Diderot, the Mechanical Arts, and the *Encyclopédie*: In Search of the Heritage of Technology Education

John R. Pannabecker[1]

In a recent symposium on critical issues in technology education, Walter Waetjen (1992) regretted the lack of a history of technology education (pp. 25; 28). This paper contributes to a history of technology education by focusing on one of the most ambitious attempts in early modern history to describe technological knowledge — Diderot's *Encyclopédie* (Diderot & d'Alembert, 1751-1772).[1] In Diderot's time, the idea of representing technological topics was not new, but Diderot's *Encyclopédie* was distinctive in several ways.[2] It was written and illustrated profusely by many contributors, numbering well over one hun-

John Pannabecker is Professor in the Technology Department, McPherson College, McPherson, KS.

[1]Diderot's *Encyclopédie* has stimulated much commentary but there are some critical secondary works. Two of Darnton's works (1979, 1984) orient the reader to the social and publishing context. The compilations of Schwab (e.g., 1984) as part of the Voltaire Foundation series are indispensable for finding one's way around the *Encyclopédie*. Kafker (1981) distinguishes Diderot's approach from the other encyclopedias of the period, such as Johann Heinrich Zedler's much larger, though less illustrated *Universal Lexicon*, Gianfrancesco Pivati's *Nuovo dizionario*, John Harris' *Lexicon technicum*, and Ephraim Chambers' *Cyclopaedia*. More recently, Kafker and Kafker (1988) published an inventory of Diderot's known contributors.

The *Encyclopédie* was published as a subscription series from 1751 to 1772. It appeared at the rate of one letterpress volume per year from 1751 to 1757 when its royal privilege was revoked. The writing continued on a clandestine basis, but Diderot's focus shifted to the plates which were less controversial. The final 10 letterpress volumes bear the date 1765; the plates were published in the 1760s and early 1770s.

An important, though less known, French contemporary work was the extensive government-funded project on the mechanical arts directed by Réaumur of the Académie des Sciences (1761-1789). Indeed, Diderot was accused of plagiarism because he used some of their documents. (Regarding this controversy, see, e.g., Berthier, 1752; Huard, 1952.) But the Académie's work was slower to be published, it was more specialized in scope, it was not part of a larger integrative work of the sciences and liberal arts, and it never achieved the same degree of notoriety. Diderot criticized it indirectly in his article ENCYCLOPÉDIE, Vol. 5, p. 647) for its inaccessibility.

[2]Space does not permit a review of the history of texts on the mechanical arts and classifications of such knowledge prior to the *Encyclopédie*. An extensive bibliography of patristic and classical texts can be found in Whitney (1990), who focused on scholarly interpretations of the mechanical arts in antiquity and the Middle Ages. But Diderot and his contributors were interested in the more practical aspects of describing technological knowledge. It is Diderot's focus on developing a framework for describing and illustrating as many of the mechanical arts as possible that distinguishes Diderot's work. See Pannabecker (1992) for a study of two of Diderot's craftsmen contributors to the *Encyclopédie*.

dred authors for the 17 folio letterpress volumes alone. A large proportion of the approximately 2,900 plates in 11 folio volumes were devoted to technology. The trying circumstances of its publication and political censorship contributed to its notoriety, later editions, and its widespread circulation. It remains one of the most accessible primary sources for the study of technology during the Enlightenment because of later reprints and its detailed illustrations.

The *Encyclopédie* is important in the heritage of technology education because it popularized the major shift from viewing the mechanical arts as embedded in the minds and shops of craftsmen to a systematic written and pictorial representation of the mechanical arts. Well-known cases of systematic teaching in the mechanical arts such as the Russian system of tool instruction have their rationalist roots in representations such as those of the *Encyclopédie*.

Purpose

The main purpose of this paper is to show what Diderot considered critical in systematizing and representing the mechanical arts in two-dimensional form. In so doing, he left an important heritage for our understanding of the development of technology, especially the ways it has been organized and represented for the purposes of dissemination. It is in examining such historical precedents that technology educators today can gain a better understanding of how the historical "packaging" of technology has influenced our own educational "delivery systems."

