siphon, a fountain of Hero, a magnet, and a thousand other little curiosities" for teaching and learning (Rousseau, l959-1969, Vol. 4, p. 26). He also mentioned the importance of the "arts and crafts" as interesting subjects whereby children learn that people are useful and necessary to each other (Rousseau, 1959-1969, Vol. 4, p. 42).

Rousseau's enduring interest in the natural sciences was reflected in his discussions of experimental science. Already in the mid to late 1730s he became interested in physics and used to visit a professor of physics at Chambéry who performed amusing experiments. Rousseau experimented likewise and almost died from it. He filled a bottle with quicklime, orpiment, and water and sealed it with a stopper. The effervescence started almost immediately and he ran to pull out the stopper. Too late! It blew up in his face like a bomb and he was blind for six weeks afterwards (Rousseau, 1926, Vol 1, pp. 293-294). This adventure contributed to his poor health and was certainly a memorable way of learning about the resistance of materials.

Rousseau and Systematic Knowledge

The eighteenth century was in many ways an age of classifying and ordering knowledge. This process of structuring knowledge, as exemplified in Diderot's (1751-1772) *Encyclopédie*, also contributed to the systematization of the mechanical arts, a sort of "science of techniques" or technology (Pannabecker, 1992, 1994). Soon after Rousseau took up residence in Paris in the early 1740s, he encountered Denis Diderot whose intimate friendship he shared for about 15 years. When Diderot became editor of the *Encyclopédie*, Rousseau agreed to participate in the work and eventually wrote several hundred articles, mostly on music. According to Lough (1984), Rousseau's article on economics (moral and political) has been "the most closely studied political article in the whole of the *Encyclopédie*" (p. 509). (See e.g., Lough [1984] and Kafker & Kafker [1988] for more details on Rousseau's participation in the *Encyclopédie*.)

But in addition to his work with Diderot, there is a thread of systematizing knowledge throughout Rousseau's life. For example, he noted in his *Confessions* that around the age of 25, never having had much formal education, he attempted to organize knowledge with the help of an encyclopedia to facilitate his own education (Rousseau, 1926, Vol. 2, p. 17). In music he was largely self-taught, having acquired a copy of Rameau's *Treatise on Harmony* in the 1730s, a work that he devoured but criticized as long, diffused and poorly organized (Rousseau, 1926, Vol. 1, p. 248). He soon turned to making music, then composing music, and later developed a new system of musical notation that he eventually presented to the French Academy of Sciences in 1742. He labored for many years on his own dictionary of music.

Rousseau's interests in integrating systematic knowledge of the natural sciences and experimentation were particularly well illustrated in his text on a flying machine. There is some uncertainty about when Rousseau wrote this essay, but it may have been in the early 1740s around the time he presented his work on a new system of musical notation.[6] Rousseau also became very interested in chemistry and took some of the famous courses offered by Rouelle in Paris, a well-known chemist of the time (Rousseau, 1926, p. 159). Late in life, he maintained a strong interest in the sciences and in systematic knowledge in his study of the work and classifications of the botanist Linnaeus.

In 1750, Rousseau became famous almost overnight for his prize-winning essay submitted for competition on the topic of whether the arts and sciences had contributed to purify morals. In this systematic treatment of critical questions on the arts, sciences, and society, Rousseau stated that the arts and sciences ("arts" as used here included liberal arts, fine arts, and mechanical arts) had tended to corrupt society, a viewpoint that he acknowledged as contrary to general opinion (Rousseau, 1959-1969, Vol. 3, pp. 5-30). But he did not pretend to have idealistic views of going back in time. This essay marked a decisive point in his life and work–the beginning of a continual and systematic questioning of social issues. This questioning eventually led to his break with urban society in 1756 and the eventual production of the works for which he is most famous.

Rousseau, Education, Mechanical Arts, and Society

In 1762, Rousseau published two books which were immediately controversial: the *Social Contract* and *Emile.* The *Social Contract* challenged the despotic tendencies of the monarchy. *Emile* challenged traditional education and the values of French society of the time. Probably the most important immediate reason that *Emile* stimulated such controversy was its unorthodox treatment of religious faith in the "Confession of Faith of a Savoyard Vicar," not its advocacy of teaching mechanical arts.

Rousseau's questioning of traditional education and his inclusion of the mechanical arts in education were part of his broader critique of society, politics, and economics. Indeed, many critics consider *Emile* to be more of a social critique than an educational treatise. The fact that Emile's tutor required him to learn a trade was an indicator of Rousseau's social criticism and his unconventional approach to education.

