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The Formation of Scientists and Christian Formation

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This article extends science and faith integration to the process of becoming a scientist and Christian formation or discipleship. A scientist who is a Christian belongs to two communities—faith and science—both grounded in tradition, training, communal understanding, and discovery. To explore the parallels between these two processes, we draw on Étienne Wenger's theory of learning as expressed in his Communities of Practice. *Embedded in an Aristotelian perspective, Wenger's theory aligns with the work of Alasdair MacIntyre and emphasizes practice, community, and tradition, over against propositions. Intentionally mentored undergraduate research, for example, in a Christian context, is a practice that intentionally brings students into both the tradition of science and the Christian tradition. Such programs can become more effective through drawing on the recent work on Christian formation which, in turn, builds on Wenger's theory of learning.*

Keywords: Christian formation, Étienne Wenger, communities of practice, Alasdair MacIntyre, undergraduate research, Lesslie Newbigin

Lesslie Newbigin argued that parallels exist between theological understanding and scientific methods. This article extends the exploration of science and faith to deepen understanding of how the process of science and becoming a scientist might resemble the process of Christian discipleship—that lifelong process of aligning one's life, values, and behavior toward Christ and ministry to the world.

Becoming a scientist is part of a vocational journey for individuals. Likewise, the Christian community often draws on vocational language in reference to the journey of faith. Both processes of transformation include growth in discernment and in the application of information in that growth toward mature understanding.[1] The process of science, in particular, involves the general process of identifying a significant research question that arises out of previous scientific research in a field, the use of the particular methods of a scientific field, the application of standards for evidence in a discipline, and the process of peer review and sharing of results. The specifics may range from one scientific discipline to another, yet each area of science exists within a community that has established standards for itself within this overarching framework.[2]

Scholars such as Tyler Scott found connections between such an understanding of science and faith. He found that students with orthodox views of God who had a deeper understanding of the nature of science were more likely to score higher on complementarism or concordism paradigms in science-theology understanding.[3] However, scholars have done little research on the parallels between

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the methods of science and Christian formation itself. Sir John Templeton, for example, attempted to connect the process of science with theological reflection. He saw scientists as role models for theological reflection through their process of testing hypotheses and developing scientific theories. This process challenges assumptions and requires open-mindedness, resulting in an intrinsically humbling process.[4] Templeton also thought science could contribute to theology by eliminating characteristics such as reliance on models that only partially capture reality. Because theology ultimately is carried out by people, it is unable to clearly and completely capture the elements it attempts to explain. Those elements remain elusive and intangible.[5] Ultimately, Templeton focused on using science to add to our spiritual information as a route to see progress in religion.[6]

Christians fail to perceive the parallels between the process of science and the process of Christian formation whenever discussions of Christian formation remain at the level of ideas and propositions. Paul Scherz suggests that the problem is located in seeing either science or religion only as a set of propositional claims, rather than as practices or ways of life.[7]

Traditions and Communities of Learning

Lesslie Newbigin, drawing on the work of Michael Polanyi, argues that all learning and knowing is an act of faith that asks us to trust the evidence of our eyes and ears, or of individuals who undertake teaching.[8] He states:

> When I say, "I believe," I am not merely describing an inward feeling or experience: I am affirming what I believe to be true, and therefore what is true for everyone. The test of my commitment to this belief will be that I am ready to publish it, to share it with others, and to invite their judgment and—if necessary—correction. If I refrain from this exercise, if I try to keep my belief as a private matter, it is not belief in the truth.[9]

Newbigin goes on to argue that we are responsible for ensuring that what we believe is true for all persons and that this truth will lead to further understanding.[10] Humanity's search for truth is not solitary but rather takes place within a tradition and community that develops skills, practices, and terminology allowing for deeper communal discussion and understanding. Individuals who become part of a scientific community involve themselves in rehearsal, training, and practice as the route to knowing.[11]

Newbigin draws a parallel between the maintenance of the scientific tradition and the Christian tradition. The scientific community depends on the mutual trust scientists have for one another, knowing that the search for truth requires the work of many individual scientists, each who grasps only a small part of the whole. Human knowledge grows through a common understanding of practice within the context of a community. Someone becomes a member of the scientific community through learning to dwell in its tradition—you become a scientist.