Some attempt will be made to show parallels between Diderot's concerns, problems, and frustrations and those faced by technology educators today. But the central focus remains Diderot's approach to representing the mechanical arts. Inquiry into the heritage of technology education needs to be conducted with due respect for the historiographical controversy of drawing connections between the past and present. In this respect, even terms can be problematic. For example, the term "technology" was rarely used in the eighteenth century; the term "mechanical arts" encompassed an important part, though not all of what we now call "technology." Thus, the occasional use of "technology" here is intended to bridge the gap for modern readers while retaining respect for the differences of the past.

The first section examines the historical context in which Diderot and his writers produced the *Encyclopédie*. The main section describes Diderot's work and four issues that are pertinent to the heritage of technology education: (a) conceptual framework; (b) systematic method of analysis and description; (c) theory and practice; and (d) technology and society.

Background

In the late 1740s to the 1760s, Denis Diderot (1713-1784) worked tirelessly to conceptualize and represent knowledge collected from craft communities, private and state industry, and existing documents to create a systematic understanding of the mechanical arts. But Diderot also emphasized the integration of the mechanical arts with the liberal arts and sciences. Darnton, a leading historian of French culture, noted that it was the mechanical arts that “constituted the most extensive and original part of the *Encyclopédie* itself” (1984, p. 198).

Historiographical Considerations

Diderot's role in stimulating interest in the mechanical arts is well known among historians of technology (e.g., Gille, 1952; Gillispie, 1958). However, in the United States, the historical awareness of technology education is still heavily influenced by works such as Bennett (1926, 1937) and Martin and Luetkemeyer (1979), which preceded the shift from industrial arts to technology education in the early 1980s. Neither Bennett nor Martin and Luetkemeyer examined Diderot's work.

While Bennett (1926) discussed Joseph Moxon's rationalist treatment of mechanical processes in the late seventeenth century (pp. 51-60), he tended to emphasize human development theories and institutional history. In his second volume, he examined the Russian system of tool instruction, emphasizing its systematic analysis of tool processes (Bennett, 1937, pp. 13-52; Pannabecker, 1986). The result is a shallow view of systematic analyses of the mechanical arts in the seventeenth and eighteenth centuries. It was during this period that Diderot constructed a systematic view of the mechanical arts.

Denis Diderot as Editor and the Publishing Venture

Diderot had grown up around craftsmen and their work because his father was a master cutler, but he did not pursue his father's trade. Diderot acquired a classical education at a school in Langres until he was 15 years old and then high school in Paris for three years (Crocker, 1966). Although his father was well off financially, he did not support his son's interest in philosophy and writing. Hence, the young Diderot was constantly in and out of debt, drifting from job to job until he landed his position as editor of the project that would eventually become the *Encyclopédie*.

It was in the late 1740s that Diderot and Jean d'Alembert, a respected mathematician, were selected as co-editors of the French translation of Chambers' *Cyclopaedia*, *or Universal Dictionary of the Arts and Sciences,* one of the learned compilations of eighteenth-century England. Before long, Diderot and d'Alembert found Chambers' work to be woefully inadequate and they proposed to the publishers a greatly expanded work. (Jean d'Alembert eventually withdrew from his duties, thus leaving the major responsibilities to Diderot.)

By the middle of the eighteenth century, the Parisian private publishing industry had the financial potential and interest in supporting such a large multivolume work. The middle and upper classes were interested in new, controversial ideas and the government was generally tolerant, provided one remained within accepted ideological limits, which Diderot did not. Indeed, the subsequent notoriety of the *Encyclopédie* was due, in part, to many highly controversial articles, especially on religious, political, and economic topics. In the late 1750s, controversy reached such levels that the *Encyclopédie*'s license for publication was revoked until sufficient political protection could be negotiated for its continued publication.

Originally sold by subscription, the *Encyclopédie* went through several editions amounting to around 25,000 copies by 1789 distributed around Europe and other continents (Darnton, 1979, p. 37). One Swiss publisher contacted Benjamin Franklin about a distribution center in America which, however, was never established. Thomas Jefferson promoted its diffusion in America: he bought a Lucca edition for public use for 15,068 pounds of tobacco and a personal copy when serving as American minister to France (Darnton, 1979, p. 318).

Mechanical Arts, Technological Progess, and Economics

The description of the mechanical arts in the *Encyclopédie* was not in itself very controversial. But the public climate towards publishing knowledge about the mechanical arts was ambivalent. Mercantilist ideas still dominated economic thought, holding that the amount of wealth in the world was fixed and each country competed to amass as much bullion as possible, especially through exportation of finished goods. Many persons considered it best to maintain secrecy over knowledge of the mechanical arts, especially the most advanced and those geared to luxury trades.