[6] Plan (1910, p. 586) placed the date of the text in 1752 although its original publication claimed the manuscript as 1742. Guéhenno (1962, Vol. 1, pp. 126-128), where I first became aware of Rousseau's text on flying, suggested sometime in the 1740s.

Emile was divided into five books: (a) book I covers birth to about age 5 and focuses on early physical growth; (b) book II covers about age 5 to 12 and addresses the development of the child in the physical environment; (c) book III covers about age 12 to 15, early adolescence; (d) book IV covers puberty and later adolescence; and (e) book V covers feminine education.[7]

Rousseau's main discussion of the mechanical arts occurs in about 20 pages in book III. But since technology education is not limited to the mechanical arts, much of the preceding book (book II) on the importance of the physical environment is directly pertinent. Here, Emile's tutor stresses the development of the body, senses, memory, and reason–"a kind of experimental physics" (Rousseau, 1964, p. 128; further citations of *Emile* are from this edition). His emphasis is on developing in the child the means or "instrument" (p. 128) and interest (p. 192) of learning science in a way that the child understands as opposed to simply memorizing. This is why the tutor does not put much stock in books at this early age. For example, the tutor introduces drawing, not so much for the specific skill as to train the eye and the hand (p. 154). The tutor's concluding anecdote to the second book concerns a father, his son, and his tutor strolling in an area where children are flying kites. The father points to the shadow of a kite and asks his son where the kite is. Without hesitating or even looking up, the son responds correctly, thus indicating his awareness of his own position in the external, physical environment. This awareness of the natural world, according to the tutor, is in the natural order of learning and thus precedes the mechanical arts in book III.

Up until this point, the tutor considers Emile's environment to be governed by the law of necessity. At this point, he shifts to a discussion of that which is useful, the central topic of book III. The tutor's most important example for conceptualizing this new environment is Defoe's Robinson Crusoe and his island. Here Crusoe is faced with the critical issues of survival and the problems to be solved in living a simple life. Much of what precedes the discussion of the mechanical arts in book III is devoted to developing this notion of utility and thus justifying a pedagogy that is not based on book-learning but on how to teach what is useful in a relatively simple society. Emile is to construct his world with what is available, like Crusoe. Even if instruments and machines are required for learning, it is better to make them first. For example, in teaching statics, instead of buying scales, he recommends using a stick balanced on the back of a chair to which weights are added (p. 198).

This discussion of a rational method of teaching about the natural world and ways of solving problems to construct Emile's world sets the context for the discussion of the mechanical arts. To understand Rousseau's pedagogy, it is

[7] See L'Aminot (1992) for a review of feminist critiques of Rousseau.

imperative to keep in mind his assumption of a simple life and values consistent with a simple life. In introducing the mechanical arts into Emile's world, the tutor introduces a relatively simple, uncluttered society, similar to that discussed by Rousseau in his *Letter to d'Alembert* (Rousseau, 1927, pp. 222-225). In this famous essay published in 1758, Rousseau had already advocated the mechanical arts as found in a small, self-supporting Swiss village. The craftsmen were highly skilled, but not narrowly specialized as in the large city guilds, and so were capable of applying their general technical knowledge to any problem.

Emile is to practice some of the mechanical arts mainly for social reasons. The tutor's ideal society sets limitations on the selection and practice of the mechanical arts. One of the most important reasons for learning a trade is to conquer social prejudices against the trades and workers (p. 227). The reason for being an apprentice is not so much to learn the craft as to raise Emile and the tutor up to the craftsman's social status, to live as a craftsman, to become as one in the craftsman's family and lifestyle. Teaching the mechanical arts in the context of home and local society was central to moral education, and consistent with Rousseau's view of egalitarian society, at least among men, that runs throughout his major writings.

The tutor's emphasis on a simple lifestyle helps to explain his restrictions on the selection and practice of the mechanical arts. Emile's world is a sort of upside-down world in which social conventions are sometimes reversed. For example, value is not determined according to some mercantilist idea of exchange but by basic usefulness; hence, the tutor's preferred order of respectability for mechanical arts: agriculture, smithing, and carpentry (p. 216). This hierarchy is essentially the opposite of conventional value, which, according to the tutor, "is attached to the different arts in inverse proportion to their real utility." In conventional society, the most useful arts earn the least and are done by "artisans" and the least useful, performed by "artists" to make baubles for the wealthy, are paid the most (p. 213).