Newbigin claims that Christian believers likewise must dwell in the Christian tradition.[12] As in the case of science, he says continued learning requires honoring the authority of the tradition which leads us to decide what claims are implausible and do not deserve serious attention. Individual modification of the tradition must be submitted to the judgment of the Christian community which may debate for many years before reaching a conclusion.[13] To be a Christian and a scientist involves belonging to two communities, and Newbigin would argue that both are grounded in tradition, training, and communal understanding and discovery.

The work of Alasdair MacIntyre, grounded in the Aristotelian tradition, aligns with Newbigin's emphasis on practice, community, and tradition over against propositions.[14] He states that a tradition is historically extended and involves a socially embodied argument. The individual's search is conducted within this context and "the history of a practice in our time is generally and characteristically embedded in and made intelligible in terms of the larger and longer history of the tradition through which the practice in its present form was conveyed to us."[15] Practices within traditions are coherent and socially established activities with long-agreed-upon standards of excellence.[16] MacIntyre further identifies the development of virtue with disciplined practice within a tradition, again focusing on the process and practices rather than assent to a set of propositions. The outcome of the process for individuals is a capacity for judgment and an ability to sort among "the relevant stack of maxims and how to apply them in particular situations."[17]

Humans extend their understanding through this process of being embodied in a tradition. Brad Strawn and Warren Brown see this extended cognition happening where human capacities are enhanced by the tools, persons, and institutions that we encounter and with whom we engage.[18] Thus they make the argument that counter to Western assumptions, the individual is a derivative of the social rather than the social of the individual.[19]

They argue that Christian faith and life exist within a network of relationships that enhance and extend our Christian life beyond individuals.[20] Persons are formed as Christians within the life of the body.[21]

> For us, then, spirituality (if and when we use this word) is the gradual and relational process of being transformed into the image and likeness of Jesus as persons and as groups resulting from experiences of extended (and thus supersized) corporate life.[22]

Drawing on MacIntyre, Strawn and Brown argue that similarities exist between the tradition of science and the Christian theological tradition, as both a process and a protection against intellectual and moral errors.[23] Human advancement of understanding is thus a process that includes individual character formation rather than content.[24] The inherited tradition of communal practice, over against privatized religious beliefs, provides an embedded corrective in both science and the Christian tradition.

Modern empiricism, born out of the Enlightenment, has stripped purpose and direction from our accepted interpretations of science. This empiricism, in turn, removed scientific understanding from the world of virtues and character formation. For Aristotle, what is, and what should be done, were inseparable. For him, the development of practical reasoning was tied to virtue formation and moral decision-making.[25] MacIntyre and others call for a return to a broader and more communal understanding of the creation of knowledge. This communal process of practical reasoning connects to character and faith formation, which express themselves in actions or practices that arise out of moral commitments. MacIntyre does nothing less than ask that we bring the pursuit of scientific truth back into the fold with moral truth and its practice.

The Process of Science and Christian Discipleship

Étienne Wenger's foundational theory of learning, based on his concept of communities of practice, and the high impact practices (HIPs) of undergraduate research in higher education provide an avenue for exploring the connection between the process of science and Christian discipleship. Undergraduate research experiences have long been identified as one of several HIPs in higher education. This type of research involves focused teamwork under the guidance of a faculty member, often leading to joint publications. Researchers have found that HIPs result in enhanced learning for students, including those from historically underserved groups.[26] The reported effectiveness of the HIPs has resulted in support for such programs from many funding sources including the National Science Foundation (NSF), which launched funding for undergraduate research in 1958–1959.[27] The example of major funders such as NSF inspired many other sources to fund undergraduate research projects in and outside the natural and behavioral sciences. In addition to institutional support of research, foundations and individual donors are among the numerous funding sources that contribute to undergraduate research programs. The role of the Council on Undergraduate Research (CUR) in recent years proved pivotal in cultivating and sustaining undergraduate research movements as a form of engaged learning.[28] Other movements, such as the Molecular Education and Research Consortium in Undergraduate Research (MERCURY), which recently celebrated its two-decade history, have contributed significantly to the training of science students in particular fields. These efforts have also shown success in recruiting females and students of color.[29]

While the educational result of such experiences has been studied, scholars have done little research on connections between undergraduate research, theories of the person, learning theory, and Christian faith formation. Harold White alludes to these broader connections when he says, "When does someone become a scientist? When curiosity about something leads to an inquiry for new knowledge."[30] He recognized that the necessary elements for this identity formation existed within the experience of undergraduate research. These elements include problem-based learning: working on complex and real problems within the context of a research team. That team identifies what is not known and develops and implements a research strategy for addressing the unknown and expanding knowledge.