It was in this climate that Diderot proposed to systematize, describe, and publish knowledge of all the mechanical arts, thus promoting a new ideology of wide and open diffusion of the arts. According to Proust (1967), Diderot had three main goals in regard to technology: (a) to reach a large public; (b) to encourage research at all stages of production; and (c) to publish all the secrets of manufacturing (p. 205).

The *Encyclopédie* contributed to the gradual shift from mercantilist attitudes towards more liberal economic views, of which certain elements of change were already underway. (See, e.g., Meyssonnier, 1989, for a discussion of early liberal economic views.) The idea of economic progress was closely linked to the development of liberal attitudes towards reduced state control of industry and commerce.

Diderot's resources were limited, however, and the *Encyclopédie* often did not present the most advanced technology of the time. Indeed, much of what it described was typical of the late seventeenth and early eighteenth centuries. (For a discussion of this issue, see, e.g., Gille, 1952; Mousnier, 1958; and

Proust, 1967.) Nevertheless, Diderot sought to promote an ideology of progress, undermine craft guild control of knowledge, and encourage technical research, especially in regard to better quality materials, production speed, and better products (ART, Vol. 1, p. 717).[3]

The *Encyclopédie* and the Mechanical Arts

In the early years of the project, Diderot reflected on its development process, for example, in his “Prospectus” in 1750, which articulated the conceptual framework. Later, he reflected on the mechanical arts in ART, an article published in the first volume of text in June 1751 and in ENCYCLOPÉDIE, an article published in the fifth volume of text in November 1755. Diderot struggled with various issues and problems, some of which afflict curriculum development projects in technology education today. Four of these issues are discussed below.

Conceptual Framework: Integrating Knowledge

In the “Preliminary Discourse” to the *Encyclopédie* and the “Prospectus,” d'Alembert and Diderot acknowledged the philosophers who influenced the conceptualization of their project. Of these predecessors, Francis Bacon and John Locke stood out, especially in regard to the mechanical arts. (For a brief introduction in English to the conceptual framework used in the *Encyclopédie*, see Darnton, 1984, pp. 190-213).

Some of Diderot's philosophy of the mechanical arts followed the reasoning of Bacon and Locke, especially on developing a common language and graphic representation that related words to things through pictorial images. Locke had written in 1689 about the importance of a general dictionary of things and words, though he thought it would probably be too time consuming and expensive (Locke, 1952, p. 306). (Such an integrated language has been critical to systematizing technology and education.) But Diderot and d'Alembert went beyond Bacon and Locke by implementing their ideas in a comprehensive work. The three main human faculties, borrowed from Bacon, were memory, reason, and imagination. These three faculties corresponded to the knowledge divisions of history, philosophy, and poetry respectively. Most of the mechanical arts were classified under the human faculty of memory as part of the division of history “Prospectus.”

The sequence of the entries in the *Encyclopédie* followed alphabetical order, but the division of knowledge was usually given in parentheses at the beginning of the article. In addition, cross-references to related topics were often

[3]References to the *Encyclopédie* are the author's translation unless otherwise noted. Articles are cited in capital letters, followed by volume; plates and commentaries are cited according to the volume of the plate. Citations including the “Prospectus” (Vol. 1) are from Diderot and d'Alembert (1751-1772).

given in the text. This system of connecting entries and relating them to the broader system of knowledge was complex and lacked consistency, however, and the alphabetical system dominated organization (Schwab, 1984, p. 15).

Method of Analysis and Description of the Mechanical Arts

The method of describing each mechanical art grew out of Diderot's concept of a science, which he viewed as “a system of rules or facts relative to a certain object” (“Prospectus,” p. xxxvij). In order to organize knowledge of the mechanical arts, Diderot outlined in the “Prospectus” (p. xxxix) a framework which was simple in appearance and presumably applicable to all the mechanical arts.