Nevertheless, the tutor's reasoning eventually breaks down into some inconsistency because he further restricts the choice of the arts. He distinguishes between arts according to gender, for example, noting that "the needle and sword could not be handled by the same hands" (p. 233). He excludes some of the metalworking arts such as basic ironworking and locksmithing. He also rules out masonry and shoemaking as well as arts that "require little skill and are automatic like weavers, stockingmakers, and stonecutters (p. 235)." Overall, the tutor prefers carpentry because it is clean, useful, and can be done at home. It keeps the body active and requires skill and craftsmanship. One alternative, if the student were really interested in the theoretical sciences, would be to make scientific instruments such as lenses and telescopes.

Turning the world upside-down as Rousseau does requires restructuring of values and concepts. But it is such a complicated task that inconsistencies are inevitable. For example, to base value on social utility in a simple society presents difficulties for the tutor in choosing a trade because many of the most useful are dirty and routine. The tutor's rejection of such trades weakens his emphasis on egalitarianism. Similarly, from a twentieth-century perspective, Rousseau's division according to gender and his relegation of women's education to the fifth book also undermine the emphasis on egalitarianism. But despite these limits, Rousseau set the stage for a tremendous surge of educational reflection in the eighteenth century and integrated the mechanical arts into his pedagogical approach as a means of reconstructing society, values, and social status.

Conclusion

Rousseau did not manage to solve the problem of flying, but the anecdote illustrates his approach to a complex problem. He was curious and more technically inclined than most of his peer philosophers. Faced with the problem of flying, he employed a rational approach to solve it. He analyzed the problem, read technical information, experimented, tinkered, and documented his work. He also became acutely aware of social biases against innovative ideas such as human flight.

Rousseau's life was one long, continuous experimentation in learning. His artisanal boyhood contributed to his learning about things and experimentation, an education that contrasted with that of his intellectual peers. He also embraced structured, systematic knowledge and study but did not reject his artisanal background as inferior. Nor did he reject the kinds of problem-solving activities so critical to constructing and reconstructing the material world. (See Pannabecker, 1991, for historical approaches to the social construction of technology.) But Rousseau did not stop at experimenting and organizing knowledge; he developed his own approach to life, critiqued social values, and promoted change in light of his chosen values.

When studying the heritage of technology education, the historical context needs to be left more open than in the history of industrial arts. For instance, it was probably the craft emphasis in industrial arts that influenced historians like Bennett to focus on the mechanical arts in Rousseau's work. Thus, since Rousseau's best known references to the mechanical arts in education occurred in *Emile*, interpretations of Rousseau's contributions were based primarily on that book. In contrast, Rousseau's importance to technology education can be grasped better by casting a larger net among his writings.

Rousseau's critique of the arts and sciences draws our attention to issues in technology and society. Technology education has made the study of technology

and society part of its agenda. But how technology has been taught in the past also deserves study. Rousseau was not primarily interested in an "objective" view of experimenting, solving problems, or teaching the mechanical arts. Ultimately, his central concern was how to prepare better individuals to construct a better society, not how to teach or learn more effectively, how to solve problems more efficiently, or how to systematize knowledge more completely.

Rousseau became highly critical of materialistic values, social and economic disparities, and the ideology of progress. Beyond and through experimentation, systematic study, and the mechanical arts, Rousseau saw education as a means to change people and thereby reduce prejudices and inequalities among people. Teaching the mechanical arts was a means of bringing together persons of different social classes and to work towards eliminating cultural prejudices.

Teaching technology also has the potential of developing in students a more critical attitude towards issues in technology and society. Parallel to Rousseau's critical reflection, technology teachers and students need to reflect on choices of what technology is taught, how it is taught, and to whom and with whom it is taught. This reflective process will help students to critique the assumptions implicit in technological culture and thereby influence the direction of technology education.

References

Artz, F. B. (1966). *The development of technical education in France 1500-1850*. Cambridge, MA: MIT Press and SHOT.

Bennett, C. A. (1926). *History of manual and industrial education up to 1870*. Peoria, IL: Manual Arts Press.

Boyd, W. (1963). *The educational theory of Jean-Jacques Rousseau*. New York: Russell & Russell.

Carbone, P. F., Jr. (1985). Toward an understanding of Rousseau's educational ambivalence. *Educational Theory, 35*, 399-410.