Finally, this learning is tied to dialogue with the larger scientific community.[31] White sees someone becoming a scientist when that individual takes on a particular posture toward life—curiosity and inquiry for new knowledge. Yet, his description of the context within which this happens is much richer than simply listing individual attributes. He points to the need to live out this posture within a community that works together on real-world problems, using strategies and approaches that build upon a tradition and history of knowledge.

Strawn and Brown argue for a parallel between an understanding of this extension of knowledge in science, and the enhancement of the Christian life in *Enhancing Christian Life: How Extended Cognition*

Augments Religious Community. They claim that our Christian understanding, like the tradition of science, is enhanced by countless other persons. The residuals left by their work become embedded in our language, social practices, and culture.[32] We carry out the search for knowledge in community and within the context of various traditions.

Many of the critiques of science fail to address this fundamental communal nature of science. For example, Julia Belluz, Brad Plumer, and Brian Resnick, in their article "The 7 Biggest Problems Facing Science, According to 270 Scientists," portray the scientific process in its ideal form as involving an individual exercise of asking a question; setting up an objective, empirical test; and finding an answer that can be replicated.[33] While they recognize the communal nature of the peer-review process, morality still is seen as embedded in individuals over against a tradition and community.

Likewise, Andrea Saltelli and Silvio Funtowicz lament the decline of the community of scientists whose personal relationships maintained moral standards through peer pressure.[34] They recommend restoring standards in science that expand the community to include more perspectives to help scientists to personally appreciate uncertainty.[35] Paul Tyson, in his work addressing Conor Cunningham's perspective on evolutionary biology, portrays theology as a set of doctrines, but science as provisional.[36] These critiques of science fail to engage with the perspective that both science and the Christian faith are embedded in communities of practice that have traditions, standards for evidence, and processes for apprenticeship.

How do institutions best support the formation of individuals who wish to belong to both scientific and faith communities? Undergraduate research experiences in a Christian context often prove to be particularly effective because of the alignment of the processes of scientific exploration and Christian discipleship, both of which involve communal endeavors that shape identity. Undergraduate research programs at Christian institutions offer unique lenses into the process of students learning to dwell in both the scientific tradition and the Christian faith tradition. Such programs provide a context for engagement in the dialogue between the two traditions. The parallels, clearly articulated by Newbigin, are best viewed through the lens of Étienne Wenger's "communities of practice," a learning theory which posits that, because we are social beings, we learn through social participation in communities.[37] Communities of practice are groups of people who share a concern, a set of problems, or a passion and who deepen their knowledge and expertise by interacting on an ongoing basis.[38] Wenger describes this process of learning as shared histories of learning and interpretation, and a close interaction of order and chaos as we move toward emergent structures and understanding. This process involves doing, experiencing, belonging, and becoming.[39]

Wheaton College, a Christian institution, has established one such program called Wheaton College Summer Research Program. This program, one of many found at faith-based institutions across North America, has the specific goals of fostering both faith formation and scientific exploration.[40] Wheaton's program is an example of one that is intentional about student vocational growth in both science and faith and has assessed student outcomes.[41] One key element in programs that include both science and faith development is regular seminars together as a community of learners. These gatherings often take place weekly. Faculty and students gather to hear presentations from each other, listen to speakers, talk about ethical issues related to their research, pray, and experience fellowship. In addition, participating faculty must be committed to informally engaging with students on issues of faith, vocation, and science as they work together. These features differ from similar programs at secular institutions and other faith-based colleges that are structured to support faculty-student research, but where the focus is more narrowly on the scholarly outcomes of each team rather than on communal experiences across both science and faith.

The Wheaton College program is one that included all the essential elements of an effective undergraduate research program, and was also intentional about faith formation in addition to vocational exploration. Dorothy Chappell, the Wheaton dean when the program was established and a coauthor of this article, carried out a twenty-year (1999–2019) assessment of the program. During these years, the program was overseen by Chappell. Students—primarily in mathematics, natural sciences, or social sciences—collaborated with faculty mentors who engaged them in the faculty member's research and helped students capture a vision for scholarship, while providing mentoring in the faith in the context of a community of Christian scientists.[42] Like other intentional summer research experiences, this program addressed theories and theory formation, the development of hypotheses, the application of theory to the generation and interpretation of data, and professional development through the dissemination

of scholarly outcomes. The faculty involved also had the goal of intentionally modeling the integration of faith and science. They encouraged student mentees to explore ideas in the context of philosophical and theological meaning, language, and historical and cultural contexts.[43]