> Here is the method we have followed for each art and craft. We treated the following questions:
> 1. The materials and the places where they are found, the manner in which they are prepared, their good and bad qualities, the different kinds available, the required processing before and during their utilization.
> 2. The main products that are made with them and how this is done.
> 3. We have supplied the names, descriptions, and diagrams of tools and machines, with their parts when taken apart and assembled; the section of certain molds and other instruments if it is appropriate to know about the interior design, their contours, etc.
> 4. We have explained and represented the workmanship and the principal operations in one or several plates where sometimes only the hands of the craftsman can be seen and sometimes the entire craftsman in action, working at the most important task in his art or trade.
> 5. We have collected and defined in the most accurate way possible the terms that are peculiar to a given art or trade. (Gendzier, 1967, pp. 39-40)

In the letterpress volumes, each craft was described in a major article such as glassmaking, ironworking, or tanning. In addition, important technical terms had separate entries, which were published in alphabetical order. In principle, each major article in the text was complemented by a series of illustrations (copperplate etchings) and a commentary in the volumes of plates. (See Figure 1.) Ideally, the article was to refer to the objects depicted in the plates by a system of code numbers and letters, thus integrating texts and images; however, there was considerable variation among contributors in their use of this method.

The first plate for each craft usually depicted an overview of the shop or a part of the shop. Subsequent plates presented greater detail. Diderot emphasized the representation of machines, moving from the simple to the complex, sometimes going from knowledge of the workmanship to that of the

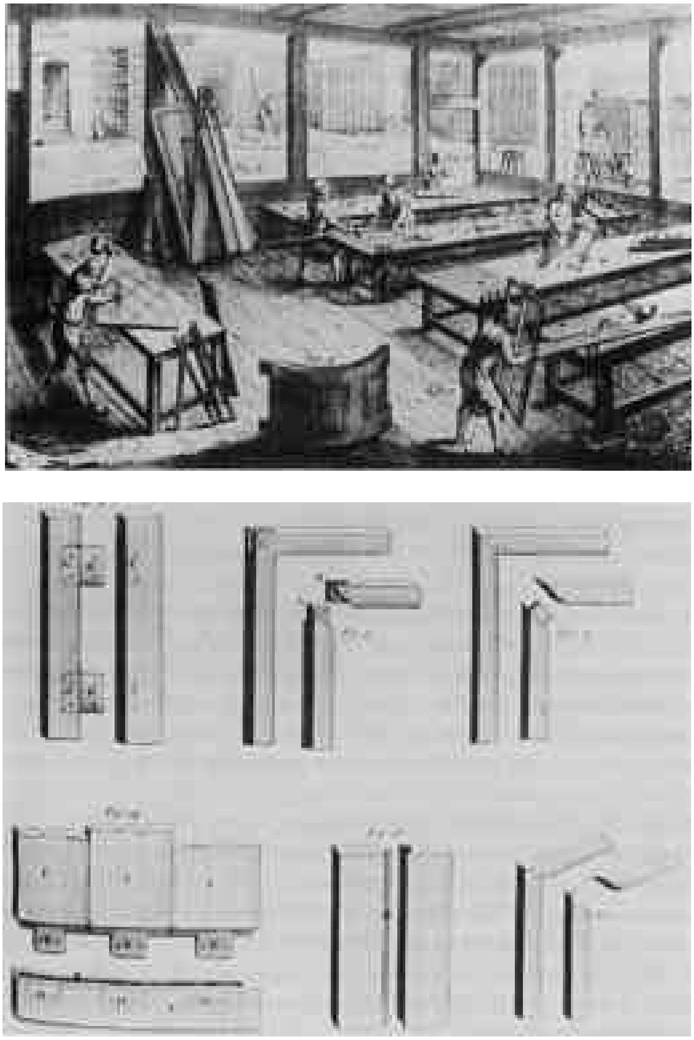

Figure 1. This plate (45% reduction) is the second in a series of 38 plates on joinery in construction. It shows various operations such as sawing and drilling. Note the detailed wood joints illustrated in the lower portion of the plate. The plate was designed by Lucotte and executed by Defehrt (Menuisier en Batimens, Vol. 7). (Courtesy Special Collections Department, Kansas State University Libraries, Manhattan, KS)

machine and other times from knowledge of the machine to that of the work itself ("Prospectus," p. xl).

A superficial reading of Diderot's system and exposure to the plates suggest an impressive coverage of the mechanical arts. He proposes to discuss the materials and their initial processing, major products, detailed analysis of tools and machines, workmanship of the craftsmen, and terminology. This system is not unlike that used by contemporary texts in the twentieth century and indeed still impresses contemporary readers.

