Kemp Elementary was built in 1922 as one of four identical new school buildings erected by the Mad River Township School District. Kemp was named for George W. Kemp, a longtime member of the township school board. In 1930, Dayton Public Schools annexed Kemp and the former Lewton Elementary into the district. Students in grades five through eight who had previously attended Kemp were transferred to Wilbur Wright. In 1939, financial restrictions led to the temporary closing of Kemp, transferring the remaining students to Wilbur Wright.

Additions to the building were made in 1941, 1954, 1957 and 1958. Throughout the years, the school served grades kindergarten through eighth, or kindergarten through fifth.

Kemp was again closed in 1982, during district reorganization. The school reopened in 1986 as an elementary school, serving grades kindergarten through sixth. Today, Kemp serves grades prekindergarten through eighth.