Chappell, in her report on the program, stated that the goals of the program included the following:

1. To further student knowledge and research skills through engagement with first-rate scholarship in literature and with specialists who are exploring and practicing the theory and applications at the frontiers of their disciplines.
2. To engage students in readings and discussion of the Christian aspects of their disciplines and beyond.
3. To participate with students in spiritual fellowship.
4. To accomplish the outcomes of information dissemination through writing a paper(s) that will be appropriate for a verbal or poster presentation at a professional societal meeting and/or publication in refereed or popular journals.[44]

Essential program components in any effective program are intentionality and commitment to the formation of students. Experiences, as in the Wheaton program, occur during the summer and require full-time investment on the part of the faculty and students. That intensity distinguishes such programs from others in which students have conducted research with faculty during a semester that requires only a portion of each student's time. In contrast, programs like the one at Wheaton award student stipends to allow students to participate in eight to ten weeks of summer research full time so as to foster the characteristics of the creation of a community of practice. Like other such programs, Wheaton's program included weekly brown bag lunch meetings during which all students discussed their projects. In addition, fifty-four percent of the respondents presented their results at professional meetings or through academic publications as coauthors.[45]

In 2020, Chappell compiled the results of surveys of the Wheaton College program participants throughout the preceding twenty-year period. The responses addressed four sets of questions: a set on experiential learning, a set on mentorship, a set on the spiritual development of the students, and a set on the career-research experience. The data set is unique in terms of length and its combination of surveys on both experiential learning measures tied to traditional summer undergraduate research experiences, and spiritual development.[46]

Chappell's summary of survey findings included professional outcomes of the research experience as well as questionnaire results. The surveys paralleled the lenses of Wenger's communities of practice learning theory, with categories including the effectiveness of the experience on participants' increased understanding of the scientific tradition in terms of the research process, their introduction to and training in techniques of science, the collaborative and communal nature of the work, and the process of the communication of discovery within science.[47]

The surveys, using Likert scales, showed strong results in terms of students growing in their understanding of science as a tradition and as a process of exploration that led to the extension of knowledge. Students showed particularly strong agreement (over eighty-five percent) with a statement related to an increased understanding of the culture of an academic discipline. In addition, participants increased their knowledge of both the role of refereed literature as background to research and the relationship of research to the identification of a cutting-edge topic with over ninety-five percent agreement.

The surveys showed evidence of increased confidence in the use of techniques and skills for the development of scholarship with over eighty-five percent of the participants agreeing. To a lesser extent, but still in a strong positive direction, over eighty percent of students agreed that they developed the experience of writing as a scholar. Student growth in self-confidence in the pursuit of a career—a measure of growth in vocational discernment—also showed strong results with over ninety percent agreeing that this was the result of the experience.

Students gained an understanding of science as communal and collaborative. This knowledge was reflected in the strength of agreement (over ninety-eight percent) with the statement: "My mentor served in a strong collaborative role in conducting authentic research."

Communities of practice develop a specialized language that allows for clear and precise communication of ideas. Seventy-five percent of respondents showed agreement that they had grown in the ability to formulate professional and/or formal papers for publication while ninety percent said that they had improved comfort levels and competence in communicating research.

Of the 468 students who participated in the program, 254 (fifty-four percent) presented or published in professional settings.[48]

Chappell's report on the outcomes of the Wheaton program mirrors the results of one of few other studies on the outcomes of research on the communities of practice framework and science engagement done by Rachel Chaffee, Karen Hammerness, Preeti Gupta, Kea Anderson, and Tim Podkul titled, "Re-examining Wenger's Community of Practice Theoretical Framework: Exploring Youth Learning in Science Research."[49] Chaffee et al. included measures of both bonding and bridging as part of their study. Bonding is authentic engagement and mentoring within a community—internal ties within a community. Bridging involves the engagement and identification with a larger group, in this case, the larger scientific community.[50] Bonding and bridging measures parallel the Wheaton measures of internally learning the structure and communal nature of scientific research and externally bridging to the literature and the scientific community through presentations. The Wheaton study and the Chaffee et al. study show increased growth in both bridging and bonding.