Yet every method of representation has its own emphases and limitations. In Diderot's method, for example, four out of the five points were impersonal; only the fourth point (workmanship of the craftsmen) even mentioned craftsmen. Thus, Diderot's emphasis was on physical objects and processes, which would now be considered a fairly low level understanding of the mechanical arts or technology. Higher levels such as intuitive knowledge, experimentation, perceptual skills, problem-solving, or the analysis of conflicting or alternate technical approaches were scarcely recognized in Diderot's system. Yet as he began to apply his system to the various mechanical arts, he came face to face with the complexities of theory and practice.

Theory and Practice

The dualism of theory (or "speculation" as Diderot called it) and practice was a recurrent theme in Diderot's writing. But this theme was complicated by the fact that Diderot's interests operated at two levels: (a) the level of representing the arts in language and drawings and (b) the level of the arts themselves. The constraints of Diderot's role as editor reinforced his preoccupation with representing the arts, but he still maintained an interest in the practice of the arts.

For example, he had no illusions about people becoming craftsmen simply by reading books. "It is handicraft which makes the artist, and it is not in Books that one can learn to manipulate" ("Prospectus," p. xl). This concern helps to understand his critique of Chambers who "read books but he hardly ever saw artists; however, there are many things that one learns only in the shops" (p. xxxv). Diderot claimed that he and his contributors visited the shops, questioned the artisans and took dictations from them, developed their thoughts, and organized terms and facts into tables (p. xxxix). (See Proust, 1967, however, for a realistic evaluation of the extent to which Diderot immersed himself in the shops, which was probably quite minimal, pp. 192-195).

Apparently as a result of these visits, Diderot concluded that "most of those who perform the mechanical Arts have taken them up by necessity, & work only by instinct. We can hardly find one dozen out of a thousand capable of explaining clearly the instruments they use and the products they make" ("Prospectus," p. xxxix). His experiences led him to express his editorial role as "the painful and delicate function of helping to give birth to their minds [or spirits], obstetrix animorum" ("Prospectus," p. xxxix).

Thus Diderot sought to find exceptional people who could both understand thoroughly each art and describe it. According to him, one writer did not seem to know enough about his subject matter; another only grazed the surface, treating the material more as a man of letters than as an artisan; and a third produced a richer text which was more the work of an artisan, but which was too short, with little detail on machines and operations ("Prospectus," p. xxxix). But he also acknowledged that space limitations imposed by his publication necessitated limiting the extent of detail ("Prospectus," p. xl).

In 1751, Diderot explicitly took up the matter of theory and practice in his article ART. He recognized the interdependence of speculation and practice but considered speculation to be the "inoperative knowledge of the rules of the Art" and its practice to be "only the habitual and non-reflective usage of the same rules" (ART, Vol. 1, p. 714). Thus Diderot tended to neglect the complexity of reflective practice so crucial to experimentation, problem-solving, and development, even though he explicitly promoted research and development.

Indeed, Diderot's craft was writing, not practicing one of the mechanical arts, and his work reflects this preoccupation. His "method" was primarily a theory of representation. But sometimes in the practice of writing and illustrating, Diderot's contributors strayed from his method, sometimes describing their art in greater depth than his method demanded. For example, Pannabecker (1992) has shown how Brullé, a printing shop foreman and contributor of the article on letterpress printing, went farther than Diderot's method of representation by attempting to describe some aspects of intuitive knowledge, alternate practices, and technical problems.

Diderot also compared the representation of the mechanical arts to the reporting of scientific work by scientists. In his article ENCYCLOPÉDIE, he noted that scientists wrote and argued about their work, thus promoting its advancement (Vol. 5, p. 647). Artisans, according to Diderot, lived in isolation and obscurity. Systematizing and writing about the mechanical arts would bring to light their hidden ideas, thus providing an account of experience for theoretical reflection.

Diderot, like technology educators today, struggled with the melding of theory and practice. While it may be easy to criticize him in retrospect for the limitations of his descriptive method, his preoccupation with representation, or his views of theory and practice, he did help bring to light both theoretical and practical considerations that would become crucial to disseminating knowledge of the mechanical arts in written and graphic form.