Chartier, R., Julia, D., & Compère, M.-M. (1976). *L'éducation en France du XVIe au XVIIIe siècle* [Education in France from the 16th to the 18th century]. Paris: Société d' édition d'Enseignement Supérieur.

Chisick, H. (1981). *The limits of reform in the Enlightenment: Attitudes towards the education of the lower classes in eighteenth-century France*. Princeton, NJ: Princeton University Press.

Diderot, D., & d'Alembert, J. (Eds.). (1751-1772). *Encylopédie ou dictionnaire raisonné des sciences, des arts et des métiers* [Encyclopedia or systematic dictionary of the sciences, arts and crafts]. Paris: Briasson, David, Le Breton, Durand.

Galliani, R. (1989). *Rousseau, le luxe and l'idéologie nobiliaire: Etude socio-historique* [Rousseau, luxury and nobiliary ideology: Socio-historical study]. Oxford: Voltaire Foundation.

Guéhenno, J. (1966). *Jean-Jacques Rousseau* (Vols. 1-2) (J. & D. Weightman, Trans.). London: Routledge and Kegan Paul.

Jimack, P. D. (1960). *La genèse et la rédaction de l'Emile de J.-J. Rousseau: Etude sur l'histoire de l'ouvrage jusqu'à sa parution* [The genesis and writing of the *Emile* of J.-J. Rousseau: Study on the history of the work un til its appearance]. Geneva: Institut et Musée Voltaire.

Kafker, F. A., & Kafker, S. L. (1988). *The Encyclopedists as individuals: A biographical dictionary of the authors of the Encyclopédie*. Oxford: Voltaire Foundation.

L'Aminot, T. (1992). *Images de Jean-Jacques Rousseau de 1912 à 1978* [Im ages of Jean-Jacques Rousseau from 1912 to 1978]. Oxford: Voltaire Foun dation.

Lough, J. (1984). The contributors to the *Encyclopédie*. In R. N. Schwab & W. E. Rex, *Inventory of Diderot's Encyclopédie* (pp. 479-564). Oxford: Voltaire Foundation.

Pannabecker, J. R. (1991). Technological impacts and determinism in technology education: Alternate metaphors from social constructivism. *Journal of Technology Education, 3*(1), 43-54.

Pannabecker, J. R. (1992). Printing technology in the *Encyclopédie*: Constructing systematic knowledge. *Journal of Industrial Teacher Education, 29*(4), 73-91.

Pannabecker, J. R. (1994). Diderot, the mechanical arts, and the *Encyclopédie*: In search of the heritage of technology education. *Journal of Technology Eduation*, *6*(1), 45-57.

Plan, P.-P. (1910, October 1). Jean-Jacques Rousseau aviateur [Jean-Jacques Rousseau aviator]. *Mercure de France*, pp. 577-597.

Rousseau, J.-J. (1926). *Les confessions* [Confessions] (Vols. 1-3). Paris: Garnier Frères.

Rousseau, J.-J. (1927). *Du contrat social ou principes du droit politique; Let tre à M. D'Alembert sur les spectacles* [On the social contract or principles of political law; Letter to Mr. D'Alembert on the theater]. Paris: Ernest Flammarion.

Rousseau, J.-J. (1959-1969). *Oeuvres complètes* [Complete works] (Vols. 1-4). Paris: Gallimard (Pléiade).

Rousseau, J.-J. (1964). *Emile ou de l'éducation* [*Emile* or on education]. Paris: Garnier Frères.

Rousseau, J.-J. (1969). *Correspondance complète de Jean Jacques Rousseau* (R. A. Leigh, Ed.). Geneva: Institut et Musée Voltaire.

Schmidt, J., & Miller, J. (1980). Aspects of technology in Marx and Rousseau. In T. De Laurentis, A. Huyssen, & K. Woodward (Eds.), *The technological imagination: Theories and fictions* (pp. 85-94). Madison, WI: Coda.

Tourneux, M. (Ed.). (1878). *Correspondance litéraire, philosophique et critique par Grimm, Diderot, Raynal, Meister, etc*. [Literary, philosophical, and critical correspondence by Grimm, Diderot, Raynal, Meister, etc.] (Vol. 5). Paris: Garnier Frères.

Woloch, I. (1982). *Eighteenth-century Europe: Tradition and progress, 1715-1789*. New York: W. W. Norton.

Zuga, K. F. (1993). A role for alternative curriculum theories in technology education. *Journal of Industrial Teacher Education, 30*(4), 49-67.