Three practices in the Chaffee et al. study were especially effective: designing and planning investigations, analyzing data, and using scientific terms appropriately.[51] Participants who engaged in these practices experienced a stronger sense of belonging, and they developed and deepened their sense of identity as members of the scientific community. They began to imagine themselves as scientists (1) by taking part in a collaborative practice to expand knowledge and produce artifacts, (2) through the growth and application of skills and knowledge, and (3) through increased understanding of the norms that guide the process.[52]

The Wheaton study included survey results related to the overlapping faith community of practice within which the students worked. While the data are less specific to Wenger's categories of understanding tradition, practice, communal understandings of knowledge, and the communal character of communicating discovery, the experience incorporated both fellowship and weekly lunch meetings with the cohort. Survey results showed that over ninety percent agreed or strongly agreed with statements on the presence of fellowship, experiences that led to spiritual development, and discussion of ethical issues related to science and faith. The strongest favorable result was around the question of faculty mentors addressing scholarly work as a valid and valued Christian endeavor (over 95% agreed or strongly agreed).

In the Wheaton program, spiritual formation, the application of faith to work, and the Christian valuing of scientific work were explored in the context of a community that exhibited characteristics of Christian formation. These characteristics merit explanation as they are notoriously difficult to assess. Jennifer Herdt summarized the difficulty. Past assessment efforts limited their emphasis to measuring doctrinal knowledge instead of practice.[53] Her review of the literature also evidenced little consensus surrounding the process of Christian formation and definitions.[54] Wilson Teo, in an earlier literature review laying out the great range of definitions, theological understandings, and desired outcomes related to Christian spiritual formation, found that many are grounded in an individualistic view of formation.[55] Chappell's assessment of spiritual formation, in contrast, was grounded in a communal experience and, though limited, paralleled Herdt's encouragement to develop approaches to Christian formation that are dialogical and foster reflection.[56]

Chappell argued that the Wheaton program showed the importance of relationships, collegiality, and friendship as essential elements in increasing understanding of ethical issues. This is consistent with other assessments that found that, when engaging topics related to faith and science, modeling a communal process of discernment is crucial to learning. Strawn and Brown suggest that such settings contribute to establishing virtues and correcting intellectual and moral errors.[57] Communities of commitment, by having established frames of reference, skills, and traditions, allow for the further exploration of complexity related to issues such as ethics. All these elements—exploration of ethical issues, spiritual formation, application of faith to work, and Christian valuing of scientific work—explored in the context of a community exhibit the characteristics of Christian formation.

Stanley Rosenberg argues that such rich pedagogical contexts as the Wheaton experience, in which two communities of practice—faith and science—overlap, are akin to Charles Malik's *Two Tasks* that call for the forming of the mind among the faithful and forming of faith among scholars.[58] Rosenberg argues that education oriented around information or propositions fosters a simplistic view of integration across communities of practice. He calls for an apprenticeship model of a student working alongside a teacher who is skilled in knowledge-making and discovery. He claims that this

model results in a thickening of knowledge, teaches humility, develops self-awareness, and leads to a greater understanding of the limits of knowledge which allows for problems to be put within their larger historical tradition.[59]

MacIntyre argues that communities of practice are necessary for the development of virtues. Consistent with this, Elaine Howard Ecklund, in her research on scientists and faith, found similar values amongst scientists and communities of faith.[60] She believes that similar virtues arise out of both the science and the faith communities of practice.[61] These results are also consistent with Robert Pennock's findings, that participation in communities was important for the long-term changes in individuals, such as the development of virtues.[62] MacIntyre might argue that the convergence of similar virtues is the natural outcome of the processes of discernment of such communities of practice.

In summary, intense summer undergraduate research programs form students as scientists. They grow in their understanding of science as a tradition, in their ability to use the techniques of science, and in their view of science as a collaborative process that involves the sharing of discovery through particularly defined channels. Students also experience Christian formation in the context of a believing community who are doing science. This context leads to a deeper understanding of ethical issues and the Christian value of work, and thus to forming students as Christians who are in the sciences.

Discussion

James K. A. Smith argues that humans are embodied actors rather than just thinking beings. Human engagement in practice is essential to their full development, and cultural practices—rituals and material practices—shape individual's identities and desires.[63] The process of mentoring students to become scientists and the process of Christian formation are examples of such practices. Erin Smith goes on to argue that an individual's formation involves transformation of self and behavior which in turn reflects changes in brain connectivity and processing. What does it mean to be human? Being human encompasses both internal reflection and externally oriented tasks.[64] The increased intentionality of reflection and task enhances our understanding of ourselves.