Technology and Society: Reconstructing Society

Diderot wanted to change society because he thought that the distinction between the liberal and mechanical arts, though well-founded, had produced a “bad effect in degrading very respectable and useful people” and neglecting the careful study of the mechanical arts (ART, Vol. 1, p. 714). From this position he sought to rebalance the relationship of the mechanical arts in society, a recurrent theme also found in the “Prospectus” and in the article ENCYCLOPÉDIE (Vol. 5).

His method for promoting social change was through language, pictorial images, and the structuring of knowledge. Written and pictorial knowledge of the mechanical arts was not widely accessible in a single work and most of the mechanical arts were taught in the context of shops. Diderot's project departed from this status quo and popularized the notion that the mechanical arts could be represented as separable from people. This notion would become pivotal for education because the knowledge became less of a secret and more transmittable in other contexts, such as books and schools.

Diderot, through language and alphabetizing all areas of knowledge, thus contributed to a new ordering of society in which the literate would have greater access to some knowledge of the mechanical arts. Koepp (1986), for example, has taken this argument to the extreme, concluding that the *Encyclopédie* was a “subtle and comprehensive expropriation” of nonliterate knowledge and power from workers by the literate culture (p. 257). This is only partially true, however, since the knowledge that they gained access to was limited to what the writers managed to represent. The deeper layers of intuition, perceptual discernment, manipulative skills, and heuristics were, at best, only partially represented in the *Encyclopédie*.

This limited representation of the mechanical arts was due in part to the fact that many of Diderot's writers were not specialized in the craft that they were describing. For example, his chief assistant Louis-Jacques Goussier designed many of the plates and seemed to either share or accept Diderot's emphasis on the physical or non-human elements of the mechanical arts. Yet, Diderot expressed his frustrations at trying to enter the deeper layers of technical culture. In 1755, he criticized artisans who suspected any curious person who asked them questions of being a tax collector or worker wanting to set up a competing shop (ENCYCLOPÉDIE, Vol. 5, p. 647). For Diderot, the artisans were at times so impenetrable that he suggested that the fastest way of learning would be to enter into apprenticeship or send a secret representative. But he recognized that some groups with higher status such as academicians also preferred to keep this knowledge secret, in order to maintain the nation's economic advantage (ENCYCLOPÉDIE, p. 647). Despite Diderot's awareness of the complexity of the social attitudes of different groups towards his work on the arts, it is the rational, technical emphasis that dominates his legacy of the mechanical arts.

Conclusion

Through the *Encyclopédie,* Diderot attempted to disseminate specialized knowledge in the mechanical arts organized by his own rational method. Furthermore, he included this knowledge in his “general system of human knowledge” (ENCYCLOPÉDIE, Vol. 5, p. 643A), but he did not achieve an integrated view of the mechanical arts and society. His legacy, which has influenced subsequent representations of technology, is a challenge for technology educators as they seek to teach the integration of technology and society while avoiding such a single-model ideology.

Paradoxically, Diderot sought to improve the status of artisans and the mechanical arts by exposing their work and knowledge, but his unified system of representation neglected the social aspects of their culture and some of the most complex forms of knowledge in the arts. The neglect of the social aspects of the arts is heightened by the dominance of the plates, which constituted a spectacular part of his rational method. In addition, viewers have typically neglected the accompanying descriptions and related articles in the letterpress volumes. This superficial exposure has, in a sense, reinforced Diderot's emphasis on what can be most easily represented: materials, products, machines, and operations.

Diderot's method obscured aspects of the arts or technology that are difficult to articulate, analyze, or draw: technical problems, intuition, design failures, experimentation, and human curiosity and creativity, all of which are critical for invention and innovation. Although Diderot claimed to be interested in invention and innovation, his burdensome duties as editor left him little time to pursue such matters. Instead, he established a method connecting language, concepts, and objects for the purposes of communication and dissemination.

Yet Diderot also left a record of his own curiosity and a convincing statement of the importance and complexity of the arts. He reminded readers that “Bacon regarded the history of the mechanical Arts as the most important branch of true Philosophy” (ART, Vol. 1, p. 714). Diderot also recognized the importance of integrating scientific knowledge with the mechanical arts. In his role as editor, he noted the necessity of a strong background in natural history, mineralogy, mechanics, rational and experimental physics, and chemistry in order to understand the arts. In establishing a systematic method of representing the mechanical arts, organizing contributors to utilize his method, and relating the arts to other forms of knowledge, Diderot left an enduring legacy for the heritage of technology education.