But tasks are not done alone. Communities carry out tasks together and, in doing so, enact communal rituals that arise out of a tradition. For example, John Skillen, in his book, *Putting Art (Back) in Its Place*, argues that art is meant to be a reminder of a communal understanding. He goes on to describe that placing art in public spaces, such as churches, frames the communal nature of values. Skillen points out that the meaning of the word liturgy is simply "the work of the people." As individuals and communities carry out various liturgies associated with daily, weekly, or seasonal rituals, they are reminded of their sense of obligation to contribute to the public good or involve themselves in acts of service.[65]

Intentionally mentored undergraduate scientific research in a Christian context and within a Christian community is a cultural practice that brings students into the communal tradition of science as well as the communal Christian tradition of the faith. Adam Laats and Harvey Siegel distinguish between belief and knowledge or understanding.[66] This same distinction can be drawn in both the tradition of science and the Christian tradition. Laats and Siegel say belief typically follows understanding.[67] Rather than focus on propositions and beliefs, a community of practice focuses on the process of understanding within specific traditions.

The process of formation of a scientist and a Christian should move understanding and belief toward closer alignment in each community, built on the nature and role of evidence and reasons in each. This process of formation should also result in virtue development in individuals, where some of these virtues align closely between science and faith communities of practice. For example, Ecklund describes a scientist who was a Christian holding both scientific and theological constructs loosely if they did not account for all the evidence, not due to doubt, but out of an understanding that they possessed a limited viewpoint.[68]

Science and faith communities of practice need each other. David Livingstone, in his book *Putting Science in Its Place*, demonstrates how science is not above culture and does not transcend our particularities. Science is not a disembodied entity but arises out of particular communities.[69] Likewise, he shows how views of science in Christian theological communities have historically been tied to fears related to undermining community identity, particularly related to race.[70] He distinguishes between flashpoints and trading zones. Flashpoints are places in which beliefs—cultural, intellectual, or doctrinal—are so central to a community's identity that when questioned, members of the community have difficulty in building pathways for dialogue with other communities. Paul Scherz suggests that such communities move

fully toward agreement with propositional claims as the only measure for belonging instead of emphasizing practices or ways of life.[71] In contrast, trading zones are spaces of engagement in which communities of practice facilitate fruitful exchange despite the different languages of science and faith.[72] These are places, not necessarily geographic as Livingstone describes, but contexts in which members of different communities of practice dialogue, listen, and learn in the context of deep knowledge of science and deep knowledge of God. In these places, participants may have aspects of their identity challenged, but in the context of communities of practice, they continue to seek God's truth in all things.

Undergraduate research programs within Christian institutions can be powerful trading zones in which young people grow in their identities as scientists and as people of faith. In these overlapping communities, students develop skills, strengthen discernment, and are mentored in the formation of virtues that serve all the communities in which they are members.[73] Another example of a trading zone is the American Scientific Affiliation (ASA). The ASA was founded in 1941 as a professional society of Christians who are in the social and natural sciences.[74] The ASA is a fellowship of Christians in the sciences who have supported its members' spiritual, intellectual, and professional formation to serve society, science, and the church. The ASA supports efforts to interpret, integrate, and communicate discoveries of natural and social science with insights of scripture and Christian theology. The ASA promotes excellence in scholarship and the professional and spiritual formation of its members.

To be a Christian who is a scientist involves belonging to two communities of practice—science and faith—both of which are grounded in tradition, training, communal understanding, and discovery. Undergraduate summer research programs that embed Christian formation into their programs attempt to meld the two together. Such programs can become even more intentional about this integration through drawing on the recent work on teaching Christian formation which, in turn, builds on Wenger's theory of learning. Allen Jackson describes the contribution of teaching to discipleship as a process that transforms a person's values and behavior toward service to others. He says teaching discipleship involves relationships, intentional conversations, and personal discipline.[75] He draws on the model of Jesus for teaching. Jesus's teaching was authoritative and authenticated by life and words. His teaching was not authoritarian in that he did not impose but rather presented the costs of discipleship, and he listened and responded. He required dialogue and for people to engage and think.[76]

Steven Garber, in *Visions of Vocation*, argues that the Hebrew notion of "knowing" involves having responsibility to, or for, something. This responsibility exists in the living out of everyday life. Garber says that this sense of "knowing" is embedded in a covenantal epistemology which is reflected in a relationship/revelation/responsibility dynamic.[77] Undergraduate research programs, like those described in this article, emphasize concepts, require questions, embrace posing problems versus giving reasons, and involve a community working together.[78]

In many models of spiritual formation, Christian discipleship is just one stage in the process for an individual. The process starts with a sense of the spirit, moves toward learning, and then to living out one's faith. Janet Hagberg and Robert Guelich would place undergraduate research in a Christian context as part of their second stage of spiritual formation, a life of discipleship, which they describe as characterized as a time of learning and belonging.[79] They describe the preceding stage as one of awe and a deep sense of love[80] and the stage that follows discipleship as one that involves "doing."[81] The model here argues that formation and learning involve all of these elements working together within the context of a community of practice. That practice goes beyond the engaged spiritual formation of the type described by M. Robert Mulholland, who calls us to a spirituality rooted in a growing relationship with God to address the pain around us.[82] Christian formation requires knowledge, understanding, skill-building, and application together with others.

Faith communities that strongly emphasize individual conversion, and/or propositional truth over virtue development and sanctification, might reflect on what they can learn from the science community of practice to enhance their formation of the next generation. Theologian Sharon Galgay Ketcham says that faith formation involves both learning and doing together. Rituals and communal practices provide coherence and meaning for a community. Christians grow together and faith formation happens while we are doing the Christian faith with others.[83] Learning is *experiencing*. Faith formation occurs when we are learning with others who are making meaning.[84] Learning is *belonging*. Learning together facilitates belonging and comes about through someone contributing to the practice of a group when that person shows increased

understanding and competence, contributing to the community.[85] Learning is *becoming*. Identify formation involves seeing oneself in connection to a community and its practice.[86] Herdt points to the need for further thought around the process and definition of Christian formation followed by the development of measures that align with understanding.[87]

Becoming a scientist, like becoming a Christian, involves a journey that begins with a choice to embed oneself within a community with a common narrative and tradition. Garber describes it as a journey toward coherence, where what we believe is reflected in how we live in the context of our responsibilities and relationships.[88] Through the practice of apprenticeship within this community, individuals are formed in their dispositions, develop virtues, solidify identities, and translate these characteristics into actions.[89] This journey is not individual but involves living out this posture within a community that works together, using strategies and approaches that build upon a long history and tradition, to provide guide rails and wisdom as individuals seek truth, coherence, and wholeness.

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Notes

[1]Allen Jackson, "The Contribution of Teaching to Discipleship," in *Teaching the Next Generations: A Comprehensive Guide for Teaching Christian Formation,* ed. Terry Linhart (Baker Academic, 2016), 3–4.

[2]This general statement about the nature of science is not meant to discount the challenges for Christians in engaging with and belonging to some fields of science. Some disciplines are underlain by assumptions that might be antithetical to any religious beliefs and require a materialistic assumption of all reality. This article does not attempt to address these types of challenges which are discipline specific. For example, many social science disciplines are foundationally based on an individualistic view of humans. Methods reflect and are limited by this assumption. For a critique of this particular assumption, see Janel M. Curry and Steve McGuire, *Community on Land: Community, Ecology, and the Public Interest* (Rowman and Littlefield, 2002).

[3]Tyler D. Scott, "A Survey of Science/Theology Paradigms Among Students at a College in the Young-Earth or Old-Earth Creationist Tradition," *Perspectives on Science and Christian Faith* 75, no. 1 (2023): 41–42, https://www.asa3.org/ASA/PSCF/2023/PSCF3-23Scott.pdf.

[4]Peter N. Jordan, "From Soul Science to Spiritual Information: John Templeton on Science and Its Religious Potential," *Theology and Science* 21, no. 2 (2023): 13, https://doi.org/10.1080/14746700.2022.2155908.

[5]Jordan, "From Soul Science," 18.

[6]Jordan, "From Soul Science," 20.

[7]Paul Scherz, *Science and Christian Ethics* (Cambridge University Press, 2022), 2.

[8]Lesslie Newbigin, *The Gospel in a Pluralist Society* (William B. Eerdmans, 1989), 19.

[9]Newbigin, *The Gospel in a Pluralist Society,* 22.

[10]Newbigin, *The Gospel in a Pluralist Society*, 23.

[11]Newbigin, *The Gospel in a Pluralist Society,* 44–45.

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[44]Chappell, "Research Cultivates Scholars in Training," 4, 6.
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