References

Académie des Sciences. (1761-1789). *Descriptions des arts et métiers* [Descriptions of the arts and crafts]. Paris: Desaint & Saillant.

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

Bennett, C. A. (1937). *History of manual and industrial education 1870-1917*. Peoria, IL: Manual Arts.

Berthier, G.-F. (1752, February). *"L'Encyclopédie"* ou dictionnaire raisonné des sciences, des arts et des métiers [The "*Encyclopedia*" or systematic dictionary of the sciences, arts and crafts]. *Journal de Trévoux,* 296-322.

Crocker, L. G. (1966). *Diderot: The embattled philosopher*. New York: Free Press.

Darnton, R. (1979). *The business of enlightenment: A publishing history of the Encyclopédie, 1775-1800*. Cambridge, MA: Belknap-Harvard University Press.

Darnton, R. (1984). *The great cat massacre and other episodes in French cultural history*. New York: Vintage.

Diderot, D., & d'Alembert, J. (Eds.). (1751-1772). *Encyclopédie 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.

Gendzier, S. J. (Ed.). (1967). *Denis Diderot's "The Encyclopédie": Selections* (S. J. Gendzier, Trans.). New York: Harper and Row.

Gille, B. (1952). *"L'Encyclopédie,"* dictionnaire technique ["The *Encyclopedia,*" technical dictionary]. In S. Delorme & R. Taton (Eds.), *"L'Encyclopédie" et le progrès des sciences et des techniques* (pp. 185-214). Paris: Presses Universitaires de France.

Gillispie, C. C. (Ed.). (1958). *A Diderot pictorial encyclopedia of trades and industry*. New York: Dover.

Huard, G. (1952). Les planches de "*l'Encyclopédie*" et celles de la "Description des Arts et Métiers" de l'Académie des Sciences [The plates of the "*Encyclopédie*" and those of the "Description of the Arts and Crafts" of the Academy of Sciences]. In S. Delorme & R. Taton (Eds.), *"L'Encyclopédie" et le progrès des sciences et des techniques* (pp. 35-46). Paris: Presses Universitaires de France.

Kafker, F. A. (Ed.). (1981). *Notable encyclopedias of the seventeenth and eighteenth centuries: Nine predecessors of the Encyclopédie*. Oxford: The Voltaire Foundation.

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

Koepp, C. J. (1986). The alphabetical order: Work in Diderot's *Encyclopédie*. In S. L. Kaplan & C. J. Koepp (Eds.), *Work in France: Representations, meaning, organization, and practice* (pp. 229-257). Ithaca, NY: Cornell University Press.

Locke, J. (1952). An inquiry concerning human understanding. In R. M. Hutchins (Ed.), *Great books of the western world: Locke, Berkeley, Hume* (pp. 83-395). Chicago: Encyclopedia Britannica.

Martin, G. E., & Luetkemeyer, J. F. (1979). The movements that led to contemporary industrial arts education. In G. E. Martin (Ed.), *Industrial arts education: Retrospect, prospect* (pp. 18-42). Bloomington, IL: McKnight.

Meyssonnier, S. (1989). *La balance et l'horloge: La génèse de la pensée liberale en France au XVIIIe siècle* [The scales and the clock: The genesis of liberal thought in France in the 18th century]. Paris: Les Editions de la Passion.

Mousnier, R. (1958). *Progrès scientifique et technique au XVIIIe siècle* [Scientific and technical progress in the eighteenth century]. Paris: Plon.

Pannabecker, J. R. (1986). Industrial education and the Russian system: A study in economic, social, and technical change. *Journal of Industrial Teacher Education*, *24*(1), 19-31.

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

Proust, J. (1967). *Diderot et "L'Encyclopédie"* [Diderot and the Encyclopedia]. Paris: Colin.

Schwab, R. N. (1984). *Inventory of Diderot's Encyclopédie*. Oxford: The Voltaire Foundation.

Waetjen, W. B. (1992). Shaping the future of a profession. In *Critical issues in technology education* (pp. 25-30). Reston, VA: International Technology Education Association.

Whitney, E. (1990). *Paradise restored: The mechanical arts from antiquity through the thirteenth century*. Philadelphia: The American Philosophical Society.